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DIVISION OF CIVIL ENGINEERING

LIST OF NEW COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1	23CE2003	Non-Destructive Testing Laboratory	0	0	2	1
2	23CE2004	Drone Surveying and Digital Mapping	0	0	2	1
3	24CE1001	Public Health Engineering Laboratory	0	0	2	1
4	24CE1002	Engineering Mechanics	3	0	0	3
5	24CE1003	Sustainable Building Materials	2	0	0	2
6	24CE1004	Structural Mechanics Laboratory	0	0	2	1
7	24CE1005	Design studio – 2D Drafting	0	0	2	1

Course code	Non-Destructive Testing Laboratory	L	T	P	C
23CE2003		0	0	2	1
Course Objectives:					
Enable the student to:					
1. Gain knowledge and practical skills for conducting non-destructive testing (NDT)					
2. Apply the concepts of NDT principles, techniques, and methodologies					
3. Assess the integrity, quality, and safety of structural components in engineering applications					
Course Outcomes:					
The student will be able to:					
1. Describe the methods in NDT					
2. Explain NDT Principles and Methodologies					
3. Conduct experiments using Advanced NDT Equipment					
4. Identify and Characterize Structural Defects					
5. Analyse and Interpret NDT Data					
6. Prepare Comprehensive NDT Reports in real-world scenario					
List of Experiments					
1.	Rebound Hammer test				
2.	Ultra-sonic pulse velocity test				
3.	Rebar Locator test				
4.	Half-cell Potential test				
5.	Core-cutter test				
6.	Chloride penetration test				
7.	Pull-out test				
References:					
1.	M. S. Shetty (2019), <i>Concrete Technology – Theory and Practice (8th Ed)</i> . S Chand and company Ltd. ISBN No. 9789352533800;				
2.	Adam M. Neville (2010). <i>Concrete Technology</i> . Prentice Hall. ISBN No. 0273732196				
Recommended by Board of Studies		14.02.2024			
Approved by Academic Council		24.02.2024			

Course code	DRONE SURVEYING AND DIGITAL MAPPING	L	T	P	C
23CE2004		0	0	2	1
Course Objectives:					
Enable the student to:					
1. Gain knowledge on the basics of drone technology with reference to land surveying					
2. Obtain the GPS waypoints along with flight planning					
3. Carry out the post processing of images/data					
Course Outcomes:					
The student will be able to:					
1. Describe the procedures for land surveying using drones					
2. Identify the payloads according to the application					
3. Plan the flight path as per regulations					

4.	Collect the data after deployment of the drone
5.	Integrate the survey data along with GIS and other software
6.	Construct the 3D model and generate surface maps/outputs/reports
List of Experiments	
1.	UAV regulations and flight planning
2.	Drone deployment and capturing data
3.	Flight simulation
4.	Field work for collecting waypoints, site observation, data collection
5.	Integration of Drone data with GIS
6.	Digital surface modelling and Generation of contours
7.	Generation of outputs and reports
References:	
1.	George Dekoulis (2018). Drone Applications. Inteltech Open Ltd. ISBN No. 978-1-83881-478-6
2.	Daniel R. Faust (2016). Civilian Drones. Rosen Publishing Group, Inc. ISBN No. 978-1-5081-4488-5
Recommended by Board of Studies	14.02.2024
Approved by Academic Council	24.02.2024

Course code	Public Health Engineering Laboratory	L	T	P	C
24CE1001		0	0	2	1
Course Objective:					
Enable the student to:					
1. Gain knowledge on the principles and techniques for analyzing water quality parameters in waste and treated water samples.					
2. Get familiarized with tests and methods for assessing contaminants in water samples.					
3. Have an understanding of water quality analysis in public health engineering.					
Course Outcome:					
The student will be able to:					
1. Examine the contaminants and impurities in water samples.					
2. Describe the significance of water quality analysis in public health engineering					
3. Interpret test results and identify implications in water quality and treatment processes.					
4. Examine the characteristics of waste water.					
5. Interpret the tests for waste water.					
6. Suggest treatment methods for wastewater.					
Module	List of Experiments				
1. Determination of pH in waste and treated water samples					
2. Dissolved oxygen (DO) measurement in waste water samples					
3. Determination of chlorine test in waste water samples					
4. Determination of TS, TDS and TSS in waste water sample					
5. Determination of total iron content in water sample					
6. Determination of fluoride content					
7. Determination of hardness in water samples					
8. Determination of electrical conductivity in water samples					
9. Optimum alum dosage for water or wastewater treatment by jar test					
10. Phosphates test in waste water samples					
11. Colorimetric assessment of water colour using a colour sensor					
Reference Books					
1.	Jain and Jain “Engineering Chemistry” 16 th Edition, Dhanpat Rai Publishing Company, New Delhi, 2019				
2.	Masters and Ela “Introduction to Environmental Engineering and Science”, Pearson. 2021				
Recommended by Board of Studies			17.04.24		
Approved by Academic Council			11.05.24		

Course code	ENGINEERING MECHANICS	L	T	P	C
24CE1002		3	0	0	3
Course Objective:					
Enable the student to:					
1. Gain knowledge about statics with emphasis on force equilibrium and free body diagrams. 2. Learn the concept stresses and response of elements. 3. Understand the mechanical behaviour of materials under various load conditions.					
Course Outcome:					
The student will be able to:					
1. Illustrate the concepts of mechanics 2. Identify the principles of dynamics 3. Examine the concepts of kinetics 4. Analyse the stresses in the members 5. Apply the equilibrium concepts in analysis of members 6. Apply the basic principles to solve problems in mechanics					
Module: 1	Basics of Statics	8 Hours			
Fundamental Principles – Coplanar forces – Resolution and Composition of forces and equilibrium of particles – Forces of a particle in space – Equivalent system of forces – Principle of transmissibility – Single equivalent force – Free body diagram – Equilibrium of rigid bodies in two dimensions and three dimensions.					
Module: 2	Analysis of Structures	8 Hours			
Types of supports and their reactions – Plane trusses and frames - Analysis of forces by method of joints and method of sections.					
Module: 3	Friction	7 Hours			
Types – Mechanism – Laws of friction - Characteristics of dry friction – simple contact friction – Wedges and Ladder friction- problems					
Module: 4	Properties of Surfaces and Solids	8 Hours			
Centroid - First moment of area – Second moment of area – Moment and product of inertia of plane areas – Transfer Theorems - Polar moment of inertia – Principal axes – Mass moment of inertia.					
Module: 5	Kinematics	7 Hours			
Displacements, Velocity and Acceleration – Rectilinear motion – Curvilinear motion – Tangential and Normal components – Radial and Transverse components.					
Module: 6	Energy and Momentum Methods	7 Hours			
Principle of work and energy for a particle and rigid body in plane motion – Conservation of energy – Principle of impulse and momentum - particle and rigid bodies in plane motion –Conservation of momentum.					
Total Lectures					45 Hours
Text Books					
1.	Irving H. Shames, “Engineering Mechanics”, 4th Edition, Prentice Hall, 2016				
2.	Beer F. P and Johnston E. R, “Vector Mechanics for Engineers Statics & Dynamics”, 9th Ed, Tata McGraw Hill, 2019				
Reference Books					
1.	Egor, P.Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi, 2015				
2.	Hibbler R. C., “Engineering Mechanics: Principles of Statics and Dynamics”, Pearson Press. 2006				
3.	Andy Ruina and Rudra Pratap, “Introduction to Statics and Dynamics”, Oxford University Press, 2019				
4.	Shanes and Rao, “Engineering Mechanics”, Pearson Education, 2006				
5.	Bansal R.K, “A Text Book of Engineering Mechanics”, Laxmi Publications, 2010				
Recommended by Board of Studies		17.04.24			
Approved by Academic Council		11.05.24			

Course code	SUSTAINABLE BUILDING MATERIALS	L	T	P	C
24CE1003		2	0	0	2
Course Objective:					
Enable the student to: 1. Understand the properties of sustainable building materials 2. Get a comprehensive overview of materials used for improving sustainability. 3. Acquire knowledge on innovative construction practices and methods					
Course Outcome:					
The student will be able to: 1. Select the sustainable building materials 2. Distinguish between conventional and modern construction materials 3. Define the concepts of embodied carbon or carbon footprint 4. Apply different sustainable construction techniques 5. Analyze the usage of waste materials for construction 6. Identify the use of smart materials					
Module: 1	Conventional Building Materials				5 Hours
Rocks - Stones - characteristics of stones – material property – Bricks and blocks - Properties of clay bricks - material test – Timber - Cement - Concrete – Steel – Aluminium - Rubber - plastics – Glass					
Module: 2	Building Components and Finishes				5 Hours
Foundations – plinth – sill – Lintels – Arches - stair cases - Flooring - Roofs and roof covering - Damp proofing – Termite proofing - Plastering and Pointing - Joinery - Painting					
Module: 3	Sustainable Building Materials				5 Hours
Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials, bio materials - Salvaged and recycled materials - Nontoxic materials: low VOC paints, coating and adhesives					
Module: 4	Sustainable Construction Techniques				5 Hours
Alternative construction techniques such as SMB, CSEB, and steam cured blocks, composite beam and panel, funicular shells, filler slabs, reinforced concrete masonry, vaulted roofs, ferro-cement walls etc., - Case studies					
Module: 5	Innovations in Construction Materials:				5 Hours
Use of waste materials - paper, glass bottles, tires, shipping containers - use of post-consumer and industrial waste - fly-ash - building demolition waste – use of salvaged materials from flooring, columns, beams, etc - Geopolymer concrete – ICF materials - recycled materials – Nano materials in construction – 3D Printing materials.					
Module: 6	Smart Materials:				5 Hours
Piezoelectric material – shape memory alloy – light emitting concrete – photochromotic materials - ER and MR rheological fluids - fiber optics - pollution absorbing bricks – smart concrete – bacterial concrete – biomimics – thermochromic materials					
Total Lectures					30 Hours
Text Books					
1.	Jamal Khatib, “Sustainability of Construction Materials”, Woodhead Publishing, 2019				
2.	Ross Spiegel.G, “Green Building Materials A Guide to Product Selection and Specification”, 3rd Edition, John Wiley & Sons, 2020				
Reference Books					
1.	Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004				
2.	Traci Rose Rider, Stacy Glass, Jessica McNaughton, “Understanding Green Building Materials”, W.W.Norton and Company, 2011				
3.	Charles J. Kibert, Sustainable Construction: Green Building Design and Delivery, 5th Edition, John Wiley & Sons, 2022, ISBN: 978-1-119-70645-8				

4.	Fernando Pacheco-Torgal, Luisa F. Cabeza, Joao Labrincha, “Eco-efficient Construction and Building Materials”, Woodhead Publishing, 2014	
5.	Michelle Addington, Daniel Schodek, “Smart Materials and Technologies in Architecture” Architectural Press, 2012	
Recommended by Board of Studies		17.04.24
Approved by Academic Council		11.05.24

Course code	STRUCTURAL MECHANICS LABORATORY	L	T	P	C
24CE1004		0	0	2	1
Course Objective:					
Enable the student to:					
1. Impart knowledge on the basics of the forces and moments					
2. Acquire knowledge on linear momentum, friction and rotation of particles					
3. Apply the principles of elasticity and plasticity					
Course Outcome:					
The student will be able to:					
1. Solve the applied mechanics problems					
2. Explain the behaviour of beams					
3. Evaluate the rigidity modulus					
4. Analyse the reactions on simply supported beam with various loads					
5. Determine the reactions of simple truss					
6. Calculate the forces in truss elements					
List of Experiments					
1.	Young’s Modulus – Uniform bending				
2.	Young’s Modulus –Non-Uniform bending				
3.	Young’s Modulus - Cantilever				
4.	Moment of Inertia of different bodies - Torsional pendulum				
5.	Rigidity Modulus – Torsional Pendulum				
6.	Reactions of a simply supported beam with point load				
7.	Reactions of a simply supported beam with UDL				
8.	Reactions of a simple truss				
Total Lectures					16 Hours
References:					
1.	Irving H. Shames, “Engineering Mechanics”, 4th Edition, Prentice Hall, 2016				
2.	Beer F. P and Johnston E. R, “Vector Mechanics for Engineers”, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2015				
Recommended by Board of Studies			17.04.24		
Approved by Academic Council			11.05.24		

Course code	DESIGN STUDIO - 2D DRAFTING	L	T	P	C
24CE1005		0	0	2	1
Course Objective:					
Enable the student to: 1. Adopt the principles of building planning bye laws in drawing 2. Draft the plan, elevation and section of various structures 3. Create the drawing using modern software tools					
Course Outcome:					
The student will be able to: 1. Select the basic commands of 2D drafting 2. Apply the principles of civil engineering drawing and planning 3. Describe the building bye-laws for planning of buildings 4. Sketch plan, elevation and section of residential buildings 5. Develop plan, elevation and section of commercial buildings 6. Prepare the layout for the approval					
List of Experiments					

1.	Introduction to AutoCAD commands
2.	Development of layout and basics of Bye laws
3.	Preparation of plan, elevation and section of residential buildings-single storey buildings (load bearing)
4.	Preparation of plan, elevation and section of residential buildings-one storey buildings(framed structure)
5.	Preparation of plan, elevation and section of institutional buildings - school (framed structure)
6.	Preparation of plan, elevation and section of industrial buildings- workshop (steel structure)
7.	Preparation of plan, elevation and section of hospital building
8.	Preparation of plan, elevation and section of auditorium building
Total Lectures	
16 Hours	
References:	
1.	Balagopal Prabhu, T. S., “Building Drawing and Detailing”, Spades Publishing, KDFA Building, Calicut, 2012
2.	AUTO CAD Tutorials and Manual- Autodesk Work Book on AUTO CAD Level I and II CAD/CAM centre, Coimbatore
Recommended by Board of Studies	
17.04.24	
Approved by Academic Council	
11.05.24	

DIVISION OF CIVIL ENGINEERING

LIST OF NEW COURSES

Course Code	Course Title	Credits [L:T:P:C]
23CE3001	Control of Corrosion in Concrete Structures	3:0:0:3
23CE3002	Advanced Concrete Technology	3:0:0:3
23CE3003	Geoinformatics For Urban Planning and Management	3:0:0:3
23CE3004	Water Distribution System Lab	0:0:2:1
23CE3005	Project Management in Lean Construction	3:0:0:3
23CE2001	Geospatial Mapping Lab	0:0:2:1
23CE2002	Geospatial Techniques	2:0:0:2

Course Code	CONTROL OF CORROSION IN CONCRETE STRUCTURES	L	T	P	C
23CE3001		3	0	0	3

Course Objectives:

Enable the student to:

1. Acquire knowledge on the principles of corrosion and methods used to prevent corrosion
2. Apply the appropriate techniques to predict and monitor corrosion in steel bars.
3. Formulate techniques to improve the durability of concrete from corrosion

Course Outcomes:

The student will be able to:

1. Identify the causes of corrosion in structures
2. Classify the types of corrosion
3. Select the appropriate methodology for testing the corrosion
4. Recommend suitable materials for corrosion protection
5. Evaluate the corrosion potential of structural elements
6. Analyse the extent of corrosion in concrete element

Module: 1 Introduction to Corrosion 7 Hours

Corrosion- forms of corrosion- Phenomenon of corrosion- Performance of construction materials – concrete and steel - Corrosion initiation- Environment condition - Durability -Design and construction errors – Code guidelines - Cover thickness

Module: 2 Forms and Mechanism of Corrosion 7 Hours

Mechanism of dry and wet corrosion - Types of corrosion - Different aeration corrosion- Galvanic corrosion-pitting corrosion-stress corrosion-factors affecting the rate of corrosion-metal based factors - environmental based factors-inhibitors- Cathode and anode-Electrolyte- Rate of corrosion.

Module: 3 Causes and Effects of Corrosion 7 Hours

Physical causes-causes of distress in concrete structures - Cracking of concrete -Honey combing of concrete-design errors - Chemical causes-acid attack on the concrete-Alkali reaction on concrete-Chloride attack- Salt attack- Carbonation- Biological attack- Marine environment

Module: 4 Testing Methodology for Corrosion 8 Hours

Immersion testing- Visual examination salt spray/fog testing-weathering test- Electrochemical testing-field corrosion tests- Physical observations- Electrical resistance test-Polarization resistance techniques-Impedance techniques- Corrosion potential- Mass loss

Module: 5 Corrosion Protection 8 Hours

Concrete protection methods -Reinforcement protection methods- Self-regulating anode -Corrosion inhibitors- Concrete coating- Corrosion resistance steels- Coating to reinforcement- Cathodic protection-design and detailing- Metallurgical methods- Galvanized reinforcement

Module: 6 Corrosion Control in Concrete 8 Hours

Introduction-frequent forms of corrosion- Environment effects - Permeability - Corrosion resistance admixtures- Bonding admixtures- Corrosion inhibiting admixtures- Air detrainning admixtures- Green materials in concrete- Case studies	
Total Lectures	45 Hours
Reference Books	
1.	M. S. Shetty., “Concrete Technology”, S. Chand & Company limited, 2013
2.	Pierre R. Roberge, “Handbook of Corrosion Engineering”, McGraw Hill, 2019
3.	Mars. G. Fontana and G. Mars, “Corrosion Engineering”, 3rd ed., McGraw-Hill Book company, 2012
4.	IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi
5.	ASTM C876-15 - Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete
Recommended by Board of Studies	31.07.2023
Approved by Academic Council	25 Aug 2023

Course Code	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
23CE3002		3	0	0	3
Course Objectives:					
Enable the student to: 1. Acquire knowledge on advanced construction chemicals. 2. Evaluate the strength and durability properties of concrete. 3. Design mix proportions of concrete.					
Course Outcomes:					
The student will be able to: 1. Examine the properties of concrete materials as per standards 2. Identify suitable admixtures for concreting. 3. Determine the properties of fresh and hardened concrete. 4. Recommend suitable non-destructive testing of concrete for field applications. 5. Design concrete mix as per IS standards. 6. Recommend the appropriate proportion of materials for high performance concrete.					
Module: 1	Admixtures for Concrete	7 Hours			
Cement -Review of manufacturing process- chemical composition, Bogue’s compounds, mechanism of hydration-heat of hydration-Aggregate-Review of types, sampling and testing, artificial aggregates - Chemical Admixtures- types, uses, mechanism of action - effects on properties of concrete - Mineral admixtures- types, chemical composition - physical characteristics - effects on properties of concrete - Rheology – basic concepts – Bingham model					
Module: 2	Concrete Chemistry	7 Hours			
Hydration chemistry – cooling of aggregates- factors affecting hydration - CSH gel formation - secondary gel - structure of hydrated cement paste - stress strain relation - strength porosity relationship - failure modes in concrete - maturity of concrete					
Module: 3	Strength and Durability	8 Hours			
Strength of concrete- modulus of elasticity, compressive strength, split tensile strength, flexural strength- effect of water cement ratio – maturity concept- Creep - factors affecting creep - effect of creep Shrinkage- factors affecting shrinkage - plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage. Durability of concrete- Factors affecting durability - permeability- cracking - reinforcement corrosion; carbonation, chloride penetration, sulphate attack, acid attack, fire resistance; frost damage, alkali silica reaction, concrete in sea water					
Module: 4	Non-Destructive Testing of Concrete	7 Hours			

Introduction - surface hardness test- Rebound Hammer -ultrasonic pulse velocity method - penetration resistance- pull-out test - core cutting – measurement of reinforcement cover – Corrosion analyser – Chemical test. Non-destructive-guidelines-structural systems – concrete wood-masonry and Metals.		
Module: 5	Mix Proportioning	8 Hours
Mix design - nominal mix- design mix – concept of mix design - variables of proportioning - general considerations - factors considered in the design of concrete mix- various methods of mix design - design of concrete mix as per IS 10262-2019 and ACI & BS mix design guidelines- Statistical quality control of concrete – mean strength – standard deviation – coefficient of variation – sampling - testing - acceptance criteria.		
Module: 6	Special Topics in Concrete Technology	8 Hours
Special concretes - lightweight concrete-heavy weight concrete - high strength concrete – high performance concrete - self compacting concrete -roller compacted concrete– fiber reinforced concrete - Geopolymer concrete-pumped concrete - ready mix concrete - green concrete, sprayed concrete; underwater concrete, mass concrete; prefabrication technology- materials for 3D printing in concrete , self-healing concrete, nano materials in concrete		
Total Lectures		45 Hours
Reference Books		
1.	Neville A.M., “Properties of Concrete”, Trans-Atlantic Publications, Inc.; 5 th Edition, 2016	
2.	R. Santhakumar, “Concrete Technology”, Oxford Universities Press, 2018	
3.	Mehta and Monteiro, “Concrete-Micro structure, Properties and Materials”, McGraw Hill Publications, 2017	
4.	Neville A. M. and Brooks J. J., “Concrete Technology” Pearson Education, 2019	
5.	IS 10262:2019 - Guideline for mix proportioning, Bureau of Indian standards	
Recommended by Board of Studies		31.07.2023
Approved by Academic Council		25 Aug 2023

Course Code	Geoinformatics for Urban Planning and Management	L	T	P	C
23CE3003		3	0	0	3
Course Objectives:					
Enable the student to:					
1. Acquire knowledge on the principles of remote sensing and Geographic Information Systems					
2. Demonstrate regional planning considering social, environmental and policy issues					
3. Interpret the results of GIS in visual and textual forms					
Course Outcomes:					
The student will be able to:					
1. Relate to the concepts of remote sensing					
2. Distinguish sensors, its data products and information					
3. Analyse the data models and database in GIS					
4. Perform spatial data analysis for development of plans, policy using GIS					
5. Practice RS and GIS techniques in Land Use planning and management					
6. Prepare maps for Urban Green Space planning and management					
Module: 1	Introduction to Concepts and Laws of Remote Sensing				8 Hours
Basic concepts, historical background, Elements of remote sensing, Electromagnetic spectrum, Radiation principle, Atmospheric effects on remote sensing – Energy interaction with earth surface features - Spectral signature (water, soil, vegetation), Resolution – Spectral, Spatial, Temporal and Radiometric, Platforms - Data acquisition					
Module: 2	Sensors and Data Acquisition Process				7 Hours
Active and Passive Sensors, Remote Sensing Data Products - PAN, Multispectral, Microwave, Thermal, Hyperspectral, Visual and digital interpretation methods- Satellites - Types - Sun synchronous - Geo					

synchronous remote sensing satellites - LANDSAT, SPOT & IRS - Recent satellites with its applications, Data Products – Level of Processing		
Module: 3	Image Processing and Classification	7 Hours
Digital image processing - Radiometric and Geometric errors in digital images and their correction – reduction and magnification, contrast enhancement- ratioing, spatial filtering, edge enhancement – Classification scheme, training site selection - image classification – Supervised and Unsupervised – Vegetation, Water and Built-up indices		
Module: 4	GIS – Data, Models and Database	8 Hours
Introduction - Data Sources, Types of maps, Scales, Projection and uses- Coordinate systems- Data types and Data Models, Algorithms, DBMS, Creation of Databases (spatial and non-spatial)-Raster and Vector - Errors and natural variation, interpretation; Data output; Selection of a GIS, Integrated Multidisciplinary Geo-investigations, Advantages and limitations of combining multidata - Files and Formats		
Module: 5	Geospatial techniques for Landuse Planning and Management	7 Hours
Spatial analysis - Interpolation, Buffer, Overlay, density analysis- Geographically Weighted Regression - spatial autocorrelation and Network analysis, Map overlay, Spatial Interpolation. Land use planning - Models and their role - Regional Network Planning: problems in Developing countries, characteristics- Connectivity, Mobility, Accessibility and Level of service		
Module: 6	Urban Green Space Planning and Management	8 Hours
Infrastructure demand analysis - Land suitability analysis of urban development. Site specifics GIS: Housing development, parks and social facilities planning- Advanced spatial analysis- Policy and decision making - Integrated multidimensional planning -Accessibility models and indices.		
Total Lectures		45 Hours
Reference Books:		
1.	Anji Reddy. M, “Remote Sensing and Geographical Information Systems”, BS Publications, 4 th Edition Hyderabad, 2016	
2.	Lillesand, T. M., and Kiefer, R.W., “Remote Sensing and Image Interpretation”, John Wiley and Sons, 7 th Edition New York, 2015.	
3.	Garg, P.K., “Theory and Principles of Geoinformatics”, Khanna Book Publishing Co., Delhi, 2019.	
4.	Peterson, Gretchen N., “GIS Cartography: A Guide to Effective Map Design”, CRC Press, 2009	
5.	Zhenjiang Shen, “Geospatial Techniques in Urban Planning”, Springer Press, 2016.	
Recommended by Board of Studies		31.07.2023
Approved by Academic Council		25 Aug 2023

Course code	WATER DISTRIBUTION SYSTEM LAB	L	T	P	C
23CE3004		0	0	2	1
Course Objectives:					
Enable the student to:					
1. Demonstrate the reaction process of chlorine in a pipe distribution system					
2. Estimate the chlorine decay coefficients					
3. Optimize the chlorine dosage in pipe distribution system					
Course Outcomes:					
The student will be able to:					
1. Identify the fluctuations of chlorine levels for various flow velocities and pipe materials					
2. Estimate the chlorine decay level in a pipe distribution system					
3. Illustrate the chlorine decay in a pipe distribution system using EPANET					
List of Experiments					
1. Study on the reaction rate of chlorine concentration for various water samples					
2. Investigation on impact of the unsteadiness of flow conditions on the temporal variability in water quality					

3. Estimation of chlorine decay rates (bulk reaction) in distribution systems 4. Estimation chlorine decay rates (wall reaction) in distribution systems 5. Investigations on the effect of flow velocity on chlorine decay 6. Development a residual chlorine decay model in a real distribution network using EPANET	
Industry Integrated lab – SUEZ Projects Pvt. Ltd.	
Reference Books	
1.	Water Distribution Operators Training Handbook, Fourth Edition, AWWA, 2014
2.	Larry W. Mays, “Water supply distribution Systems Handbook”, McGraw Hill, 2000
3.	Prabhata K. Swamee, Ashok K. Sharma, “Design of Water Supply Pipe Networks”, John Wiley & Sons, 2008.
Recommended by Board of Studies	31.07.2023
Approved by Academic Council	25 Aug 2023

Course code	GEOSPATIAL MAPPING LAB	L	T	P	C
23CE2001		0	0	2	1
Course Objectives:					
Enable the student to: 1. Demonstrate the application of different components of GIS and computational techniques 2. Develop skills on the usage of tools in GIS 3. Apply GIS tools for decision making					
Course Outcomes:					
The student will be able to: 1. Identify satellite images for varied applications 2. Select appropriate tools for decision making based on the criteria 3. Apply GIS tools for temporal and spatial data acquisition and analysis					
List of Experiments					
1. Digitization and geo-referencing 2. Creation and Editing of Shape files 3. Preparation of Composite and Mosaic Images 4. Image classification 5. Land use/land cover map preparation 6. Water quality mapping					
Text Books					
1.	Anji Reddy M, “Textbook of Remote Sensing and Geographical Information Systems”, B S Publications, 2016.				
2.	C.P. Lo. Albert K.W. Yeung, “Concepts and Techniques of Geographic Information Systems”, 2nd edition, PHI Learning Private Limited, Delhi, 2014.				
Reference Books					
1.	Andrew N. Rencz, “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley & Sons Inc, April 2004				
2.	Basudeb Bhatta, “Remote Sensing and GIS”, 2nd edition, Oxford University Press 2011.				
3.	Kali Charan Sahu, “Textbook of Remote Sensing and Geographical Information Systems”, Atlantic Publishers, 2018.				
4.	Lillesand and Kiefer, “Remote Sensing and Image Interpretation”, Wiley Publications, 2011.				
5.	George Joseph and C Jeganathan, “Fundamentals of Remote Sensing”, Orient Blackswan Publishers, 2018.				
Recommended by Board of Studies			31.07.2023		
Approved by Academic Council			25 Aug 2023		

Course code	GEOSPATIAL TECHNIQUES	L	T	P	C

23CE2002		2	0	0	2
Course Objectives:					
Enable the student to:					
1. Acquire knowledge on principles of remote sensing. 2. Analyse the satellite image for interpretation 3. Apply GIS tools for civil engineering applications					
Course Outcomes:					
The student will be able to:					
1. Distinguish the principles of remote sensing and GIS for various applications 2. Employ data analysis methods using RS and GIS techniques 3. Analyse and Interpret the data for modelling applications 4. Distinguish sensors and satellites data for specific applications 5. Formulate methodologies for usage of data models 6. Develop procedures to solve issues related to environment using RS and GIS techniques					
Module: 1	EMR and its Interaction with Atmosphere and Earth				5 Hours
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing - Atmospheric scattering, absorption – Atmospheric windows – typical spectral reflective characteristics of water, vegetation and soil					
Module: 2	Platforms and Sensors				5 Hours
Platforms types – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Earth Resources and Meteorological satellites – Airborne and spaceborne TIR and microwave sensors.					
Module: 3	Image Interpretation and Analysis				5 Hours
Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – multispectral image classification – Supervised and unsupervised.					
Module: 4	Geographic Information System				5 Hours
Introduction – Maps – Definitions – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales					
Module: 5	Data Entry, Storage and Analysis				5 Hours
Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS					
Module: 6	Applications of GIS in Civil Engineering				5 Hours
Dam deformation - structural movement – Shoreline changes – Landslide Risk Analysis - Monitoring Urban Growth – Highway maintenance system – Intelligent Transportation System - Flood damage assessment – Flood Modelling					
Total Lectures					30 Hours
Text Books					
1.	Anji Reddy M, “Textbook of Remote Sensing and Geographical Information Systems”, BS Publications, 2016.				
2.	C.P. Lo. Albert K.W. Yeung, “Concepts and Techniques of Geographic Information Systems”, 2nd edition, PHI Learning Private Limited, Delhi, 2014.				
Reference Books					
1.	Mahesh Gaur, C.B. Pandey and R. K. Goyal, “Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, Scientific Publishers, , 2016				
2.	Basudeb Bhatta, “Remote Sensing and GIS”, 2nd edition, Oxford University Press 2011.				
3.	Kali Charan Sahu, “Textbook of Remote Sensing and Geographical Information Systems”, Atlantic Publishers, 2018.				
4.	Lillesand and Kiefer. “Remote Sensing and Image Interpretation”, Wiley Publications. 2011.				

5.	George Joseph and C Jeganathan, “Fundamentals of Remote Sensing”, Orient Blackswan Publishers, 2018.	
Recommended by Board of Studies		31.07.2023
Approved by Academic Council		25 Aug 2023

Course code	PROJECT MANAGEMENT IN LEAN CONSTRUCTION	L	T	P	C
23CE3005		3	0	0	3
Course Objectives:					
Enable the student to:					
1. Acquire knowledge on the Principles in Lean Construction					
2. Manage constraints and uncertainties in Project Execution					
3. Minimize waste and improve efficiency in Construction					
Course Outcomes:					
Students will be able to:					
1. Apply the fundamental principles of Lean thinking in construction.					
2. Evaluate the benefits of Lean principles in Project Management.					
3. Identify the key components of the Last Planner System					
4. Analyze constraints and uncertainties for effective project management.					
5. Apply Lean tools to create a project schedule.					
6. Evaluate the effectiveness of Lean techniques.					
Module: 1	Introduction to Lean Construction				7 Hours
Principles of Lean thinking in construction - Lean construction history and evolution - Lean tools and concepts in project management - Comparison of traditional vs. Lean project management approaches					
Module: 2	Last Planner System (LPS)				8 Hours
Last Planner methodology and its application - Pull planning techniques for scheduling - Collaborative planning and commitment-based management - Managing constraints and uncertainties in construction projects					
Module: 3	Quality Management in Lean Construction				7 Hours
Building a culture of quality in construction - Lean quality management principles - Error-proofing techniques and mistake-proofing solutions					
Module: 4	Lean and Green Construction				8 Hours
Aligning Lean principles with sustainable construction practices - Identifying environmentally friendly solutions in construction projects - Reducing the environmental impact of construction processes					
Module: 5	Technology and Lean Construction				8 Hours
Role of technology in Lean construction - Digital tools for Lean project management - Building Information Modeling (BIM) and Lean principles					
Module: 6	Lean Construction: Applications and Case Studies				7 Hours
Case studies in Lean construction projects - Applying Lean principles to various construction scenarios - Review and reflection on Lean construction implementation					
Total Lectures					45 Hours
Reference Books					

1.	Lincoln H. Forbes, Syed M. Ahmed, “Lean Project Delivery and Integrated Practices in Modern Construction”, CRC Press, 2020.
2.	Lauri Koskela, Mike Kagioglou, Patricia Tzortzopoulos, “Lean Construction Core Concepts and New Frontiers”, CRC Press, 2022.
3.	Joe Donarumo, Keyan Zandy, “The Lean Builder A Builder's Guide to Applying Lean Tools in the Field”, Lulu Publishing Services, 2019
4.	John S. Oakland, Marton Marosszeky, “Total Construction Management: Lean Quality in Construction Project Delivery”, CRC Press, 2017
5.	Fidelis A. Emuze, Tarcisio A. Saurin, “Value and Waste in Lean Construction”, CRC Press, 2015
Recommended by Board of Studies	
31.07.2023	
Approved by Academic Council	
25 Aug 2023	

DEPARTMENT OF CIVIL ENGINEERING

LIST OF NEW COURSES

Course code	Course Title	Credits			
		L	T	P	C
21CE2001	Engineering Sustainability and Circular Economy	2	0	0	2
21CE2002	Geospatial Techniques	2	0	2	3
21CE3001	Foundations of Building Information Modelling	3	0	0	3
21CE3002	Digital Age Construction with BIM	3	0	0	3
21CE3003	Advanced Design of Concrete Structural Systems	3	0	2	4
21CE3004	Advanced Design of Steel Structures	3	0	2	4
22CE2001	Technical Aptitude	0	0	1	0
22CE2002	Smart Cities: The future of City life	3	0	0	3

Course Code	ENGINEERING SUSTAINABILITY AND CIRCULAR ECONOMY	L	T	P	C
21CE2001		2	0	0	2
Course Objectives:					
Enable the student to: 1. comprehend the concepts of sustainability 2. acquire the knowledge on social, economic and environmental aspects of sustainability 3. learn the application of sustainability concepts in civil engineering					
Course Outcome:					
The student will be able to: 1. identify the concepts of sustainability 2. understand the Concepts of Economic Sustainability 3. analyse the Concepts of Environmental and Social aspects of Sustainability 4. enumerate the concepts of Circular economy along with Sustainability 5. apply the concepts of sustainability and circular economy to environmental and geotechnical engineering. 6. apply the concepts of sustainability and circular economy to construction and transportation engineering					
MODULE: 1	INTRODUCTION TO SUSTAINABILITY	5 Hours			
Definition - Principles – SDG goals- Background - Triple bottom line of sustainability - Paradigm shift on sustainability - Civil Engineer perspective of sustainability					
MODULE: 2	ECONOMIC SUSTAINABILITY	5 Hours			
Traditional Sustainable Economics - Life cycle cost analysis, Present future and annual worth - Rate of Return - Benefit/Cost Ratio.					
MODULE: 3	ENVIRONMENTAL AND SOCIAL SUSTAINABILITY	5 Hours			
Structure of Life cycle assessment - LCIA categories - Product category rule (PCR) and Environmental Product Declaration (EPD) - Ecological footprint - Water footprint - Planet boundary - Human Development Index (HDI) – Environmental Impact Assessment- Social Impact Assessment					
MODULE: 4	CIRCULAR ECONOMY	5 Hours			
Basics of Environmental Economics - Institutional Framework for a Circular Economy - Circular Economy: Concepts and Facts - Economic Instruments for Solving Environmental - Environmental Legislation related to a Circular Economy - Implementation of Circular Economy on Macro level - Natural Systems, Green Startup Ecosystems and Opportunities on Global and National Level					
MODULE: 5	APPLICATIONS IN ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING	5 Hours			
Low Impact Development - Outdoor air quality – Urban planning - Satellite cities - Coastal Resilience- Living shorelines - Alternate filler materials - Stabilized earth wall - Geothermal energy foundations					
MODULE: 6	APPLICATIONS IN CONSTRUCTION AND TRANSPORTATION ENGINEERING	5 Hours			

Use of recycled construction and demolition wastes – Recycled plastic - Design for adaptability and deconstruction (DFAD) - Material and waste management - Community participation - Worker Safety - Multimodal transportation - Intelligent transportation system - Crash modification factors – Green building and energy reuse	
Total Lectures	30 Hours
Text Books	
1.	Braham, A. (2017). Fundamentals of sustainability in civil engineering. CRC Press.
2.	Derrible, S. (2019). Urban engineering for sustainability. MIT Press.
Reference Books	
1.	Yates, J. K., & Castro-Lacouture, D. (2018). Sustainability in engineering design and construction. CRC Press.
2.	Babu, G. S., Saride, S., & Basha, B. M. (Eds.). (2017). Sustainability issues in civil engineering. Springer Singapore.
3.	Ramjeawon, T. (2020). Introduction to Sustainability for Engineers. CRC Press.
4.	Tietenberg, T., & Lewis, L. (2018). Environmental and natural resource economics. Routledge.
5.	Wiesmeth, H. (2020). Implementing the Circular Economy for Sustainable Development. Elsevier.
Recommended by Board of Studies	
Approved by Academic Council	18th December 2021

Course Code	GEOSPATIAL TECHNIQUES	L	T	P	C
21CE2002		2	0	2	3
Course Objective:					
Enable the student to: 1. familiarize the basic concepts and principles of various components of remote sensing. 2. comprehend the satellite image analysis and interpretation 3. provide an exposure to GIS and its practical applications in civil engineering.					
Course Outcome:					
The student will be able to: 1. explain the principles of remote sensing and GIS 2. describe the analysis methods RS and GIS data 3. interpret the data for modeling applications 4. distinguish sensors and satellites data for specific applications 5. perform the raster and vector data analysis 6. develop methods to solve issues related to environment using RS and GIS techniques					
MODULE: 1	EMR AND ITS INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL	8 Hours			
Definition of remote sensing and its components – Electromagnetic spectrum – Wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein’s Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – Spectral Signature Concepts – Interaction with earth’s features- Spectral Response Pattern					
MODULE: 2	SATELLITES AND CLASSIFICATION OF RS TECHNIQUES	8 Hours			
Platforms types – Orbit types –Motion of Planets and Satellites -Satellites Sun-synchronous and Geosynchronous – Classification – Satellite Sensors – Sensor parameters-, Passive and Active sensors – Resolution concept and types – Characteristics of different platforms: Landsat, SPOT, IRS series, IKONOS, QUICKBIRD – Radar, LIDAR, SAR, MODIS, AMSRE, Sonar Remote Sensing Systems					
MODULE: 3	IMAGE INTERPRETATION AND ANALYSIS	7 Hours			
Types of Data Products – Types of Image Interpretation – Basic elements of image interpretation - Visual interpretation keys – Digital Image Processing – Pre-processing – Image Enhancement Techniques – Multispectral Image Classification – Supervised and Unsupervised.					
MODULE: 4	GEOGRAPHIC INFORMATION SYSTEM	8 Hours			
GIS - History of Development - Components of GIS – Hardware, Software and Organizational Context – Introduction – Maps – Definitions – Map projections – Types of Map projections – Map analysis – GIS					

definition – Basic components of GIS – Standard GIS softwares – Data type – Spatial and Non-spatial (attribute) data – Measurement scales – Data Base Management Systems (DBMS)		
MODULE: 5	DATA ENTRY, STORAGE AND ANALYSIS	7 Hours
Data models – Vector and Raster data – Data compression – Data input by digitization and scanning – Attribute data analysis – Digital Image Processing – Preprocessing – Image Rectification – Image Enhancement Techniques – Image classification – Supervised and Unsupervised classification algorithms- Integrated Data Analysis		
MODULE: 6	APPLICATIONS OF GIS IN CIVIL ENGINEERING	7 Hours
Deformation studies of deflection - Dam deformation - Bank and Shoreline - Monitoring Urban Growth - Traffic analysis - Accident analysis - Site suitability analysis for Transport Infrastructure – Vehicle routing – Highway maintenance system – Intelligent Transportation System - Flood damage assessment – Flood Modelling-Web based GIS: Definition, Merits - Architecture – Map Server .		
Total Lectures		30 Hours
List of Experiments		
1. Raster image preprocessing and Image enhancement practice to enhance the image for analysis 2. Raster image feature classification using Supervised classification technique 3. Raster image feature classification using Unsupervised classification practice 4. Geo-referencing process on bringing image to real coordinate 5. Creating database systems for managing the data of a project 6. Extracting the vector data from the raster image and create the base map		
Text Books		
1.	Reddy, M. A., & Reddy, A. (2008). Textbook of remote sensing and geographical information systems (pp. 4-4). Hyderabad: BS publications.	
2.	Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). Principles of geographical information systems. Oxford university press.	
Reference Books		
1.	Rencz, A. N., & Ryerson, R. A. (Eds.). (1999). Manual of remote sensing, remote sensing for the earth sciences (Vol. 3). John Wiley & Sons.	
2.	Bhatta, B. (2011). Remote Sensing and GIS. Oxford University Press.	
3.	Sahu, K. C. (2007). Textbook of remote sensing and geographical information systems. Atlantic Publishers & Dist.	
4.	Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote sensing and image interpretation. John Wiley & Sons.	
5.	Dadhwal, V. K., & Kumar, S. (2018). George Joseph and C. Jeganathan: Fundamentals of Remote Sensing.	
Recommended by Board of Studies		
Approved by Academic Council		18th December 2021

Course Code	FOUNDATIONS OF BUILDING INFORMATION MODELLING	L	T	P	C
21CE3001		3	0	0	3
Course Objective:					
Enable the student to:					
1. gain experience in how to work in teams, in which they are exposed to holistic view of the building industry. 2. learn different aspects of collaborative modeling, BIM based scheduling and estimating 3. integrate personal and group knowledge to achieve positive results in complex engineering and construction tasks.					
Course Outcome:					
The student will be able to:					
1. apply knowledge of mathematics, science, and engineering 2. design a system, component, or process to meet desired needs within realistic constraints 3. identify, formulate, and solve engineering problems 4. understanding of professional and ethical responsibility					

5. acquire the skills necessary for using BIM		
6. analyze the building operations using software tools		
MODULE: 1	AN OVERVIEW OF BIM	8 Hours
Introduction to Building Information Modelling (BIM) – BIM benefits – Construction benefits – Building Lifecycle of BIM – BIM workflow process – Basic principles of Level of Development (LOD) – Differences between the Level of Details.		
MODULE: 2	IMPLEMENTATION OF BIM	7 Hours
BIM roles and responsibilities – Impact of BIM in design – Benefits of BIM Dimensions – Managing BIM in different sectors of AEC Industry – BIM Practices in Foreign Countries – Real time buildings that are built with BIM model.		
MODULE: 3	BIM MODELLING	8 Hours
Application of Revit in BIM Modelling – Creation of Architectural models – Development of site systems – Structural systems – Modelling of Structural elements – Material management – Creation of family components and editing – Placing electrical and plumbing fixtures – Modelling mechanical duct systems.		
MODULE: 4	WORKING WITH BIM DATA	8 Hours
Quantification – Performing and managing virtual takeoff data – Mapping of Material data for Schedules – Quantity schedule preparation – Creating Sheets – Revision Manager – Adding Detailing components and drafting views.		
MODULE: 5	BIM DESIGN CO-ORDINATION AND MANAGEMENT	7 Hours
BIM in clash detection checks – Generating clash detection reports – Linking file between disciplines – Managing shared positioning – Monitoring changes and Project co-ordination – Creation of Central Model and enabling work-sharing between the team. Application of 4D/5D/6D in BIM		
MODULE: 6	CASE STUDIES	7 Hours
BIM for Operations & Maintenance for Network Rail – BIM in renovation and execution Plan for Pollution control Plant Project – LOD 400 BIM Model for an Airport – 3D Laser Scan to BIM and inspecting the Quality and Quantity of the Project.		
		Total Lectures
		45 Hours
Text Books		
1.	Kymmell, W. (2008). Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations (McGraw-Hill Construction Series). McGraw-Hill Education.	
2.	Liu, R., & Issa, R. R. (2016). Survey: Common knowledge in BIM for facility maintenance. Journal of Performance of Constructed Facilities, 30(3), 04015033.	
Reference Books		
1.	Inyim, P., Rivera, J., & Zhu, Y. (2015). Integration of building information modeling and economic and environmental impact analysis to support sustainable building design. Journal of Management in Engineering, 31(1), A4014002.	
2.	Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.	
3.	Reeves, T., Olbina, S., & Issa, R. R. (2015). Guidelines for using building information modeling for energy analysis of buildings. Buildings, 5(4), 1361-1388.	
4.	Eastman, C. M., Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.	
5.	Sacks, R., Eastman, C., Lee, G., & Teicholz, P. (2018). BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers. John Wiley & Sons.	
Recommended by Board of Studies		
Approved by Academic Council		18th December 2021

Course Code	DIGITAL AGE CONSTRUCTION WITH BIM	L	T	P	C
21CE3002		3	0	0	3
Course Objective:					
Enable the student to: 1. integrate personal and group knowledge to achieve positive results in complex engineering and construction tasks. 2. learn real time data monitoring 3. optimize the Construction of Precast Buildings using BIM.					
Course Outcome:					
The student will be able to: 1. apply knowledge of BIM Workflow in Concept development and Model Development. 2. identify and formulate the time and cost attributes. 3. design a system, component, or process to meet desired needs within realistic constraints 4. evaluate the design system of precast Engineering 5. develop the workflow process and integrating using different tools 6. analyze and predict the structure using real time data monitoring					
MODULE: 1	STRUCTURAL BIM	8 Hours			
Introduction to Structural systems – Initial Preliminary design of structure – Determining the Internal forces – Iterative design – Integrated generation of reinforcement detailing drawings and rebar schedules – Visual Programing for Parametric Structures.					
MODULE: 2	BIM IN CONSTRUCTION MANAGEMENT	7 Hours			
Construction Engineering and Management – BIM based quantity and cost estimation – Project Scheduling – Construction based 4D simulations – Tracking construction stage – Advanced Cost Management techniques.					
MODULE: 3	GREEN FACILITY BIM	8 Hours			
Early phase conceptual model – Insight Energy Analysis – Visualizing the Solar Impact – Modelling and Energy Analysis for Parametric Structures – Natural Ventilation Analysis – Carbon Footprint analysis data – Cloud based Green Building Studio.					
MODULE: 4	OPTIMIZATION OF PRECAST CONSTRUCTION PLANNING USING BIM	8 Hours			
Modelling and Creation of Precast Elements – Configuration of Precast Connections – Essential Precast Design – Generation of Precast Concrete Reinforcement detailing drawings – Planning and Monitoring the Precast Fabrication with Collaborated team.					
MODULE: 5	BIM INTEROPERABILITY	7 Hours			
Open data exchange within AEC workflows – Common data environments – Integrations and APIs of BIM – Data exchange through IFC files – BIM Interoperability tools – Study on BIM interoperability between Autodesk-Bentley-Trimble Products.					
MODULE: 6	BIM OPTIMIZATION AND DIGITAL TWIN	7 Hours			
Role of Digital Twins and its levels – BIM vs Digital Twin – Assent Information model and management – Real time data monitoring and prediction – Automation of Decision making based on future prediction – AI based reinforcement optimization.					
Total Lectures					45 Hours
Text Books					
1.	Kymmell, W. (2008). Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations (McGraw-Hill Construction Series). McGraw-Hill Education.				
2.	Liu, R., & Issa, R. R. (2016). Survey: Common knowledge in BIM for facility maintenance. Journal of Performance of Constructed Facilities, 30(3), 04015033.				

Reference Books	
1.	Inyim, P., Rivera, J., & Zhu, Y. (2015). Integration of building information modeling and economic and environmental impact analysis to support sustainable building design. Journal of Management in Engineering, 31(1), A4014002.
2.	Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.
3.	Reeves, T., Olbina, S., & Issa, R. R. (2015). Guidelines for using building information modeling for energy analysis of buildings. Buildings, 5(4), 1361-1388.
4.	Eastman, C. M., Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.
5.	Sacks, R., Eastman, C., Lee, G., & Teicholz, P. (2018). BIM handbook: A guide to building information modeling for owners, designers, engineers, contractors, and facility managers. John Wiley & Sons.
Recommended by Board of Studies	
Approved by Academic Council	18th December 2021

Course Code	ADVANCED DESIGN OF CONCRETE STRUCTURAL SYSTEMS	L	T	P	C
21CE3003		3	0	2	4
Course Objective:					
Enable the student to: 1. recognize the behavior of reinforced concrete structures 2. apprehend the design of various structural elements 3. cognize the failure of buildings in field and improvement procedures					
Course Outcome:					
The student will be able to: 1. identify the behavior of structural elements 2. analyse the structure for different loading system 3. design the RC structures for its behavior. 4. design and detail the structural elements 5. adopt suitable structural systems to ensure the stability 6. understand the reasons for the failure of structural system					
MODULE: 1	DESIGN CONCEPTS:	8 Hours			
Introduction to Limit state - Collapse - Serviceability – Deflection and Crack Width - Short term deflection – Long term deflection - Mechanism of flexural cracking - Crack width – Code guidelines – Shrinkage and thermal cracking – Fire resistance of concrete elements					
MODULE: 2	DESIGN LOADS AND COMBINATION	7 Hours			
Static and Dynamic loading on structures – Accidental loads – Construction loads – Service loads - Design wind pressure - Gust factor - Base shear – Storey drift – Lateral stability – Modelling – Frame analysis and design - Optimal design of structural elements					
MODULE: 3	DESIGN OF SLAB	8 Hours			
Flat slabs – Introduction – types – advantages - components – Design for flexure – Design for shear - Diaphragm action - Flexible and Rigid diaphragm – Grid floor systems – Approximate analysis methods – Code guidelines					
MODULE: 4	INELASTIC BEHAVIOUR OF FRAMES	8 Hours			
Inelastic behaviour – Stress strain behaviour - Load deflection behaviour - Moment Curvature relation - Concept of Plastic Hinges – Moment redistribution – Plastic moment - Rotation capacity – Cyclic load behaviour – Joint strength – failure modes – Case studies					
MODULE: 5	DESIGN FOR SPECIAL ELEMENTS	9 Hours			

Design of liquid retaining structures - Shear wall - Design consideration – IS 13920 guidelines – Design of shear wall for axial load and bending – Detailing – Deep beams - Design as per IS 456- Design of Corbels for flexure and shear		
MODULE: 6	QUALITY CONTROL AND DETAILING PRACTICES	6 Hours
Durability – Minimum requirements – Construction joints - Progressive collapse – Structural ties - Structural Integrity - Design of Beam column joints – Ductile detailing – IS 13920 guidelines – Robustness		
Total Lectures		45 Hours
List of Experiments/Projects		
1.	Lateral stability of frames under wind load	
2.	Lateral stability of frames under seismic load	
3.	Analysis of frame with shear wall	
4.	Analysis of frame with flat slab	
5.	Optimal design of structural elements	
6.	Durability assessment of structural members	
7.	Strength and deflection behaviour of flexural members	
8.	Analysis of raft foundation	
Text Books		
1.	Devadas, M. (2003). Reinforced concrete design. Tata McGraw-Hill Education.	
2.	Varghese, P. C. (2009). Advanced reinforced concrete design. PHI Learning Pvt. Ltd..	
Reference Books		
1.	Sinha, S. N. (1996). Handbook of Reinforced Concrete Design. Tata McGraw-Hill Education.	
2.	Raju, N. K. (2005). Advanced reinforced concrete design. CBS Publishers & Distributors Pvt Limited.	
3.	Varghese, P. C. (2008). Limit state design of Reinforced Concrete. PHI Learning Pvt. Ltd.	
Recommended by Board of Studies		
Approved by Academic Council		18th December 2021

Course Code	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	C
21CE3004		3	0	2	4
Course Objective:					
Enable the student to:					
1. comprehend the behavior of steel connections					
2. familiarize with the analysis and design of the industrial buildings					
3. evaluate the performance of light gauge steel structures					
Course Outcome:					
The student will be able to:					
1. identify the appropriate structural steel section					
2. explain the behavior of different steel structural elements					
3. perform the analysis of steel structures					
4. design the components of steel structural elements and its connection					
5. appraise on the quality parameters for steel structures					
6. understand the reasons for failure of a steel structure					
MODULE: 1	DESIGN CONCEPTS OF STRUCTURAL STEEL	8 Hours			
Introduction to Limit state - Properties of steel: Mechanical properties, Hysteresis, ductility – Hot rolled sections: compactness and non-compactness, slenderness, residual stresses - Moment rotation behaviour - Cross-section yielding and member instability - Durability - Fire resistance and corrosion					
MODULE: 2	DESIGN OF STEEL ELEMENTS	7 Hours			
Effective length - Built-up section - Members subjected to combined forces - Shear buckling strength - Post-critical method - Shear Moment Interaction — Column base - Axial and Moment resisting base plates - Lateral stability					

MODULE: 3	DESIGN OF CONNECTIONS	8 Hours
Types of connections – Design of bolts and welds - Strength under combined stresses - Prying action - simple and eccentric joints and frame connections - Seated connections – Moment Resistant Connections – Clip angle connections - Split beam connections – Standardization of connections		
MODULE: 4	EARTHQUAKE DESIGN OF STEEL STRUCTURES	7 Hours
Seismic analysis methods - Seismic loading principles - Behavior of steel components-Moment frame systems-Concentrically braced frames- Eccentrically braced frames - Seismic design and detailing - Joint ductility – Risk assessment -Case studies on failure of steel structures		
MODULE: 5	DESIGN OF INDUSTRIAL BUILDINGS	
Types of roof system - Loading (wind/seismic) - Metal walls: Design of girts, sag rods, and wind posts, crane load specifications, Euro code and AISC provisions - Modelling concepts - Sway and non-sway frames - Analysis and design of roof truss - Pre-engineered buildings - Purlins - Stresses due to Erection and handling - Member design		
MODULE: 6	DESIGN OF COLD FORMED STEEL STRUCTURES	7 Hours
Types - Effective area - Effective stress - Behavior of unstiffened and stiffened elements – Design of beams – Flexural members – Lateral buckling of beams – Behavior of compression elements - Design of compression members – Wall studs		
Total Lectures		45 Hours
List of Experiments/Projects		
1.	Analysis and design of Pre-engineered building	
2.	Lateral stability of steel frame	
3.	Analysis and design of steel truss	
4.	Design of parking structure	
5.	Analysis and design of tower	
6.	Modeling and analysis of steel silo	
7.	Studies on behavior of laterally restrained and unrestrained beam	
8.	Studies on buckling of steel columns	
Text Books		
1.	Jayagopal, L.S. & Tensing.D (2015). Design of Steel structures. Vikas Publishing house.	
2.	Subramanian, N. (2008). Design of steel structures. Oxford university press	
Reference Books		
1.	Duggal, S. K. (2000). Design of steel structures. Tata McGraw-Hill Education.	
2.	Chen, W. F., & Sohal, I. (2013). Plastic design and second-order analysis of steel frames. Springer.	
3.	Bhavikatti, S. S. (2009). Design of Steel Structures (By Limit State Method As Per Is: 800 2007). IK International Pvt Ltd.	
4.	Franssen, J. M., Kodur, V., & Zaharia, R. (Eds.). (2009). Designing steel structures for fire safety. CRc Press.	
Recommended by Board of Studies		
Approved by Academic Council		18th December 2021

Course code	TECHNICAL APTITUDE	Credits			
22CE2001		0	0	1	0
Course Objective:					
1. To improve the skill set of the Civil Engineering students 2. To recall the concepts of structural analysis, design, estimation and costing 3. To enhance the knowledge in the Civil Engineering domains such as Geotechnical, Transportation and Environmental and Water Resources Engineering					
Course Outcome:					
At the end of the course students will be able to 1. Recall the theory of mechanics of solids and fluids					

2. Prepare and develop the plan for waste management and pollution control
3. Explain the foundation details with geotechnical data
4. Perform the Environmental impact assessment and water quality analysis
5. Evaluate the quality of water and construction materials
6. Design and detail the concrete, hydraulic and pavement structures
Technical topics:
1. Leveling and Contouring
2. Advanced building materials, Specification and Costing
3. Fluid flow properties and Hydraulic machineries
4. Structural systems, Forces and analysis concepts
5. Properties of soil and strength assessment
6. Mix design of concrete, and quality control
7. Concepts of RC, steel design and detailing
8. Design of rigid and flexible pavements
9. Water quality testing and pollution control
10. Solid waste management
Reference Books
1. PE, T. G. H. (2016). <i>Handbook of civil engineering calculations</i> . McGraw-Hill Education
2. Lindeburg, M. R. (2011). <i>Civil engineering reference manual</i> . McGraw-Hill Education
3. Newnan, D. G. (2004). <i>Civil Engineering Problems and Solutions</i> . Dearborn Trade Publishing
Recommended by Board of Studies
Approved by Academic Council 24 th September 2022

*There is no End semester exam for Technical Aptitude, the internal marks will be converted to 100marks for assessment.

Course code	SMART CITIES: The future of City life	L	T	P	C
22CE2002		3	0	0	3
Course Objective:					
4. To understand the concepts and components of smart cities					
5. To familiarize with the technology intervention in Smart Cities					
6. To gain knowledge on the governance and management of Smart cities					
Course Outcome:					
At the end of the course students will be able to					
7. Illustrate the concept of Smart Cities					
8. Classify the components of Smart City					
9. Examine the sustainability requirements for the various components					
10. Design the systems required for smart city					
11. Apply the regulations and policies					
12. Summarize the performance of various systems					
Module: 1	Introduction to Smart Cities	8 Hours			
Introduction to Smart Cities: Smart Cities– concept, origin and ideology -characteristics of smart cities – smart economy, smart governance, smart mobility, smart environment, smart living – smart building, Introduction to sustainable development					
Module: 2	Planning and development of Smart city Infrastructure	7 Hours			
Planning and development of Smart city Infrastructure: Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.					
Module: 3	Contemporary connected City	8 Hours			
Contemporary connected City					
Networks, Urban Information, Types of Spatial Data, Sensors, Computer vision, Low orbital satellite imagery, IoT, RFID, Machine to machine communication, framework.					

Module: 4	The Fourth Utility	8 Hours
The Fourth Utility: Information and the Data Deluge, Storage Methodologies, Mobile Computing, Social Media, Geocoding, Geoprocessing and Geotagging, Data Integration, Cloud computing, Open source, Digital twin models for smart city		
Module: 5	Productive Cities	7 Hours
Productive Cities – Urban poverty-Measuring urban poverty-Urban Vulnerabilities- City production and consumption- Wealth and inequality- SEWA, India, Improving human development in Smart Cities.		
Module: 6	Governance	7 Hours
Governance: Smart Regulations, Policy, Public Private Partnership, City Building as Industry, Government of India - policy for smart city, Mission statement & guidelines, Evaluation of performance, Smart cities in India, Case studies of smart city		
Total Lectures		45 Hours
Text Books		
1.	Amitabh Satyam and Igor Calzada, “The Smart City Transformations: The Revolution of 21 st Century”, Bloomsbury India, New Delhi, 2017	
2.	Mani, N, “Smart Cities and Urban Development in India”, New Century Publications, New Delhi, 2016	
3.	Tripathi Gupta, “Smart Cities Transforming India”, Pentagon Press, New Delhi, 2016	
Reference Books		
1.	Alex Grosu, “Public Transport in Smart Cities: An Utopian View by Alex Grosu”, Kindle Edition, Amazon Digital Services LLC, 2017	
2.	Stamatina Th. Rassia, Panos M. Pardalos, “Cities for Smart Environmental Energy Futures: Impacts on Architecture and Technology (Energy Systems)”, Springer, Softcover reprint of the original, 1 st Ed 2014 Edition, 2015	
3.	Houbling Song, Ravi Srinivasan, Tamim Sookoor, Sabina Jeschke, “Smart Cities: Foundations, Principles and Applications”, Wiley Publishers, 1 st Edition, 2017	
Recommended by Board of Studies		
Approved by Academic Council		24 th September 2022

**DEPARTMENT OF
CIVIL ENGINEERING**

LIST OF NEW COURSES

Sl. No	Code No.	Course Title	Credits			
			L	T	P	C
1	20CE2001	Surveying and Geomatics Engineering	3	0	0	3
2	20CE2002	Mechanics of Solids	3	0	0	3
3	20CE2003	Fluid Mechanics and Machinery	3	0	0	3
4	20CE2004	Soil Mechanics and Foundation Engineering	3	0	0	3
5	20CE2005	Water Supply and Sanitary Engineering	3	0	0	3
6	20CE2006	Solid Waste Management	3	0	0	3
7	20CE2007	Transportation Engineering	3	0	0	3
8	20CE2008	Traffic Engineering and Management	3	0	0	3
9	20CE2009	Smart City Planning and Management	3	0	0	3
10	20CE2010	Engineering Sustainability: Analysis and Design	2	0	0	2
11	20CE2011	Analysis of Structures	3	0	0	3
12	20CE2012	Mechanics and Design of Concrete Structures	3	0	0	3
13	20CE2013	Design of Steel Structures	3	0	0	3
14	20CE2014	Water Resources Systems	3	0	0	3
15	20CE2015	Quantity Surveying and Estimation	3	0	0	3
16	20CE2016	Construction Technology and Automation	3	0	0	3
17	20CE2017	Disaster Preparedness and Planning	3	0	0	3
18	20CE2018	Construction Engineering and Management	3	0	0	3
19	20CE2019	Design of Precast Concrete Structures	3	0	0	3
20	20CE2020	Artificial Intelligence in Project Management	3	0	0	3
21	20CE2021	Surveying and Geomatics Engineering Laboratory	0	0	2	1
22	20CE2022	Fluid Mechanics and Machinery Laboratory	0	0	2	1
23	20CE2023	Materials Testing and Evaluation Laboratory	0	0	2	1
24	20CE2024	Geotechnical Engineering Laboratory	0	0	2	1
25	20CE2025	Environmental Engineering Laboratory	0	0	2	1
26	20CE2026	Concrete and Quality control Laboratory	0	0	2	1
27	20CE2027	Transportation Engineering Laboratory	0	0	2	1
28	20CE2028	Structural Design Laboratory	0	0	2	1
29	20CE2029	Design Studio - 4D and 5D	0	0	2	1
30	20CE2030	Design Studio – 6D and 7D	0	0	2	1
31	20CE2031	Concrete Technology	3	0	0	3
32	20CE2032	Prestressed Concrete	3	0	0	3
33	20CE2033	Basics of Dynamics and Aseismic Design	3	0	0	3
34	20CE2034	Repair and Rehabilitation of Structures	3	0	0	3
35	20CE2035	Building Information Modelling	3	0	0	3
36	20CE2036	Municipal Waste Management	3	0	0	3
37	20CE2037	Noise Pollution and its Control	3	0	0	3
38	20CE2038	Environmental Laws and Policy	3	0	0	3
39	20CE2039	Irrigation Engineering and Hydraulic Structures	3	0	0	3
40	20CE2040	Heritage Science and Technology	3	0	0	3
41	20CE2041	Basics of Remote Sensing and Geographical Information System	3	0	0	3
42	20CE2042	Mechanical, Electrical and Plumbing Services	3	0	0	3
43	20CE2043	Ground Improvement Techniques	3	0	0	3
44	20CE2044	Sustainable Design of Campus	3	0	0	3
45	20CE2045	Building Automation and Additive Manufacturing	3	0	0	3
46	20CE2046	Data Analytics for Civil Engineering	3	0	0	3
47	20CE2047	Intelligent Transportation Systems	3	0	0	3
48	20CE2048	Airport and Aerotropolis	3	0	0	3
49	20CE2049	Air Pollution and Atmospheric Chemistry	0	0	2	1
50	20CE2050	AR/VR/MR for Civil Engineering	0	0	2	1
51	20CE2051	Global Climate Change and Its Impact	3	0	0	3
52	20CE2052	Green Buildings	3	0	0	3
53	20CE2053	Smart Buildings	3	0	0	3
54	20CE2054	Interior Design	3	0	0	3

55	20CE2055	Docks and Harbour	3	0	0	3
56	20CE3025	LTCC-CE-001 - Advanced Design of Reinforced Concrete Buildings				3
57	20CE3026	LTCC-PM-001 - Project Management for Engineers				3
58	20CE3027	LTCC-DE-001 - Applied Industrial IoT				3
59	20CE3028	LTCC-DE-002 - Geospatial Practices for Engineers				3
60	21CE1001	Engineering Mechanics	3	0	0	3
61	21CE3001	Foundations of Building Information Modelling	3	0	0	3
62	21CE3002	Digital Age Construction with BIM	3	0	0	3

Course code	SURVEYING AND GEOMATICS ENGINEERING	L	T	P	C
20CE2001		3	0	0	3
Course Objective:					
1. To introduce the principle of surveying methods 2. To teach different methods of surveying 3. To provide knowledge about the surveying applications in Civil Engineering					
Course Outcome:					
At the end of the course students will be able to 1. Perform basic land surveying instruments and perform related calculations. 2. Select methods to measure angles and distances 3. Schedule field surveying operations 4. Examine the implementation of surveying procedures for setting out curves 5. Appraise the usage of equipment’s and methods in triangulation survey 6. Formulate the surveying methods and executions					
Module: 1	Introduction to Surveying:				9 Hours
Surveying: Principles, linear and angular methods, levelling: principles of levelling-instruments bench mark, temporary and permanent adjustment-booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning, curvature and refraction correction – reciprocal levelling, errors in levelling; contouring: characteristics, methods, uses.					
Module: 2	Theodolite Surveying				8 Hours
Theodolite–principle and practices –types- temporary and permanent adjustments- horizontal and vertical angles – repetition and reiteration methods – traversing - closing error and distribution-bowditch’s rule – omitted measurements -heights and distances single plane method.					
Module: 3	Tacheometric Surveying				7 Hours
Tacheometric surveying - principle of stadia method – distance and elevation formulae for staff held vertical – instrumental constants - anallactic lens -tangential method					
Module: 4	Curves and Setting Works				7 Hours
Curve surveying: curves types - elements of simple curves – setting out simple curves by linear and angular methods – transition curve - requirements and functions. setting out introduction- setting out of a building and culvert					
Module: 5	Modern Surveying				7 Hours
Total Station – parts of a total station - accessories –advantages and applications - errors in total station survey- processing and preparation of maps, area, contouring					
Module: 6	Drone Surveying				7 Hours
Introduction - benefits of drone surveying - Application of drone surveying – flight planning and regulations – image acquisition and processing - topographic modelling.					
Total Lectures					45 Hours
Text Books					
1.	Punmia B. C., Ashok k Jain, Arun K Jain., “Surveying”, Vol I,II,III, Laxmi Publications, 2005				
2.	Arora, K.R., “Surveying, Vol-I, II and III”, Standard Book House, 2015.				
Reference Books					
1.	Basak, N., “Surveying and Levelling”, McGrawHill and Co., New Delhi 2015.				
2.	Bhavikatti. S.S., “Surveying: Theory and Practice”. IK International Publishing House Pvt Ltd, 2016				

3.	Madhu, N, Sathikumar, R and Satheesh Gobi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson India, 2006.
4.	Paul R. Wolf, Charles D. Ghilani, “Elementary Surveying: An Introduction to Geomatics”, Prentice Hall, 2006
5.	George Dekoulis., “Drones Applications”, Intech open, 2018
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	MECHANICS OF SOLIDS		L	T	P	C
20CE2002			3	0	0	3
Course Objective:						
1. To provide knowledge about the analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. 2. To familiarize the fundamental concepts of stress, strain and deformation of solids with applications to bars, beams and trusses. 3. To impart the procedures to estimate the load carrying capacity of various structural components and elements						
Course Outcome:						
At the end of the course students will be able to 1. Illustrate the concepts and principles of Engineering Mechanics 2. Explain the behaviour of structural elements 3. Analyze the structural members for various forces 4. Estimate the response of the elements 5. Develop suitable response intricacies 6. Adapt suitable analysis procedure						
Module: 1	Simple Stresses and Strains					9 Hours
Stress - Strain-types of stresses and strain - Hooke's law - tension -compression and shear - stressstrain diagrams - relation between elastic constants - Hoop stress - composite bars in tension and compression - Principle of superposition - bars of varying sections and of different materials - Thermal stresses and strains - principal stresses and strains - Mohr's circle. Theory of failures.						
Module: 2	Determinate and Indeterminate beams					12 Hours
Beams and Bending - Types of loads, supports - Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, uniformly distributed load, uniformly varying load - Point of Contra flexure - Theory of Simple bending. Indeterminate Beams - Shear force and Bending moment for Fixed, Continuous and Propped Cantilever beams.						
Module: 3	Deflection of Beams					8 Hours
Slope and deflection of beams - Macaulay's method - Moment area method - Conjugate beam method.						
Module: 4	Thin and Thick Cylinders					6 Hours
Introduction - Thin Cylindrical Cylinder - hoop stress - longitudinal stresses - Lamé's theory.						
Module: 5	Torsion in circular shaft					5 Hours
Torsion - Torsion equation - solid and hollow circular shaft - Torsional rigidity - power transmitted by the shafts						
Module: 6	Theory of Columns					5 Hours
Theory of columns - Long column and short column - Euler's formula - Rankine's formula - Secant formula - Beam column.						
					Total Lectures	45 Hours
Text Books						
1.	Rajput.R.K. "Strength of Materials", S.Chand and Company Ltd., New Delhi 2014.					
2.	Bhavikatti, S., "Structural Analysis", Vol.1 and 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2011					
Reference Books						
1.	Egor.P.Popov V, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi 2001					
2.	Vazirani.V.N, Ratwani.M.M, Duggal .S.K, "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1". Khanna Publishers, New Delhi 2014.					

3.	Timoshenko.S.P. and Young .D.H., “Elements of Strength of Materials”, V Edition, Affiliated EastWest Press Pvt. Ltd., New Delhi, 2002.
4.	Vaidyanathan, R. and Perumal, P., “Structural Analysis”, Vol.1 and 2, Laxmi Publications, New Delhi, 2014
5.	Ramamrutham S, “Theory of structures”, Dhanpat Rai publications, 2004 Godfrey Boyle, “Renewable Electricity and the Grid: The Challenge of Variability”, Earthscan , 2012
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	FLUID MECHANICS AND MACHINERY				L	T	P	C
20CE2003					3	0	0	3
Course Objective:								
1. To introduce fundamental concepts of fluid statics and dynamics								
2. To familiarise the concepts of flow measurements and flow characteristics in open channels and pipes								
3. To provide knowledge about working principle and operation of pumps and turbines								
Course Outcome:								
At the end of the course, student will be able to								
1. Recall the behaviour of fluids under static condition, measure pressure changes and estimate total pressure on plane surfaces								
2. Demonstrate flow measurement methods								
3. Identify the flow pattern and estimate total energy								
4. Select method to design pipe flows including losses								
5. Formulate and solve boundary layer problems								
6. Relate the physical parameters using dimensional analysis								
Module: 1	Introduction							8 Hours
Fluid Properties – Newton’s law of Viscosity – Classification of Fluids - Fluid Statics - Pressure – Pascal’s law – Atmospheric, Absolute, Gauge and Vacuum pressures – Pressure measurement - Hydrostatics: Forces on plane and curved surfaces-Total pressure and Centre of pressure								
Module: 2	Fluid Movement and Measurements							8 Hours
Equations of Motion Euler’s equation in one dimensional form – Bernoulli’s equation – Flow measurements: Venturimeter, Orificemeter, Weirs and Notches								
Flow Through Pipes: Loss of energy in pipes – Hydraulic Gradient, Energy Gradient – Major energy loss – Minor energy losses								
Module: 3	Uniform Flow							7 Hours
Open channel flow – Types, Geometrical elements of open channel –Velocity distribution in open channel – Steady uniform flow - Chezy’s equation, Manning’s equation – Most Economical sections for uniform flow – Specific energy and specific force – Critical depth and velocity								
Module: 4	Gradually varied and rapidly varied Flow							8 Hours
Dynamic equations of gradually varied flow – Water surface flow profile classifications - Critical, Subcritical and Super-critical flow – Hydraulic jump – Energy dissipation.								
Module: 5	Turbines							7 Hours
Impact of Jets - Hydraulics Turbines – Layout and Components of Hydro-electric project – Impulse turbine - Reaction turbines – Francis turbine – Kaplan turbines – Draft tube – Performance of turbines, Headlosses and efficiencies, Specific speed								
Module: 6	Pumps							7 Hours
Centrifugal pumps – Working principle – Single stage and multi-stage pumps - Minimum speed – Cavitation – Specific speed - Performance curves - Reciprocating pumps – Working principle of reciprocating pumps – Airvessels.								
Total Lectures								45 Hours
Text Books								
1.	Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines” , S.Chand and Co., New Delhi, 2008.							
2.	Bansal, R.K., “Fluid Mechanics and Hvdraulic Machines”, Laxmi Publications, New Delhi, 2005							

Reference Books	
1.	Modi, P.N. & Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi, 2007
2.	Som S.R. & Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, 2012
3.	Subramanya, K., “Fluid Mechanics and Hydraulic Machines”, McGraw Hill India Pvt. Ltd., New Delhi, 2011
4.	Yunus A.Cengel., “Fluid Mechanics”, Tata McGraw Hill India Pvt. Ltd., 2010.
5.	Chandramouli, “Applied Hydraulic Engineering”, Yes Dee Publishers Pvt. Ltd., 2017.
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	SOIL MECHANICS AND FOUNDATION ENGINEERING	L	T	P	C
20CE2004		3	0	0	3
Course Objective:					
1. To impart the knowledge to classify the soil based on the index properties and to access their engineering properties based on the classification					
2. To familiarize the students on compaction, stress transformation, consolidation and shear strength of soils					
3. To familiarize the geotechnical design of different type of foundations and retaining walls.					
Course Outcome:					
At the end of the course, student will be able to					
1. List the basic equations of elasticity					
2. Distinguish between the applications of different types of finite elements.					
3. Develop the finite element discrimination for seepage, consolidation soil structure interaction problems.					
4. Identify the suitable foundation for construction					
5. Design the foundation system for shallow depth					
6. Analyse the earth retaining structures for different soil medium					
Module: 1	Soil Characterization	8 Hours			
Nature of soil – soil types and soil formation - Geological cycle - Phase diagrams - Functional relationships based on index properties - Physical characterization of soil - Dry and Wet sieve analysis - Atterberg’s Indices - Standard nomenclature - IS Soil Classification.					
Module: 2	Permeability and Seepage	7 Hours			
Darcy's law and its validity - factors affecting permeability - permeability tests - permeability of stratified soil masses - seepage pressure - quick condition - flow nets					
Module: 3	Compaction & Consolidation of soil	8 Hours			
Definitions - Differentiate between compaction and consolidation - compaction mechanism and proctor tests - field compactions methods - factors affecting compaction - consolidation mechanism through spring analogy - Terzaghi’s one dimensional consolidation theory (only formula): Time factor, pre-consolidation pressure, consolidation settlement					
Module: 4	Stress Distribution and Shear Strength of Soil	8 Hours			
Stress distribution – soil media – Boussinesq theory – Use of Newmarks influence chart – Mohr's strength theory - Mohr- coulomb’s strength theory - Modified Mohr coulomb’s theory - shears parameters through lab - field tests based on drainage conditions					
Module: 5	Site Investigation	7 Hours			
Methods of exploration – auguring and boring – Wash boring and rotary drilling – Depth of boring – Spacing of bore hole – Sampling techniques – undisturbed sampling methods - Split spoon sampler - Thin wall sampler - Penetration tests (SPT and SCPT) - Bore log report – Data interpretation					
Module: 6	Shallow Foundation and Deep Foundation	7 Hours			
Shallow Foundations: Types, Basic terms, SBC computation using IS and Terzaghi methods. Deep Foundations: Pile - Pile capacity					
Total Lectures					45 Hours

Text Books	
1.	Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, NewDelhi, 2011.
2.	Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., 2002
Reference Books	
1.	Gopal Ranjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International Pvt. Ltd, New Delhi, 2005
2.	Purushothama Raj. P., “Soil Mechanics and Foundation Engineering”, 2 nd Edition, Pearson Education, 2013
3.	Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005
4.	Punmia B C, Ashok Kumar Jain “Soil Mechanics and Foundation Engineering”, Lakshmi Publications Pvt Ltd, 16 th edition, 2005
5.	Ramamurthy T N and Sitharam T G “Geotechnical Engineering (Soil Mechanics)”, S Chand Ltd., 2008
Recommended by Board of Studies	
Approved by Academic Council	25 th September 2021

Course code	WATER SUPPLY AND SANITARY ENGINEERING	L	T	P	C
20CE2005		3	0	0	3
Course Objective:					
1. To learn to design, construct, operate and maintain water conveyance system. 2. To understand design, build, operate and maintain sanitation system. 3. To learn to support the treatment and recycle system of wastewater, sewerage, and solid waste.					
Course Outcomes:					
At the end of the course students will be able to 1. Select appropriate treatment to raw water 2. Design the pipe-network for water supply and sewage disposal effectively. 3. Calculate and Estimate the quantity and quality of water used for domestic as well as construction. 4. Design the water distribution and sewer networks. 5. Make use of available standards. 6. Prepare the plan and implement house plumbing work effectively.					
Module: 1	Water Supply	8 Hours			
Sources and suitability of water –Water demand and types – Population forecasting – Quality of water – Water borne diseases – Water quality standards – Water quality index.					
Module: 2	Wastewater Engineering	9 Hours			
Water treatment plan: objectives, location and layout – Characteristics of wastewater – Sewage treatment and sewerage system – Primary, secondary and tertiary treatment of wastewater, sludge treatment and disposal – Effluent discharge standards – Primary and secondary treatment unit operations and unit processes of wastewater.					
Module: 3	Conveyance of Water	8 Hours			
Introduction to Conveyance of water – Types of pipes – Pipe joints and distribution system – Laying of pipes – Valves and its types – Types of meter – Fitting & fixtures – Leakage control methods – Water conservation.					
Module: 4	Sanitation System	8 Hours			
Introduction of sanitation system: Objectives, Collection methods – Conservancy system – Water carriage system – Drain and its classification – Sewer joint – Sewer section – Manhole – Laying – Appurtenances – Maintenance works: Cleaning operations, Causes of odor, Requirements, & equipment and tool – Safety measures for sewer men.					
Module: 5	House plumbing	7 Hours			
Plumbing: terms, tools, pipes, fittings, practice & operations – fixing and jointing pipes and accessories – traps – drainage plant – safety and precautions – sanitary fittings.					
Module: 6	Recycling of Wastewater and Sludge	5 Hours			
Introduction to Recycling – Advanced recycling method – Sludge management					
Total Lectures					45 Hours
Text Books					
1.	Goel S., “Water and Wastewater Engineering”, Cambridge University Press, 2019				

2.	Punmia, B.C “Water Supply Engineering”, Laxmi Publications, 2012
Reference Books	
1.	Davis M.L, and Cornwell D.A., “Introduction to Environmental Engineering”, McGraw Hill, 2012.
2.	Peavy H.S., Rowe D.R., and Tchobanoglous G., “Environmental Engineering”, McGraw Hill. 1985.
3.	Kenneth W., Warner F.C., and Davis W.T, “Air Pollution its Origin and Control”, Prentice Hall, 1997.
4.	Mishra P.C., “Fundamental of Air and Water Pollution”, South Asia Books, 1990.
5.	Masters G., “Introduction to Environmental Engineering and Science”, Prentice Hall. 2004.
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	SOLID WASTE MANAGEMENT	L	T	P	C
20CE2006		3	0	0	3
Course Objective:					
1. To impart knowledge and skills with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of solid waste. 2. To impart knowledge on various recycling options available for the solid waste. 3. To educate the engineering principles, design criteria, methods and equipments available to manage the solid waste					
Course Outcome:					
At the end of the course students will be able to 1. Analyse the nature and characteristics of municipal solid wastes 2. Sort out the functional elements for solid waste management 3. Apply the techniques and methods used in transformation, conservation and recovery of materials from solid waste 4. Identify and design waste containment systems 5. Gain knowledge in regulatory requirements regarding municipal solid waste management 6. Apply the basic scientific principles for solving practical waste management challenges					
Module: 1	Introduction to Solid Waste	8 Hours			
Types and sources of solid waste – classification of solid waste - need for solid waste management - salient features of Indian legislations on management and handling of municipal solid wastes.					
Module: 2	Storage, Collection and Transport of Wastes	8 Hours			
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems - need for transfer and transport – transfer stations optimizing waste allocation–compatibility, storage, labeling and handling of hazardous wastes.					
Module: 3	Waste Characterization and Source Reduction	7 Hours			
Waste generation rates – factors affecting waste generation-composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan - source reduction of wastes –waste exchange - extended producer responsibility.					
Module: 4	Waste Processing Technologies	8 Hours			
Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting - thermal conversion technologies and energy recovery – incineration - treatment of biomedical wastes, waste characterization, waste reduction and environmental control.					
Module: 5	Waste Disposal	7 Hours			
Waste disposal options – disposal in landfills: landfill classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactor - leachate and landfill gas management, Environmental Risk Assessment: Risk, Methods, case studies.					
Module: 6	Energy from Solid Waste	7 Hours			
Composting – incineration - biogas generation - case study on best practices - Swachhbharat features – Solid waste management at Industries: Generation in agriculture, process industry, Mineral and Metallurgical industry, Disposal of industrial and mill tailings, Resource and energy recovery, Recycling of solid waste.					
Total Lectures					45 Hours
Text Books					

1.	Bhude A.D. and Sundaresan, B.B, “Solid Waste Management Collection”, Processing and Disposal, 2001
2.	Paul T Willams, “Waste Treatment and Disposal”, John Wiley and Sons, 2000
Reference Books	
1.	Tchobanoglous.G. Theisen, H. M., and Eliassen, R. “Solid. Wastes: Engineering Principles and Management Issues”. New York: McGraw Hill, 1993.
2.	Manual on “Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
3.	Manser A.G.R. and Keeling A.A, “Practical Handbook of Processing and Recycling of Municipal solid Wastes”, Lewis Publishers, CRC Press, 1996
4.	George Tchobanoglous and Frank Kreith, “Handbook of Solid waste Management”, McGraw Hill, New York, 2002
5.	Government of India, “Manual on Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, New Delhi, 2000
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	TRANSPORTATION ENGINEERING	L	T	P	C
20CE2007		3	0	0	3
Course Objective:					
1. To Introduce characteristics of highway and railway engineering 2. To Give overview on the basics of highway and railway engineering 3. To impart the various process and methods involved in the planning, development, design, construction and maintenance of highway and railway engineering.					
Course Outcome:					
At the end of the course students will be able to 1. Understand the concepts of development of highway and railway engineering 2. Explain the components of highway and railway engineering 3. Carryout the engineering surveys involved in planning of highway and railway engineering 4. Design the geometric elements of highway and railway engineering 5. Recognize the functions of structural elements of highway and railway engineering 6. Identify the materials used for the construction of highway and railway engineering					
Module: 1	Introduction to Highway and Railway Engineering				7 Hours
Characteristics- Historical development – Highway and Railway development in India– Classification – Engineering Surveys – Highway and Railway planning in India- Highway and Railway Projects – Built Operate Transfer(BOT),Built Own Operate and Transfer(BOOT),and Public Private Partnership(PPP)					
Module: 2	Traffic Engineering Studies and Analysis				7 Hours
Sampling in traffic studies; adequacy of sample size; application of sampling methods for traffic studies, objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) - Spot speed - Speed and delay - Volume - Origin – destination - Parking. Traffic manoeuvres and Stream Characteristics; application in intersection design.					
Module: 3	Highway Pavement materials and Design				8 Hours
Introduction- Flexible pavements: factors affecting design and performance-design of flexible pavements – Rigid pavements: components and functions – factors affecting design and performance-design of concrete pavements					
Module: 4	Geometric Design of Highways				8 Hours
Cross section elements; sight distance, design of horizontal alignment–design speed, super elevation, extra widening- transition curve-design of vertical alignment– summit curve and valley curve-design of intersections-problems					
Module: 5	Railway Planning and Construction				8 Hours
Elements of permanent way – Selection of gauges - Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level					

Crossings - Track Stress, coning of wheels, creep in rails, defects in rails. Points and crossing – station and yards–signalling and control system.		
Module: 6	Railway Maintenance	7 Hours
Earthwork – Stabilization of track on poor soil - Tunneling Methods, drainage and ventilation – Calculation of Materials required for track laying - Construction and maintenance of tracks – Signalling - Railway Station and yards and passenger amenities		
Total Lectures		45 Hours
Text Books		
1.	Khanna,S.K.,Justo,C.E.GandVeeraragavan,A,“HighwayEngineering”,Revised10thEdition, Nem Chandand Bros,2017	
2.	Venkatramaiah C.,, Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015.	
Reference Books		
1.	KadiyaliL.R, “Transportation Engineering”, Khanna Publishing, 2016	
2.	FredL.Mannering,ScottS.Washburn,WalterP.Kilareski,“PrinciplesofHighwayEngineering and Traffic Analysis”, 6 th Edition, John Wiley, 2016	
3.	Rangwala, “Railway Engineering”, Charotar Publishing House, 27th Edition 2017	
4.	Saxena S.C. and Arora S.P. “A Text Book Of Railway Engineering”, Dhanpat Rai Publications , 2010	
5.	Hutchinson, B.G., `Principles of Urban Transport System Planning' - McGraw Hill Book Co., London, UK, 1982.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
20CE2008		3	0	0	3
Course Objective:					
1. To familiarize the fundamentals of traffic engineering 2. To enable to identify the different theories of traffic flow 3. To impart the importance of traffic safety and management					
Course Outcome:					
At the end of the course students will be able to 1. Understand the fundamentals of traffic engineering 2. Carry out different traffic studies 3. Design channels, intersections, signals, roundabouts and parking arrangements 4. Express the application of traffic flow theory 5. Enhance safety and environment in all design aspects 6. Develop Traffic management Systems					
Module: 1	INTRODUCTION	8 Hours			
Scope of Traffic Engineering - Elements of Traffic Engineering - road user, vehicle and road way. Road Characteristics – Road user characteristics – PIEV theory – Vehicle characteristics - IRC standards - Design speed, volume – Performance characteristics – Fundamentals of Traffic low – Urban Traffic problems in India.					
Module: 2	TRAFFIC SURVEY	8 Hours			
Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting					
Module: 3	LEVEL OF SERVICE AND CAPACITY	7 Hours			
Concept, applications and significance - Highway capacity - Capacity of urban and rural roads - PCU concept and its limitations – Road user facilities - Parking facilities - Cycle tracks and cycle ways - Pedestrian facilities – Traffic flow theory					
Module: 4	INTERSECTION DESIGN	8 Hours			
Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated - Design of signal setting - phase diagrams - timing diagram – Signal co					

ordination – Roundabouts - Grade separated intersections - Geometric elements for divided and access controlled highways and expressways		
Module: 5	ROAD SAFETY	8 Hours
Street lighting -Traffic signs including Variable Message sign and road markings – Significant roles of traffic control personnel – Networking pedestrian facilities and cycle tracks - Traffic regulation and control Traffic safety – Principles and practices – Road safety Audit – Traffic and environment hazards – Air and Noise Pollution – causes - abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport		
Module: 6	TRAFFIC MANAGEMENT SYSTEM	6 Hours
Area Traffic Management System – Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods-Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education – Car pooling		
Total Lectures		45 Hours
Text Books		
1.	Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 2013	
2.	Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan Press Ltd.1996	
Reference Books		
1.	Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd., New Delhi, 2011	
2.	Garber and Hoel, “Principles of Traffic and Highway Engineering”, CENGAGE Learning, New Delhi, 2010	
3	Coleman A. O'Flaherty, “Transport Planning and Traffic Engineering” CRC Press, 2018	
4.	Hobbs.F.D., “Traffic Planning and Engineering”, University of Brimingham, Peragamon Press Ltd, 2005	
5.	SP:43-1994, Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	SMART CITY PLANNING AND MANAGEMENT	L	T	P	C
20CE2009		3	0	0	3
Course Objective:					
1. To understand the concepts of Smart City 2. To learn the components of Smart City 3. To learn the application of Smart City					
Course Outcome:					
At the end of the course students will be able to 1. Identify the concepts of smart city 2. Understand the components of Smart City 3. Apply the concepts of urban mobility 4. Apply the smart energy and smart building concepts 5. Apply the smart water management concepts. 6. Analyse the smart cities across the countries					
Module: 1	Smart Cities: State of Art				8 Hours
Evolution of Smart City, Components of Smart City, Mobiles phones and big data for smart technology, policy framework for smart cities					
Module: 2	Smart urban Mobility				8 Hours
Need for urban mobility, Components, Land use, urban form, Transit oriented development (TOD), ICT support for smart mobility.					
Module: 3	Smart Energy				7 Hours
Urban Density and Energy Use, Concepts of Smart Energy, Strategies in making a City Energy smart, Smart Grid, Use of Electric Vehicles.					
Module: 4	Smart Buildings				8 Hours

Definition, Major Sub-systems-Lighting, HVAC, Vertical transportation, Energy monitoring and management, communication monitoring and surveillance, Fire safety and Early warning system, Access control and system security, Benefits and policies		
Module: 5	Smart Water Management	7 Hours
Water- Growing demand and shrinking resources, Water resources and cycle, Steps in implementing smart water management, Categories and Options, policy challenges		
Module: 6	Smart City: Case Studies	7 Hours
International: City of Singapore, Vienna, Philadelphia, Indian: AMRUT Mission, City of Pune, Amritsar, Bhopal		
Total Lectures		45 Hours
Text Books		
1.	Anil kumar ,” Introduction to Smart Cities”, Pearson Education India, 2019	
2.	Binti Singh, Manoj Parmar, “Smart City in India Urban Laboratory, Paradigm Or Trajectory”, Taylor & Francis, 2019	
Reference Books		
1.	Houbing Song, Ravi Srinivasan, Sabina Jeschke, Tamim Sookoor, “Smart Cities Foundations, Principles, and Applications”, Wiley 2017	
2.	Leonidas Anthopoulos, “Smart City Emergence Cases From Around the World”, Elsevier Science, 2019	
3.	Sukanya Krishnamurthy, Torsten Schroeder, “Architecture and the Smart City”, Taylor & Francis 2019	
4.	Claudio Coletta, Leighton Evans, Liam Heaphy, Rob Kitchin, “Creating Smart Cities”, Taylor & Francis, 2018	
5.	Schahram Dustdar, Stefan Nastić, Ognjen Šćekić , “Smart Cities The Internet of Things, People and Systems”, Springer International Publishing, 2017	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	ENGINEERING SUSTAINABILITY: ANALYSIS AND DESIGN	L	T	P	C
20CE2010		2	0	0	2
Course Objective:					
1. To understand the concepts of sustainability 2. To learn the social, economic and environmental aspects of sustainability 3. To learn the application of sustainability concepts in civil engineering					
Course Outcome:					
At the end of the course students will be able to 1. Identify the concepts of sustainability 2. Understand the Concepts of Economic Sustainability 3. Analyse the Concepts of Environmental Sustainability 4. Analyse the Social aspects of sustainability 5. Apply the concepts of sustainability to environmental and geotechnical engineering. 6. Apply the concepts of sustainability to construction and transportation engineering					
Module: 1	Introduction to Sustainability				5 Hours
Definition - Principles - Triple bottom line of sustainability - Paradigm shift on sustainability - Civil Engineer perspective of sustainability					
Module: 2	Economic Sustainability				5 Hours
Traditional Sustainable Economics - Life cycle cost analysis - Present future and annual worth - Rate of Return - Benefit/Cost Ratio.					
Module: 3	Environmental Sustainability				5 Hours
Structure of Life cycle assessment - LCIA categories - Product category rule (PCR) and Environmental Product Declaration (EPD) - Ecological footprint - Water footprint - planet boundary.					
Module: 4	Social Sustainability				5 Hours
Existing Civil Engineering Concepts - Social Media and Civil Engineering - Human Development Index (HDI) - Social Impact Assessment.					
Module: 5	Applications in Environmental and Geotechnical Engineering				5 Hours

Low Impact Development - Drinking water treatment - Outdoor air quality - Coastal Resilience-Living shorelines - Alternate filler materials - Stabilized earth wall - Geothermal energy foundations,		
Module: 6	Applications in Construction and Transportation Engineering	5 Hours
Use of Flyash, bamboo - Design for adaptability and deconstruction (DFAD) - material and waste management - Community participation - Worker Safety - Multimodal transportation - Intelligent transportation system - Crash modification factors.		
Total Lectures		30 Hours
Text Books		
1.	Andrew Braham, Sadie Casillas, “Fundamentals of Sustainability in Civil Engineering”, CRC Press, 2020	
2.	Sybil Derrible, “Urban Engineering for Sustainability”, MIT Press, 2019	
Reference Books		
1.	Yates J. K., Daniel Castro-Lacouture, “Sustainability in Engineering Design and Construction”, CRC Press 2018	
2.	Sivakumar Babu G.L., Sireesh Saride, B. Munwar Basha,” Sustainability Issues in Civil Engineering”, Springer Singapore2018	
3.	Jan Seidel,” Sustainability in Civil Engineering”, GRIN Verlag 2007	
4.	Toolseeram Ramjeawon ,” Introduction to Sustainability for Engineers” CRC Press 2020	
5.	Barbara A. Luke, Richard Newport Wright, William Edward Kelly ,”Engineering for Sustainable Communities Principles and Practices” ASCE, 2017	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	ANALYSIS OF STRUCTURES	L	T	P	C
20CE2011		3	0	0	3
Course Objective:					
1. To provide knowledge about different methods of analysis 2. To impart the different techniques available for the analysis of structures 3. To enable to identify the best suitable method of analysis					
Course Outcome:					
At the end of the course students will be able to 1. Illustrate the concepts and principles 2. Explain the behaviour of structural elements 3. Analyze the structural members for various forces 4. Analyze the response of the Structural elements 5. Develop suitable response intricacies 6. Adapt suitable analysis procedure					
Module: 1	Energy Method Principles	7 Hours			
Work energy principles – Principle of virtual work-Castigliano’s first, second theorem. Static indeterminacy - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures.					
Module: 2	Slope Deflection Method	8 Hours			
Kinematic indeterminacy - Analysis of Continuous Beams and Portal Frames - Bending Moment and Shear Force Diagram.					
Module: 3	Moment Distribution Method	8 Hours			
Fixed End Moments, Stiffness factor, Distribution factor -Analysis of Continuous Beams- with and without sinking of supports, Portal Frames- with and without sway - Bending Moment and Shear Force Diagram.					
Module: 4	Influence Lines	7 Hours			
Influence lines for bending moment and shear force - Muller Breaslau’s - principle - determinate and indeterminate beams.					
Module: 5	Analysis of Arches & Cables	8 Hours			
Three hinged Parabolic and Circular and two hinged arches - Cables tension forces in towers.					
Module: 6	Stiffness Method	7 Hours			
Forces not acting at co-ordinates-Formulation of Structure Stiffness matrix -Determination of Displacements - Application to determinate and indeterminate trusses, beams and frames.					
Total Lectures					45 Hours

Text Books	
1.	Bhavikatti S.S, “Structural Analysis Volume-I and Volume II”, Vikas Publications, 2011
2.	Vazrani & Ratwani, “Analysis of Structures”, Khanna Publications, 2002
Reference Books	
1.	Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill, 2011
2.	Wang, C.K, “Indeterminate Structural Analysis”, McGraw Hill Book Company, 2010
3.	Hibbeler, “R.C.;Structural Analysis”, Pearson Education Asia publication, 2008
4.	Devdas Menon, “Structural Analysis”, Narosa Publishing House, 2017
5.	Pandit and Gupta; Structural Analysis; Tata McGraw Hill, Pub. Co.Ltd
Recommended by Board of Studies	
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25 th September 2021	

Course code	MECHANICS AND DESIGN OF CONCRETE STRUCTURES	L	T	P	C
20CE2012		3	0	0	3
Course Objective:					
1. To provide students with a rational basis of the design of reinforced concrete members and structures 2. To enhance with the advanced understanding of material and structural behavior 3. The subject will be approached by looking into the behavior of reinforced concrete at different levels: material level, element level and structural and systems level					
Course Outcome:					
At the end of the course students will be able to 1. Identify the design philosophies for RCC elements 2. Demonstrate the behaviour of elements for load calculations 3. Illustrate the LSM for estimating stress resultants 4. Design the section and reinforcement for the structural elements 5. Develop suitable detailing diagrams 6. Prepare the design for buildings					
Module: 1	Material and its behaviour				8 Hours
Introduction - Composition of RCC - Design criteria - strength properties - stress strain behavior - Micro-Cracking Mechanism - Multi-Axial Loading Responses - Failure Theories – Plasticity – Fracture					
Module: 2	Element level behaviour				8 Hours
Bending - shear transfer – creep – shrinkage - ductility failure modes - IS code - Limit State of Collapse - limit state of serviceability.					
Module: 3	Slabs and Beams				7 Hours
Design of one way, two way, continuous slabs - singly reinforced, doubly reinforced, cantilever beams.					
Module: 4	Columns and Footing				8 Hours
Short column- axially loaded - uniaxial bending - biaxial bending columns - long column - isolated, combined footings.					
Module: 5	Multistorey Building				7 Hours
Planning, preliminary design, analysis and final design of a framed RCC building					
Module: 6	Field Practice				7 Hours
Reading reinforcement diagrams of existing buildings, Study of an existing RCC building, Case Studies					
Total Lectures					45 Hours
Text Books					
1.	Unnikrishna Pillai and Devdass Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd., 2003				
2.	Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi,2007				
Reference Books					
1.	Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, 2002				
2.	Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., 2006				
3.	Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi 2005				

4.	IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi
5.	SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	DESIGN OF STEEL STRUCTURES		L	T	P	C
20CE2013			3	0	0	3
Course Objective:						
1. To impart knowledge on design connections, tension and compression members. 2. To enable to design Flexural members. 3. To enable to design Industrial Building.						
Course Outcome:						
At the end of the course students will be able to 1. Identify the behaviour of members 2. Estimate the forces in members. 3. Design the member for forces 4. Choose suitable codal provisions 5. Explain the design intricacies 6. Formulate the design for steel structures						
Module: 1	Connections					8 Hours
Properties of structural steel- classification of steel sections- limit state design concepts- loads and load combination, connection- welding, bolting- design of bolted and welded joints- simple connections - efficiency of joints.						
Module: 2	Tension Members					8 Hours
Types of sections- net area- net effective sections of angle and tee in tension – block shear - lug angles- design of tension splice - concept of shear lag - built-up sections - splicing of tension members						
Module: 3	Compression Members					7 Hours
Compression members – effective length - slenderness ratio – buckling – mode of failure - design of compression members - design of single and compound section members- design of laced and battened columns – slab base and gusseted base						
Module: 4	Beams					8 Hours
Design of laterally supported and unsupported beams- built up beams- design of welded plate girders- intermediate and bearing stiffeners - economical design aspects						
Module: 5	Truss					7 Hours
Roof truss - loading types - wind pressure - Roof and side covering- Design of purlin and elements of truss - end bearing - Design of gantry girder						
Module: 6	Industrial Framed Structures					7 Hours
Planning and design of roof truss supporting system and column base - Introduction to PEB frames - Modeling of steel section - Optimal design of steel section - AI based stability assessment						
					Total Lectures	45 Hours
Text Books						
1.	Duggal. S.K, “Limit State Design of Steel Structures”, Tata McGraw Hill Publishing Company, 2014					
2.	Bhavikatti.S.S, “Design of Steel Structures by Limit State Method as per IS:800–2007”, IK International Publishing House Pvt. Ltd., 2014					
Reference Books						
1.	Subramanian.N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2013.					
2.	IS: 875(Part3): Wind Loads on Buildings and Structures, Bureau of Indian Standards					
3.	IS 800:2007, General construction in steel, Bureau of Indian Standards					
4.	Shiyekar. M.R., “Limit State Design in Structural Steel”, Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.					
5	Dayaratnam P, “Design of Steel Structures”, S. Chand Ltd, 2008					

Recommended by Board of Studies	
Approved by Academic Council	25 th September 2021

Course code	WATER RESOURCES SYSTEMS	L	T	P	C
20CE2014		3	0	0	3
Course Objectives:					
1. To introduce the concepts of surface, ground water hydrology and irrigation 2. To enable the student to develop skills to appreciate water resources systems 3. To know the purpose of various hydraulic structures					
Course Outcome:					
At the end of the course students will be able to 1. Recognise the concepts to manage water resources and apply for hydrological modelling 2. Decide and plan basic water resources projects 3. Analyse the flow in streams 4. Appreciate the importance of reservoirs and hydraulic structures 5. Identify the irrigation methods 6. Plan structures for recharging groundwater					
Module: 1	Surface Hydrology	8 Hours			
Hydrologic Cycle – Precipitation – Measurement of precipitation – average precipitation - Evaporation – Factors affecting evaporation – Empirical methods – Transpiration – Evapotranspiration – Empirical methods – Infiltration – Measurement of Infiltration capacity					
Module: 2	Runoff	8 Hours			
Introduction – Factors affecting runoff – Estimation of Runoff and yield – Empirical methods – maximum flood discharge. Hydrograph Analysis: Hydrograph – Components of Hydrograph – Base flow separation - Unit Hydrograph – Derivation of Unit Hydrograph an isolated storm & a complex storm – S-Curve – Derivation of S-Curve – Problems					
Module: 3	Reservoir Planning	7 Hours			
Introduction – Types of reservoirs – Types of flood control reservoirs – Selection of site for a reservoir – Mass inflow curve and demand curve –Analytical method for determination of storage capacity – Flood routing (definition only)					
Module: 4	Ground Water Hydrology	8 Hours			
Types of Geologic formation and aquifers – Water table and peizometric surface – Aquifer properties – Darcy’s law – Dupuit – Thiem’s theory – Steady flow to a well in an unconfined aquifer – steady flow to a well in a confined aquifer – Specific capacity and well efficiency – Groundwater recharging					
Module: 5	Irrigation Systems	7 Hours			
Base period – Wilting point – Delta - Duty –Determination of irrigation and water requirements – Irrigation and water efficiencies - Factors affecting duty – Methods of improving duty. Irrigation Methods: Canal irrigation – Lift irrigation – Tank irrigation – Surface Irrigation – Merits and demerits –Sprinkler irrigation – Drip irrigation					
Module: 6	Hydraulic Structures	7 Hours			
Control Structures, River training and control Dams – types – Canal Regulation works – Canal falls – Head and Cross regulator – Canal escapes – Cross drainage works – Diversion Head works – Weirs and Barrages – Causeways and Culverts.					
Total Lectures					45 Hours
Text Books					
1.	Subramanya, K., “Engineering Hydrology”, Tata McGraw Hill, 4 th edition, 2013.				
2.	Arora, K. R., “Irrigation, Water Power and Water Resources Engineering”, Standard Publishers Distributors, 2012				
Reference Books					
1.	Linsley, R. K. and Franzini, J.B., “Water Resources Engineering”, McGraw Hill Inc, 4th edition 2013.				
2.	Sahasrabudhe, S.R., “Irrigation Engineering and Hydraulic Structures”, Katson Publishers, 3rd edition,2011.				

3.	Michael, A.M., “Irrigation – Theory and Practices”, Vikas Publishing House, New Delhi, 2004.
4.	Garg S. K., “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, 2009.
5	Muluneh Yitayew, Louis Waller, Irrigation and Drainage Engineering, Springer International Publishing, 2015.
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	QUANTITY SURVEYING AND ESTIMATION	L	T	P	C
20CE2015		3	0	0	3
Course Objective:					
1. To impart the knowledge about the types of estimates 2. To identify the methods used for different structural components 3. To provide knowledge about rate analysis and process of preparation of bills					
Course Outcome:					
At the end of the course students will be able to 1. List the detailed specification for different types of structures 2. Plan the rate analysis of civil engineering works 3. Determine the rates of various items of civil works 4. Justify estimated cost of civil construction projects 5. Evaluate the actual value of any property 6. Explain specifications and tendering process for contracts					
Module: 1	Introduction to Estimates And Specifications				8 Hours
Quantity surveying– purpose of estimates - types of estimates - various items to be included in estimates - principles in selecting units of measurement for items, various units and modes of measurement for different trades - IS 1200, specifications – purpose and basic principles of general and detailed specifications: detailed specifications for various items of work					
Module: 2	Analysis of Rates:				8 Hours
Rate analysis and preparation of bills (BOQ) - data analysis of rates for various items of works – abstract estimates for Building projects					
Module: 3	Building and Sanitary Works:				9 Hours
Quantity surveying of building – method of estimate, estimate of walls - estimate of masonry platform - estimate of single room building with verandah - estimate of two roomed building - sanitary - estimation of a septic tank and soak pit					
Module: 4	RCC works and Structures and Roads:				8 Hours
RCC works and structures and roads: R.C.C and Steel works - RCC Slab – beam – column with foundation - RCC framed building - Road- RCC slab culvert - detailed estimate for WBM - Bituminous road – introduction to MEP in building					
Module: 5	Valuation				7 Hours
Valuation: rent fixation, gross income, net income – depreciation - methods of depreciation: straight line method, declining balance method, sinking fund method, plinth area method					
Module: 6	Report preparation				5 Hours
Introduction – Report On Estimates for the Construction of Residential Building – Report on Estimate for Construction of a Culvert – Report on the Estimate for a Road Construction – Principle for the preparation of Water supply Scheme.					
Total Lectures					45 Hours
Text Books					
1.	Dutta.B.N, “Estimating and Costing in Civil Engineering Theory and Practice,” UBS publishers 2016.				
2.	Birdie.G.S, “A Text Book on Estimating and Costing”, Dhanpat Rai and Sons, New Delhi, 2000.				
Reference Books					
1.	Jogleka.P.T, “Practical Information for Quantity Surveyors”, Institution of Surveyors, 2017.				
2.	Vazirani V. N., “Civil Engineering Estimating and Costing”, Khanna Publishers, 2004				
3.	Kohli R.C, “A Textbook of Estimating, Costing and Accounts (Civil)”, S. Chand Publishing, 2012				
4.	Rangwala .S.C, “Valuation of Real Properties”, Charotar Publishing House, Anand, 2008.				

5.	IS 1200 : Part 1– 19 – Method of measurement of buildings and civil engineering works
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	CONSTRUCTION TECHNOLOGY AND AUTOMATION				L	T	P	C
20CE2016					3	0	0	3
Course Objective:								
1. To impart the knowledge on the construction practices adopted in the field. 2. To select heavy equipment based on applications, utilization, productivity and other factors. 3. To provide knowledge about automation in construction								
Course Outcome:								
At the end of the course students will be able to 1. Adopt the construction practices adopted in the field 2. Demonstrate basic knowledge about construction equipment 3. Identify the equipment types for different construction projects 4. Evaluate the material handling equipment and the equipment productivity 5. Demonstrate construction project management skills 6. Adapt automation in construction site								
Module: 1		Building Layout					8 Hours	
Site selection – building types – requirements – bye laws – necessity – building approval – principles of planning – functional requirements – loads on buildings – load bearing structure – Framed structure – precast structure - green building concepts								
Module: 2		Construction Practices					8 Hours	
Foundations - Shallow and Deep Foundations - Brick Masonry - Plastering and Pointing – temporary structures – Formwork - Shoring - Scaffolding - Underpinning - Roofing - Flooring - Joints in concrete - Contraction/Construction/Expansion								
Module: 3		Service Requirements					7 Hours	
Fire Protection - Thermal Insulation - Ventilation and Air conditioning - Acoustics and Sound Insulation - Damp Proofing – Anti Termite treatment								
Module: 4		Construction Equipments					8 Hours	
Planning of equipment – selection of equipment – excavation - tunneling operation – equipment for drilling and blasting - pile driving equipment - Equipment management in projects - maintenance management – equipment cost – operating cost – cost control of equipment - safety management								
Module: 5		Materials Handling & Erection Equipment:					7 Hours	
Forklifts and related equipment - portable material bins –conveyors – industrial trucks- position equipment-unit load equipment-storage equipment- equipment for transportation of materials- erection equipment - crane types - mobile crane - Erection Technology - Prefabrication in Construction Industry - equipment productivities - use of drones for spread out sites – safety measures								
Module: 6		Automation in Construction					7 Hours	
Introduction – advantage and disadvantage of Automation in construction – contour crafting – use of robots for repetitive activities – painting robot – 3D printing in construction – Robotic production of precast elements – robotic in earthworks – digital technologies in construction								
							Total Lectures	45 Hours
Text Books								
1.	Bhavikatti SS, “Building construction”, Vikas Publishing House, 2012							
2.	Mahesh Verma, “Construction Equipment Planning and Applications”, 5 th edition, Metroplolitan Book Co. Publishers,, 2005							
Reference Books								
1.	Punmia B.C., “Building construction”. Laxmi Publications, 2008							
2.	Gurcharan Singh, “Building Planning, Designing And Scheduling”, Standard Publishers, New Delhi, 2006							
3.	Arora, S. P. and Bindra S. P., “Building Construction”, Dhanpat Rai and Sons, New Delhi, 2003							
4.	Leonhard E. Bernold, “Construction Equipment and Methods: Planning, Innovation, Safety”, Wiley Global Education. 2013							

5.	Douglas D. Gransberg, Calin M. Popescu, Richard Ryan, "Construction Equipment Management for Engineers, Estimators, and owners", CRC Publishers, 2006
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	DISASTER PREPAREDNESS AND PLANNING	L	T	P	C
20CE2017		3	0	0	3
Course Objective:					
1. To introduce about types of natural and environmental disasters. 2. To enable to develop skills in various stages of disaster preparedness, mitigation and Management. 3. To provide knowledge on the methodologies for disaster risk assessment.					
Course Outcome:					
At the end of the course students will be able to 1. Recall the types of disasters and its causes. 2. Understand disaster cycle and assess the risks. 3. Apply disaster concepts to disaster management 4. Analyse relationship between development and disasters. 5. Decide the roles and responsibilities of organizations and institutions to society and its organizational structure. 6. Design the disaster management and mitigation plan.					
Module: 1	Introduction				8 Hours
Concepts and definitions: disaster – hazard – vulnerability - risks – severity - frequency and details - capacity - impact – prevention - mitigation - Disaster management cycle – its phases - prevention, mitigation, preparedness, relief and recovery - structural and non-structural measures - risk analysis - vulnerability and capacity assessment - early warning systems.					
Module: 2	Disaster Classification				8 Hours
Disasters classification - Natural disasters: floods, draught, cyclones, earthquakes, tsunamis, landslides, coastal erosion, soil erosion and forest fires - Manmade Disasters: industrial pollution, nuclear radiation, chemical spills, fire accidents and terrorist strikes. Causal Phenomena - typical effects - general characteristics - measure and predictability - specific preparedness measures.					
Module: 3	Disaster Impacts				7 Hours
Environmental – physical – social – ecological – economic - political – health - psycho-social issues -Hazard locations: global and national disaster trends - climate change and urban disasters, Medical Health Response to Different Disasters.					
Module: 4	Disaster Management				7 Hours
Pre disaster tools: Environmental Risk Assessment (ERA), Environmental Management Systems (EMS), Strategic Environmental Assessment (SEA), Environmental Vulnerability/Hazard Mapping. Policies and legislation for disaster risk reduction – Hazard and vulnerability profile of India – mountain and coastal areas – ecological fragility.					
Module: 5	Institutional Framework				7 Hours
Roles and responsibilities - Institutions arrangements (Community based Organisations) - financial arrangements - Role of Central, State, District and Armed Forces in disaster response - Police and other Departments - NGOs and other stakeholders - Institutional Framework - Nodal Ministries related with disaster – social responsibility.					
Module: 6	Post Disaster Management				8 Hours
Post disaster environmental response – water, sanitation, food safety, waste management, disease control, security and communications. Rehabilitation, Reconstruction and Recovery: Reconstruction and Rehabilitation, Disaster Resistant House Construction, Sanitation and Hygiene, Education and Awareness, Dealing with Victims’ Psychology, Long-term Counter Disaster Planning.					
Total Lectures					45 Hours
Text Books					
1.	Pradeep Sahni, “Disaster Risk Reduction in South Asia”, Prentice Hall,2004				
2.	Singh B.K., “Handbook of Disaster Management: Techniques and Guidelines”, Rajat Publication;2008				
Reference Books					

1.	Jon Ingleton, "Natural Disaster management", Tulor Rose, 1999
2.	Iyengar, C.B.R.I. "Natural Hazards in the Urban Habitat", Tata McGraw Hill Co., 2001.
3.	Ghosh G.K., "Disaster Management", APH Publishing Corporation, 2006
4.	Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
5.	Inter-Agency Standing Committee (IASC) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC. Feb. 2007
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	CONSTRUCTION ENGINEERING AND MANAGEMENT				L	T	P	C
20CE2018					3	0	0	3
Course Objective:								
1. To introduce the latest construction technologies adopted in Industry								
2. To impart knowledge on project management and monitoring techniques								
3. To inculcate the concepts of construction management tools and techniques to improve productivity								
Course Outcome:								
At the end of the course student will be able to								
1. Recall the basics of building components								
2. Understand the items / facets of construction engineering								
3. Apply the construction engineering techniques for various components								
4. Demonstrate construction project management skills and apply tools of project management								
5. Explain the importance of project management								
6. Propose an Engineering and Management Plan								
Module: 1	Aspects of Construction Engineering:							7 Hours
Site selection – site layout - site clearance - components of building - construction sequence - setting out buildings – excavation – timbering - foundation types - shoring and strutting - anti-termite treatment - dewatering and backfilling								
Module: 2	Constructions Methods:							7 Hours
Methods of construction - Masonry constructions – bonds in masonry construction - concrete constructions – Framed construction - Pre-engineered construction – Prefabricated construction – precast and prestressed construction – steel construction - Joints in the construction								
Module: 3	Underground and Underwater Construction:							7 Hours
Tunnel – shaft sinking – tunnel driving in hard and soft strata – bedding of conduits – cement grouting – tunnel lining method – underwater construction – challenges – underwater drilling, blasting, concreting – concrete diaphragm walls – dewatering methods – effect of groundwater movement								
Module: 4	Project Management:							8 Hours
Basics forms of organization - concepts and need of management in construction -principles of management - functions of management – role of Project management consultants (PMC) - construction project planning: life cycle, identification, preparation, appraisal - planning – implementation - monitoring and control								
Module: 5	Construction Management:							8 Hours
Site mobilization – demobilization aspects – network: need, importance - bar chart – CPM – PERT – Repetitive Project modeling techniques - analysis of network - time-cost trade off - scheduling technique - resource allocation and levelling – reporting techniques								
Module: 6	Resources Productivity:							8 Hours
Product quality control – labour safety – protection of environment – labour productivity control – equipment productivity control – materials productivity control – material wastage analysis – role and functions of construction managers - Improve resources productivity – functions of equipment management – measurement of in-progress activity								
Total Lectures								45 Hours
Text Books								
1.	Seetharaman, S., “Construction Engineering and Management”, Umesh Publications, 2007							
2.	Sengupta, B., and Guha, H., “Construction Management and Planning”. Tata McGraw-Hill Book cc. 2000							

Reference Books	
1.	Aviad Shapira, Robert Schmitt, Robert L. Peurifoy, Clifford J. Schexnayder, “Construction Planning, Equipment and methods”, Tata McGraw Hill Publications, 8 th edition, 2010
2.	Rana, V. K., “Construction Management Practice”, Tata McGraw-Hill publishing CO, 2000
3.	Chitkara, K. K., “Construction Project Management”, Tata McGraw-Hill publishing COM, 2000
4.	Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000
5.	Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	DESIGN OF PRECAST CONCRETE STRUCTURES	L	T	P	C
20CE2019		3	0	0	3
Course Objective:					
1. To impart the knowledge of production, transportation and erection process of precast elements 2. To explain the design concept of precast structural members 3. To impart the behaviour and analysis of different types of precast joints					
Course Outcome:					
At the end of the course students will be able to 1. Identify the suitable prefabrication building system 2. Explain the behavior of precast elements 3. Classify different types of joints for prefabricated structures 4. Analyse the building system and joints 5. Design the components of precast building system 6. Appraise the possibilities of progressive collapse					
Module: 1	Introduction	8 Hours			
Introduction – Precast concrete structural elements -Prefabricated systems - Advantages – Modular coordination - Materials – Production – Transportation – Erection – smart lifting systems - Quality control - automation in precast concrete production and construction					
Module: 2	Prefabricated Components	8 Hours			
Over all structural system - roof and floor system - components - facial elements - design considerations and requirements —bearing for precast units					
Module: 3	Design Principles	7 Hours			
Loading - load factor - modeling - analysis of frames - design of members - slab - beam – wall - guidelines - energy saving techniques - code provisions					
Module: 4	Joints and Connections	8 Hours			
Joints and connections – tolerance - connection materials - requirements of structural joints – types of joints – detailing of joints - diaphragm connection – beam to column and column to column and column to foundation connections – advanced shear connections -joint fillers					
Module: 5	Prestressed Precast Concrete	7 Hours			
Design requirements for safety against progressive collapse – design of ties - introduction to prestressed precast concrete - stability and failure analysis - Prestressed precast elements					
Module: 6	Applications and Case Studies	7 Hours			
Precast frame – roll of BIM in coordination - application of sensor systems in precast technology - advanced materials for precasting - Case studies on precast construction and failures					
Total Lectures					45 Hours
Text Books					
1.	Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2015				
2.	Kim S. Elliott “Precast Concrete Structures”, CRC Press, 2019				
Reference Books					
1.	.IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice				
2.	Code of Practice for Precast concrete construction 2003, PCI Design hand book				
3.	IS 12592 : 2002 Precast Concrete Manhole Cover and Frame – Specification				
4.	Hubert Bachmann, Alfred Steinle, “Precast Concrete Structures” Wiley, 2011.				

5.	Robert E. Englekirk, "Seismic Design of Reinforced and Precast Concrete Buildings", Wiley, 2003
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	ARTIFICIAL INTELLIGENCE IN PROJECT MANAGEMENT	L	T	P	C
20CE2020		3	0	0	3
Course Objective:					
1. To understand the principles and concepts of Artificial intelligence 2. To understand the principles of Machine learning 3. To study the application of AI in project management					
Course Outcome:					
At the end of the course students will be able to 1. Identify the problems in Civil Engineering and solve using AI 2. Formulate problems and make decisions 3. Explain various search algorithms for problem solving 4. Apply Artificial Intelligence in real time problems 5. Participate in the design of systems that act intelligently and learn from experience 6. Assess the applicability, strengths and weaknesses of the basic knowledge representation					
Module: 1	Introduction to Artificial Intelligence				8 Hours
Definitions, Knowledge in AI-Representing Knowledge- Metrics, Reasoning-Forward and Backward-Reasoning with uncertainty, Search-Exhaustive-Simple-Heuristic-knowledge rich					
Module: 2	Machine Learning				8 Hours
Navies Bayes Classifiers, Bayesian Networks, Decision trees, K-means clustering algorithm, Artificial Neural Network.					
Module: 3	Engineering Design and Project Planning				7 Hours
Design- ANN for selection, GA for optimization, Planning- KBES- Estimation, ANN-Sequencing of project activities, GA-Schedule of Construction activities, Fuzzy logic- Determine Project Priorities					
Module: 4	AI in Cost Estimation				8 Hours
Estimate the Suitable mark, Predict possible cost overruns, Optimize the cost time trade off					
Module: 5	AI in Risk Management				7 Hours
Estimate probability of occurrence, Monte Carlo Simulation for risk evaluation and adaptation, model probability distributions.					
Module: 6	AI in Performance Management				7 Hours
Predict performance of future projects, Expert decisions, Improve Management efficiency, Case Studies-Impact of AI in Project Management					
Total Lectures					45 Hours
Text Books					
1.	Krishnamoorthy C.S., Rajeev S, “Artificial Intelligence and Expert Systems for Engineers”, CRC Press, 2018				
2.	Pijush Samui, “Artificial Intelligence in Civil Engineering”, Lap Lambert Academic Publishing, 2012				
Reference Books					
1.	Rajesakaran S, Vijayalakshmi Pai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and Applications”, Prentice Hall of India New Delhi 2003				
2.	Rich E, K Knight, “Artificial Intelligence”, Tata McGraw Hil, 2009				
3.	Saroj Kaushik, “Artificial Intelligence”, Cengage Learning. 2011				
4.	Paresh Chandra Deka, “A Primer on Machine Learning Applications in Civil Engineering”, CRC Press Book, Taylor and Francis Group, 2019				
5.	Russell, Norvig, “Artificial intelligence, A Modern Approach”, Pearson Education, 2nd edition, 2004				
	Recommended by Board of Studies				
	Approved by Academic Council				25 th September 2021

Course code	SURVEYING AND GEOMATICS ENGINEERING	L	T	P	C
20CE2021	LABORATORY	0	0	2	1
Course Objective:					
1. To train to acquire skill in operation of various survey instruments 2. To give hands on training on the use of conventional and modern tools of surveying 3. To enhance the knowledge to carryout and interpret the field surveying procedures					
Course Outcome:					
At the end of the course students will be able to 1. Memorize the procedures of usage of surveying instruments 2. Identify the method for a typical survey 3. Demonstrate the appropriate methods of surveying 4. Organize the field operations during surveying 5. Use modern survey equipment to measure areas and volumes 6. Construct layouts and diagrams as per the field data					
List of Experiments:					
1. Fly Levelling 2. Reciprocal Levelling 3. REM – Remote Elevation Measurement 4. Longitudinal and Cross sectioning (LS & CS) 5. Find out horizontal angles 6. Height and Distances by Base Inaccessible method 7. Stakeout using total station 8. Setting out of Curve- Angular Method 9. Contouring Using Total Station 10. Area Calculation using Drone Image and GIS 11. Volume Calculation using Drone Image and GIS 12. Contouring using Drone Image and GIS					
Text Books					
1. Punmia B. C., Ashok k Jain, Arun K Jain., “Surveying”, Vol I,II,III, Laxmi Publications, 2005					
2. Arora, K.R., “Surveying, Vol-I, II and III”, Standard Book House, 2015.					
Reference Books					
1. Basak, N., “Surveying and Levelling”, McGrawHill and Co., New Delhi 2015.					
2. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2016					
3. Madhu, N, Sathikumar, R and Satheesh Gobi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson India, 2006.					
4. Paul R. Wolf, Charles D. Ghilani, “Elementary Surveying: An Introduction to Geomatics”, Prentice Hall, 2006					
5. George Dekoulis., “Drones Applications”, Intech open, 2018					
Recommended by Board of Studies					
Approved by Academic Council 25 th September 2021					

Course code	FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
20CE2022		0	0	2	1
Course Objective:					
1. To give hands on training on principle and working of different flow measuring instruments 2. To impart knowledge on working of different types of turbines and pumps. 3. To demonstrate energy losses in pipe connections					
Course Outcome:					
At the end of the course students will be able to 1. Recall the principles of instruments used in flow related measurements. 2. Demonstrate energy losses in pipe connections. 3. Experiment and select turbines and pumps 4. Demonstrate instrumentation techniques in pipes 5. Develop monitor pressure variation using sensors 6. Control pipe distribution networks					
List of Experiments:					
Fluid Mechanics					
1. Determination of Darcy’s Friction Factor with pressure sensors					

2. Calibration of Flow Meters. 3. Flow over weirs / Notches. 4. Flow through Mouth piece / orifice. 5. Determination of Minor Losses in pipes fitted with pressure transducers 6. Determination of Metacentric height Fluid Machinery 1. Performance of Centrifugal Pump fitted with sensors for head measurement 2. Performance of Submersible Pump fitted with pressure and flow sensors 3. Performance of Gear Oil pump 4. Performance of Jet pump 5. Load Test on Pelton Wheel fitted with SCADA and sensors 6. Load Test on Francis Turbine fitted with SCADA and sensors	
Text Books	
1.	Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 2008.
2.	Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2005
Reference Books	
1.	Modi, P.N. & Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 2007
2.	Som S.R. & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2012
3.	Subramanya, K., "Fluid Mechanics and Hydraulic Machines", McGraw Hill India Pvt. Ltd., New Delhi, 2011
4.	Yunus A.Cengel., "Fluid Mechanics", Tata McGraw Hill India Pvt. Ltd., 2010.
5.	Chandramouli, "Applied Hydraulic Engineering", Yes Dee Publishers Pvt. Ltd., 2017.
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	MATERIALS TESTING AND EVALUATION LABORATORY	L	T	P	C
20CE2023		0	0	2	1
Course Objective:					
1. To demonstrate the basic principles in the areas of mechanics of materials and structural analysis 2. To apply the theory of mechanics of solids on real specimens 3. To give hands on training on testing of real specimens					
Course Outcome:					
At the end of the course students will be able to 1. Be familiar with the operations and laboratory testing equipment 2. Conduct various tests on steel and other materials following BIS code 3. Interpret the laboratory test results					
List of Experiments					
1. Tension Test on Mild Steel 2. Double Shear Test on Mild Steel 3. Brinell Hardness Test 4. Rockwell Hardness Test 5. Charpy and Izod Impact Test 6. Test on Open Coil Helical Springs 7. Test on Closed Coil Helical Springs 8. Test on Carriage Springs 9. Verification of Maxwell reciprocal theorem 10. Deflection Test on Steel Beam 11. Compressive Test on Bricks 12. Torsion Test on mild steel					
Text Books					
1.	Bansal, R. K., “Strength of Materials”, Laxmi Publications (P). Ltd., 2007.				
2.	Rajput, R. K., “Strength of Materials”, S Chand and Co., 2007.				
Reference Books					
1.	Timoshenko S.P., “History of Strength of Materials”, Dover Publications, 1953.				
2.	IS 1500:2005 (ISO 6506-1:1999), Indian Standard “Method for Brinell Hardness Test For Metallic Materials” Bureau of Indian Standards, New Delhi				

3.	IS 280:2006 Indian Standard “Mild Steel Wire for General Engineering Purposes”, Bureau of Indian Standards, New Delhi
Recommended by Board of Studies	
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25 th September 2021	

Course code 20CE2024	GEOTECHNICAL ENGINEERING LABORATORY	L 0	T 0	P 2	C 1

Course Objective:

1. To provide the hands on training in determination of Engineering and index properties of soils, applied in field problems.
2. To provide the knowledge on the use of experimental results pertaining to foundation problems
3. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test and unconfined compressive test

Course Outcome:

At the end of the course students will be able to

1. Determine the index properties of soil
2. Determine the insitu density and compaction characteristics of soil
3. Determine the engineering properties of soil
4. Calculate the shear strength parameters of the soil
5. Analyse the settlement of the saturated soil using PLAXIS 2D
6. Determine the optimum moisture content and dry density of the soil

LIST OF EXPERIMENTS

1. Determination of moisture content using i) Oven drying method and ii) Infrared moisture balance iii) Pycnometer
2. Determination of moisture content and specific gravity of soil
3. Determination of relative density of soil
4. Grain size distribution using Sieve Analysis
5. Standard Proctor compaction test
6. Determination of field density using i) Sand replacement method and ii) core cutter method
7. Determination of Liquid limit, Plastic limit & Shrinkage limit
8. Permeability test using i) Constant head method and ii) Variable head method
9. Direct shear test
10. California bearing ratio test
11. Unconfined Compression test
12. Consolidation Test
13. Triaxial Compression test
14. Analysis of foundation design using PLAXIS 2D
15. Analysis of retaining wall design using PLAXIS 2D

Text Books

1. John T. Germaine, Amy V. Germaine, “Geotechnical Laboratory Measurements for Engineers”, Wiley, 2009
2. Ravi Kumar Sharma “A Laboratory Manual on Soil Mechanics: (Testing and Interpretation) I.K. International Publishing House Pvt. Limited, 2016

Reference Books

1. Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, New age International (P) limited publishers, New Delhi, 2008
2. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 2008
3. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi
4. Venkatappa Rao G. and Goutham .K. Potable, “Geosynthetics Testing – A laboratory Mannual”, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008
5. Braja M. Das, “Soil Mechanics Laboratory Manual”, Oxford University Press, 2002

Recommended by Board of Studies
Approved by Academic Council

25th September 2021

Course code	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
20CE2025		0	0	2	1
Course Objective:					
1. To conversant with the experimental procedures for quantitative estimation of water quality parameters 2. To give hands on training on the testing water sample for drinking water 3. To give training on the determination of wastewater characteristics and microbiological characteristics.					
Course Outcome:					
At the end of the course students will be able to 1. Examine the characteristics of water and waste water. 2. Suggest suitable treatment method to water for drinking purpose. 3. Check the microbiological presence in the water and wastewater.					
Module	List of Experiments				
1. pH in given sample 2. Electrical conductivity, Total Dissolved Solids (TDS), Total solids and settleable solids present in given sample 3. Acidity and Alkalinity in given sample 4. Turbidity and optimum coagulant dose of a sample from jar test experiment 5. Hardness, Chlorides, Sulphates in given sample 6. Dissolved Oxygen (DO), Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) for given sample 7. Monitoring of air pollutant (PM10 / PM2.5) using High volume sampler 8. Determination of chemical species ions, trace elements, total organic carbon, water soluble organic carbon, polycyclic aromatic hydrocarbon using advanced instruments (i.e., IC, AAS, GC) in air samples. 9. Determination of emission factors of air pollutants for combustion sources, 10. Determination of bioaerosol and volatile organic compound. 11. Monitoring and analysis of meteorological parameters (i.e., wind speed, wind direction, temperature, relative humidity, solar radiation etc). Wind rose plotting based on the winds measurements. 12. Determination of link or relationship between Personal exposure assessment and indoor air quality parameters.					
Text Books					
1.	Rao Surampalli, Rama Pulicharla, Tian C. Zhang, “Handbook of Environmental Engineering”, McGraw-Hill Education, 2018				
2.	Varandani N. S, “Environmental Engineering”, Pearson Education India., 2017				
Reference Books					
1.	Sawyer, N.C., and McCarty, P.L., “Chemistry for Environmental Engineering”, McGraw- Hill Book Co., New York, 2003.				
2.	Lee C. C, “Environmental Engineering Dictionary”, Government Institutes, 2005				
3.	“Standard Methods for the Examination of Water and Wastewater”, APHA-AWWAPCF, latest Edn., Washington (D.C). 1995.				
4.	Jack G. Kay, George E. Keller, Jay F. Miller, “Indoor Air Pollution: Radon, Bioaerosols, and VOCs”, CRC Press, 1991.				
Recommended by Board of Studies					
Approved by Academic Council			25 th September 2021		

Course code	CONCRETE AND QUALITY CONTROL LABORATORY	L	T	P	C
20CE2026		0	0	2	1
Course Objective:					
1. To provide good understanding of concepts and their applications in the lab					
2. To understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure.					
3. To impart knowledge about statistical analysis and interpret laboratory test results					
Course Outcome:					
At the end of the course students will be able to					
1. Determine the workability of cement concrete					

2. Characterize various highway materials through relevant tests 3. Design the mix which fulfills the required properties for fresh and hardened concrete	
LIST OF EXPERIMENTS	
1. Standard Consistency and Setting time Test Cement 2. Fineness Test on Cement - sieve, Blaines apparatus 3. Soundness and compressive strength of cement 4. Specific Gravity, Density of aggregates 5. Bulking of fine aggregate 6. Grading of fine aggregate 7. Elongation and Flaky index 8. Slump cone test 9. Compaction Factor test 10. Mix Design by Indian Standard Method 11. Compressive strength and Modulus of Elasticity of concrete 12. Tensile Strength and Flexural strength of concrete 13. Core test (Demo) 14. Rebound hammer test 15. UV test	
Text Books	
1.	Malhotra V. M, Nicholas J. Carino, “Handbook on Nondestructive Testing of Concrete”, CRC Press, 2006
2.	IS 269 : 1989, Indian Standard, “Ordinary Portland cement - 33 Grade Specification”, Bureau of Indian Standards, New Delhi
3	IS 383 : 1970, Is 1489 (Part 1) : 1991, IS : 12269 -1987, IS: 303-1970 (Second Revision), IS 2386 – 1963 Part I, III, IS : 2430 – 1986
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	TRANSPORTATION ENGINEERING LABORATORY	L	T	P	C
20CE2027		0	0	2	1
Course Objective:					
1. To understand different tests to find various properties of aggregates					
2. To enable the students to conduct different tests on bitumen					
3. To enable the students to conduct different tests on Soil subgrade and hence to assess their suitability in pavement construction.					
Course Outcome:					
At the end of the course students will be able to					
1. Conduct traffic studies for estimating traffic flow characteristics					
2. Characterize the pavement materials					
3. Perform quality control tests on pavements and pavement materials					
4. Estimate earth work from longitudinal and cross-section details					
5. Design grade intersections					
6. Assess the quality of various pavement materials and their suitability in highway construction					
List of Experiments :					
1. Aggregate crushing value					
2. Aggregate impact value					
3. Los Angeles abrasion value					
4. Shape tests-Flakiness index and Elongation index					
5. Angularity of course aggregates and fine aggregates					
6. Specific gravity and water absorption of course aggregate					
7. Stripping value of road aggregates					
8. Dry Packing characteristics of aggregates (ASTM C29/ C29 M – 97)					
9. California Bearing Ratio test (Soaked and Un-soaked CBR)					
10. Dynamic cone penetration test (ASTM D6951 (2015) procedure)					
11. Penetration value of bitumen					
12. Softening point of bitumen					
13. Ductility of bitumen					
14. Flash and Fire point of bitumen					

15. Measurement of mixing and compaction temperature of bitumen	
Text Books	
1.	MoRTH, “Specification for Road and bridge works”, (5th revision) 2013
2.	Kadiyali L .R., “Principles and Practices of Highway Engineering”, Khanna Publishers, 2009
Reference Books	
1.	MS-2 manual Seventh edition, Asphalt Institute, 2015
2.	Khanna S. K., C. E. G. Justo, A Veeraragavan, “Highway Engineering”, Khanna Publishers, 10e
3.	Mc Shane, WR and RP Roess, Traffic Engineering, Prentice Hall
4.	Pignataro LJ. Traffic Engineering: Theory and Practice; Prentice hall, Inc.
5.	IS, ASTM, AASHTO, TRL, IRC, BS procedures / specifications and guidelines.
Recommended by Board of Studies	
Approved by Academic Council	25 th September 2021

Course code	STRUCTURAL DESIGN LABORATORY	L	T	P	C
20CE2028		0	0	2	1
Course Objective:					
1. To demonstrate the basic principles in the areas of mechanics of materials and structural analysis 2. To apply the theory of mechanics of solids on real specimens 3. To give hands on training on testing of real specimens					
Course Outcome:					
At the end of the course students will be able to 1. Analyse the RCC and steel structures 2. Design the RCC and steel structures 3. Interpret the member forces and reaction 4. List the different types of loads 5. Understand the stresses developed due to external loads 6. Evaluate the member capacity in RC frames					
List of Experiments					
1. Introduction to analysis and design. 2. Analysis of continuous beam 3. Analysis of single Storey Frame 4. Analysis of Multi-Storey Frame 5. Design of multi-Storey Frame 6. Analysis of Multi-Storeyed building 7. Design of Multi-Storeyed building 8. Wind load analysis on RCC building 9. Analysis and Design of Steel truss 10. Analysis and Design of Footing 11. Analysis of Bridge Deck 12. Analysis, Design and Report of a 3 Storey building					
Text Books					
1.	Sharma T.S, “STAAD Pro V8i for Beginners” 2014				
2.	Sharma T.S “Design of RCC Buildings using Staad Pro V8i, 2017				
Reference Books					
1.	SAP 2016 - Reference manual				
2.	STAAD Pro 2007 V8i – Analysis Reference Manual, 2015				
3.	STAAD Pro Exercise Book – CAD Desk, 2020				
Recommended by Board of Studies					
Approved by Academic Council			25 th September 2021		

Course code	DESIGN STUDIO - 4D AND 5D	L	T	P	C
20CE2029		0	0	2	1
Course Objective:					
1. To learn use of project management in 4D time 2. To understand 5D cost in Autodesk Revit. 3. To learn how to add 4D and 5D into 3D model					
Course Outcome:					
At the end of the course students will be able to					

1. Understand the concepts of scheduling for buildings 2. Understand the BIM tools for construction planning 3. Apply BIM tools for 4D time scheduling 4. Evaluate the costing for various components 5. Apply BIM tools for 5D costing 6. Apply 4D and 5D into 3D model	
List of Experiments: 1. Creating a schedule showing the build stages for residential building 2. BIM tools and new workflows of construction planning 3. Scheduling and planning with 4D BIM for residential building 4. Costs and Pricing for various items of a residential building 5. 5D costing in Revit 6. Integrating 4D and 5D into 3D model	
Reference Books	
1.	ASCENT, Autodesk Revit 2021 Structure Fundamentals, SDC Publications, 2020
2.	Elise Moss, Autodesk Revit 2021 Architecture Basics, SDC Publications, 2020
Recommended by Board of Studies	
Approved by Academic Council	

Course code	DESIGN STUDIO - 6D AND 7D	L	T	P	C
20CE2030		0	0	2	1
Course Objective:					
1. To understand the concepts of sustainability (6D) 2. To understand the concepts of facility management and application (7D) 3. To learn to implement 6D and 7D in real time buildings					
Course Outcome:					
At the end of the course students will be able to					
1. Understand the concepts of Energy analysis 2. Apply relevant tools for energy analysis 3. Apply LEED tracking systems 4. Evaluate the life cycle using BIM 5. Apply BIM for facility management 6. Apply BIM for Technical support					
List of Experiments:					
1. Conceptual Energy analysis in building using relevant tool 2. Detailed Energy analysis using specific tool 3. LEED tracking 4. Life cycle assessment using BIM 5. BIM for maintenance plan 6. BIM for technical support and asset management					
Reference Books					
1.	ASCENT, Autodesk Revit 2021 Structure Fundamentals, SDC Publications, 2020				
2.	Elise Moss, Autodesk Revit 2021 Architecture Basics, SDC Publications, 2020				
Recommended by Board of Studies					
Approved by Academic Council		25 th September 2021			

Course code	CONCRETE TECHNOLOGY	L	T	P	C
20CE2031		3	0	0	3
Course Objective:					
1. To study details regarding properties and testing of building materials. 2. To study properties of concrete and concrete mix design. 3. To impart the basic concepts in different types of concrete					
Course Outcome:					
At the end of the course students will be able to 1. Categorize the construction materials, their components and manufacturing process, 2. Identify the quality control properties of concrete making materials 3. Design the mix design of concrete based on various parameters. 4. Predict the properties of concrete in fresh and hardened concrete.					

5. Adopt the different types of concrete in details.		
6. Demonstrate non- destructive techniques on concrete structures		
Module: 1	Cement	8 Hours
Cement - Ingredients - Manufacturing process - Types and grades - Properties of cement and Cement mortar - Tests on Cement - Fineness - Soundness, Consistency - Setting time		
Module: 2	Aggregates	8 Hours
Aggregate – classification - Grading – Fine aggregate - grading – Bulking - Coarse Aggregate -Crushing strength - Impact strength - Flakiness Index - Elongation Index – Abrasion resistance		
Module: 3	Fresh and Hardened Concrete	7 Hours
Workability – workability tests – Segregation - Bleeding – Properties of Hardened concrete – Compressive strength – split tensile strength – flexural strength – mixing equipment – transporting methods – compacting method – equipment used – Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance		
Module: 4	Concrete Mix Design	8 Hours
Principles of Mix Proportioning – Properties of concrete related to Mix Design – Design Mix and Nominal Mix – BIS Method of Mix Design		
Module: 5	Special Concretes	7 Hours
Light weight concretes – foam concrete- self compacting concrete – vacuum concrete – High strength concrete – Fibre reinforced concrete – Ferrocement – Ready mix concrete – SIFCON – Shotcrete – Polymer concrete – High performance concrete – Geopolymer Concrete- Bio Concrete		
Module: 6	Nondestructive Test	7 Hours
Semi destructive and non-destructive test - Rebound hammer test – ultra sonic pulse velocity test – RCPT test – permeability test - rebar analyser – corrosion test		
Total Lectures		45 Hours
Text Books		
1.	Shetty M.S., “Concrete Technology”, S. Chand & Company, 2013	
2.	Bhavikatti, “Concrete Technology”, I.K. International Publishing House Pvt. Limited. 2015	
Reference Books		
1.	Gambhir M.L., “Concrete Technology”, Tata McGraw Hill, 2004	
2.	Aminul Islam Laskar, “Concrete Technology Practices”, Narosa Publishers, 2015	
3.	Santhakumar A R, “Concrete Technology”, Oxford University press, 2018	
4.	Nevellic, “Properties of Concrete”, Longman Scientific & Technical, 2005	
5.	IS383: 2016, Course and Fine aggregate for concrete - Specification	
6.	IS10262: 209, Guidelines to Concrete Mix Design.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	PRESTRESSED CONCRETE	L	T	P	C
20CE2032		3	0	0	3
Course Objective:					
1. To provide knowledge on various prestressing methods, types and advantages of prestressing techniques					
2. To enable to design prestressed concrete structures subjected to flexure					
3. To impart the procedures for evaluation and estimation of losses of prestressing					
Course Outcome:					
At the end of the course students will be able to					
1. Identify appropriate prestressing techniques					
2. Explain the concepts of prestressing					
3. Analyse the prestressed concrete structures					
4. Design the prestressed concrete structural elements					
5. Appraise on the quality parameters of PSC structures					
6. Investigate the rationale for failure of a PSC structure					
Module: 1	Introduction	8 Hours			

Basic concepts – advantages – materials required- systems and methods of prestressing –analysis of sections – stress concept – strength concept – load balancing concept – effect of loading on the tensile stresses in tendons – tendon profile - health monitoring of PT systems - tendon force monitoring with smart strand		
Module: 2	Design for Flexure	8 Hours
Basic assumptions for calculating flexural stresses – limit state of collapse - permissible stresses in steel and concrete – moment of resistance – design for flexure - layout of cables and location of wires in pre and post tensioned members		
Module: 3	Design for Serviceability	7 Hours
Factors influencing deflections – calculation of deflections – short term and long term deflections – losses of prestress		
Module: 4	Design of Anchorage Zone	8 Hours
Determination of anchorage zone stresses in post-tensioned beams by Magnel’s method, Guyons’ method and IS1343 code – design of anchorage zone reinforcement – spalling tension - external tendons - re grouting methods		
Module: 5	Continuous Beam	7 Hours
Methods of achieving continuity in continuous beams –analysis for secondary moments – concordant cable and linear transformation – calculation of stresses – principles of design		
Module: 6	Precast Elements	7 Hours
Introduction to post tensioned precast structural elements - Case studies - failure – nonstructural elements - applications - Modeling of PT elements and conceptual design		
Total Lectures		45 Hours
Text Books		
1.	Krishna Raju N., “Prestressed concrete”, 5th Edition, Tata McGraw Hill Company, NewDelhi, 2015	
2.	Rajagopalan.N, “Prestressed Concrete”, Narosa Publishing House, 2014.	
Reference Books		
1.	IS1343: 2012, “Code of Practice for Prestressed Concrete”, Bureau of Indian Standards, New Delhi, 2012	
2.	IS 1785 : Part I and II : 1983 Specification for Plain Hard-drawn Steel Wire for Prestressed Concrete	
3.	Lin T.Y. and Ned.H. Burns, “Design of Prestressed Concrete Structures”, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.	
4.	Dayaratnam.P., “Prestressed Concrete Structures”, Oxford and IBH,2013	
5.	Praveen Nagarajan “Prestressed Concrete Structures”, Pearson, 2013	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	BASICS OF DYNAMICS AND ASEISMIC DESIGN	L	T	P	C
20CE2033		3	0	0	3
Course Objective:					
1. To understand the basic principles of free and forced vibration of SDoF and MDoF					
2. To analyze the forces in the members as per IS 1893 and ductile detailing as per IS 13920					
3. To understand the principles of vibration control methods and retrofitting techniques					
Course Outcome:					
At the end of the course students will be able to					
1. Identify the elements of vibratory system and to develop mathematical models					
2. Determine the fundamental frequency and mode of vibration of structural elements					
3. Estimate the response of structures subjected to dynamic forces					
4. Apply theory of dynamics to structures subjected to seismic forces					
5. Illustrate the codal provisions for seismic resistant design					
6. Recommend suitable alternate techniques and retrofitting methods					
Module: 1	Free and Forced Vibration of SDOF				8 Hours
D'Alembert's principle - principle of virtual work -idealization of a structure as SDOF system - Equation of motion - damped and undamped free vibrations - critical damping - logarithmic decrement - un-damped forced vibration- response to harmonic excitation					

Module: 2	Free Vibration of MDOF System:	8 Hours
Mathematical model of MDOF system - natural frequencies and mode shapes – orthogonality conditions - analysis for natural frequencies and mode shapes - solution of the Eigen value problems		
Module: 3	Forced Vibration of MDOF System	7 Hours
Idealizations of multi-storeyed building frames for dynamic analysis- Portal and cantilever method for lateral load analysis		
Module: 4	Introduction to Seismology	8 Hours
Elements of Seismology- Causes of Earthquake- Plate Tectonics- Seismic Waves- Magnitude and Intensity- Precursors for earthquake.		
Module: 5	Analysis and Design as per Codal provisions	7 Hours
Architectural features as per codal provisions- estimation of earthquake forces as per codal provisions IS1893:2016 – static and dynamic methods- Ductile detailing as per IS 13920:2016		
Module: 6	Lessons from past earthquakes	7 Hours
Failure of buildings due to earthquakes, Buildings designed as per Codal provisions and their performance, Early warning systems for earthquake		
Total Lectures		45 Hours
Text Books		
1.	Paz Mario, “Structural Dynamics - Theory and Computation”, CBS Publishers and Distributors Pvt. Ltd., 2012	
2.	Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2009	
Reference Books		
1.	Anil K Chopra, “Dynamics of structures” Prentice-hall, 2015	
2.	Duggal,S.K. “Earthquake Resistant Design of Structures”, Oxford University Press, 2007	
3.	James C. Anderson, Farzad Naeim, “Basic Structural Dynamics”, Wiley, 2012	
4.	Madhujit Mukhopadhyay “Structural Dynamics : Vibrations & Systems”, Ane Books India, 2008	
5.	Damodarasamy S. R., Kavitha S.” Basics of Structural Dynamics and Aseismic Design”, PHI Learning, 2009	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
20CE2034		3	0	0	3
Course Objective:					
1. To learn various inspection and maintenance of structures 2. To understand the repair techniques of damaged structures 3. To get exposed to retrofitting and demolition techniques.					
Course Outcome:					
At the end of the course students will be able to 1. Understand distress and damages to concrete steel and masonry structures 2. Inspect the structures for its maintenance 3. Interpret damage of structures using various tests 4. Apply of repair techniques to damage structures and various 5. Evaluate the strength of structural elements 6. Retrofit and strengthen RCC and Steel structures					
Module: 1	Inspection And Maintenance				8 Hours
Distress structures-Inspection - Cracks and Damages : R.C. C, Masonry, Steel structures-Causes of Deterioration - Visual examination of cracks – Evaluation of cracks - Assessment Procedure- prevention and remedy Maintenance - importance of maintenance - routine and preventive maintenance.					
Module: 2	Strength and Durability Aspects				8 Hours
Quality Assurance-Strength, permeability, Thermal properties-Effects due to Climate, Corrosion, Temperature-Effect of Cover thickness-Steel Structures: Erection-Fabrication-Defects in Joints –Corrosion-					

prevention and remedial measures-masonry structures: defects in masonry –preventive and remedial measures		
Module: 3	Damage Diagnosis and Assessment	7 Hours
Non Destructive Testing using Rebound hammer, Ultra sonic pulse velocity - Semi destructive testing - Probe test - Pull out test - Chloride penetration test - Carbonation - Carbonation depth testing - Corrosion activity measurement - Substrate preparation - Importance of substrate/surface preparation - General surface preparation methods and procedure - Reinforcing steel cleaning		
Module: 4	Repair Techniques	8 Hours
Epoxy injection – Shoring - Underpinning - Corrosion protection - Corrosion inhibitors-Corrosion resistant steel-Coating to reinforcement- Cathodic protection- miscellaneous methods – special techniques for repairing, heritage structures		
Module: 5	Rehabilitation and Retrofitting of Structures:	7 Hours
Design Philosophy-Methods of Retrofitting -Strengthening Techniques - Strengthening of beams-Slabs, Columns, Footings - RCC Structures - Repair of Structures distressed due to Corrosion –Fire Earthquake		
Module: 6	Demolition Techniques	7 Hours
Sequence of operations - demolition of structural elements - Engineered demolition methods –Case study		
Total Lectures		45 Hours
Text Books		
1.	Varghese P. C, “Maintenance, repair and rehabilitation and minor works of buildings”, PHI Learning Pvt. Ltd, 2014.	
2.	Modi, Poonam I, Patel, Chirag N., “Repair and rehabilitation of concrete structures”, PHI Learning Pvt Ltd.. 2015	
Reference Books		
1.	Dodge Woodson.R “Concrete Structures, Protection, Repair and Rehabilitation”, Butterworth-Heinemann,Elsevier,New Delhi 2012	
2.	Shetty.M.S. “Concrete Technology-Theory and Practice”, ,S.Chand and Company, 2008.	
3.	Vidivelli.B “Rehabilitation of Concrete Structures”, Standard Publishes Distribution.1st edition 2009.	
4.	Ravishankar.K. Krishnamoorthy.T.S, “Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures”, Allied Publishers, 2004.	
5.	Chakrabarti A, “Handbook on seismic retrofit of buildings”, Narosa Publishing House, 2010.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	BUILDING INFORMATION MODELING	L	T	P	C
20CE2035		3	0	0	3
Course Objective:					
1. Introduce the tools of BIM 2. Explain the concepts of BIM 3. Demonstrate the modeling features of BIM					
Course Outcome:					
At the end of the course students will be able to 1. Model the architectural features 2. Select the appropriate materials for MEP 3. Analyse the efficiency of HAVC system 4. Plan the schedule for the construction projects 5. Estimate the cost of project 6. Interpret the clash analysis report					
Module: 1	Introduction				8 Hours
Introduction to Building Information Modeling (BIM) -BIM Benefits- Construction and fabrication Benefits- Design Benefits-Discussions of the Roles and Impacts of BIM in the Design - Tools (Autodesk/Tekla/Bentley) - hardware system requirements					
Module: 2	BIM workflow				8 Hours
Quantification - Perform Virtual Take off - Perform 2D takeoff - Manage Takeoff Data - Update and Analyze data - Export Takeoff Data - Autodesk Rendering - Autodesk Rendering Overview - Adding Materials to a					

Model - Creating and Editing Materials - Material Mapping - Lighting - Sun and Sky Lights -Exposure Control - Ground Planes - Photorealistic Rendering - Data visualization		
Module: 3	BIM Modeling – Architecture, Structure	7 Hours
Creation of Architectural and Structural models 3D - Structure and MEP- Creating Sets- Building Elements- Structural Systems- Planning and Design - Intrusion detection - Lighting Control - Indoor Air quality services - Elevators/ escalators - parking lot monitoring system - card and keypad access - fire safety - Model checking - Information retrieval		
Module: 4	Electrical and plumbing	8 Hours
Electrical Design - Spaces and Lighting - Lighting Analysis - Light Fixtures - Site Lighting - Power and Communication - Modeling - Creating Circuits - Creating Fire Alarm System Model - Creating Power Distribution Systems - Modeling Conduits- Wiring- Heating and Cooling Load Analysis - Report - Logical Systems - Air Systems - Mechanical System & Duct Work - Mechanical Piping System - Pipe Fittings - Filters - plumbing and water monitoring		
Module: 5	Construction Management 4D	7 Hours
Project Management- Construction Engineering and Management- Facility Management - BIM based Quantity and Cost Estimation - BIM 4D Simulation: Project scheduling and construction-based monitoring - Construction Cost Estimating and Scheduling - BIM 360 – Cloud based BIM Management		
Module: 6	BIM Design coordination and Clash analysis	7 Hours
BIM and Clash Detection- BIM and Elements of Cost Estimation 5D - Clash Detection - Over View of Clash Detective Tool - Clash detective Window - Working With Clash tests - Use Clash Tests - Set Clash Rules - Select Object for Clashing - View Clash results - Produce clash Reports - Introduction to Project life cycle information (6D) - Collaboration - data handling - Point cloud - Risk assessment - Decision making		
Total Lectures		45 Hours
Text Books		
1.	Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.	
2.	Eynon, J. (2016). Construction Manager's BIM Handbook. John Wiley & Sons.	
Reference Books		
1.	Eastman, C., Teicholz, P., Sacks, R., & Liston, C. “BIM handbook: A guide to building information”, 2011	
2.	Teicholz, P. (Ed.). “BIM for facility managers”, John Wiley & Sons. 2013	
3.	Pittard, S., & Sell, P. (Eds.). “BIM and Quantity Surveying”, Routledge. 2016	
4.	Duell, R., Hathorn, T, and Hathorn, T.R. “Autodesk Revit Architecture 2016 Essentials”, Wiley and Sons, Inc. 2015	
5.	Raymond Issa, Svetlana Olbina “Building Information Modeling: Applications and Practices”, American Society of Civil Engineers, 2015	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	MUNICIPAL WASTE MANAGEMENT	L	T	P	C
20CE2036		3	0	0	3
Course Objective:					
1. To impart knowledge and skills with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of solid waste. 2. To impart knowledge on various recycling options available for the solid waste. 3. To educate the engineering principles, design criteria, methods and equipments available to manage the solid waste					
Course Outcome:					
At the end of the course students will be able to 1. Analyze the nature and characteristics of municipal solid wastes 2. Sort out the functional elements for solid waste management 3. Apply the techniques and methods used in transformation, conservation and recovery of materials from solid waste 4. Identify and design waste containment systems					

5. Gain knowledge in regulatory requirements regarding municipal solid waste management		
6. Apply the basic scientific principles for solving practical waste management challenges		
Module: 1	Sources and Classification	8 Hours
Types and sources of solid waste – classification of solid waste - need for solid waste management - salient features of Indian legislations on management and handling of municipal solid wastes		
Module: 2	Waste Characterization and Source Reduction	8 Hours
Waste generation rates – factors affecting waste generation-composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan - source reduction of wastes –waste exchange - extended producer responsibility		
Module: 3	Storage, Collection and Transport of Wastes	7 Hours
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems - need for transfer and transport – transfer stations optimizing waste allocation–compatibility, storage, labeling and handling of hazardous wastes – E-waste		
Module: 4	Waste Processing Technologies	8 Hours
objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting - thermal conversion technologies and energy recovery – incineration - treatment of biomedical wastes		
Module: 5	Waste Disposal	7 Hours
Waste disposal options – disposal in landfills: landfill classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactor - leachate and landfill gas management – E-waste disposal		
Module: 6	Energy from Solid Waste	7 Hours
Composting – incineration - biogas generation - case study on best practices - Swachhbharat features – Resources recovery from E-waste		
Total Lectures		45 Hours
Text Books		
1.	Bhide A.D. and Sundaresan, B.B, “Solid Waste Management Collection”, Processing and Disposal, 2001	
2.	Paul T Willams, “Waste Treatment and Disposal”, John Wiley and Sons, 2000	
Reference Books		
1.	Tchobanoglous.G. Theisen, H. M., and Eliassen, R. “Solid. Wastes: Engineering Principles and Management Issues”. New York: McGraw Hill, 1993.	
2.	Manual on “Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.	
3.	Manser A.G.R. and Keeling A.A, “Practical Handbook of Processing and Recycling of Municipal solid Wastes”, Lewis Publishers, CRC Press, 1996	
4.	George Tchobanoglous and Frank Kreith, Handbook of “Solid waste Management”, McGraw Hill, New York, 2002	
5.	Government of India, “Manual on Municipal Solid Waste Management”, CPHEEO, Ministry of UrbanDevelopment, New Delhi, 2000	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	NOISE POLLUTION AND ITS CONTROL	L	T	P	C
20CE2037		3	0	0	3
Course Objective:					
1. To learn the fundamental concepts for noise pollution and its mitigation. 2. To impart knowledge on the sources, effects and control techniques for noise pollution. 3. To impart knowledge on measurement and analysis of noise.					
Course Outcomes:					
At the end of the course students will be able to 1. Identify the nature and characteristics of noise pollution 2. Analyze the noise pollution problems 3. Detect the various effects of noise pollution					

4. Apply suitable preventive measures and identify the technologies and methods to control of noise		
5. Choose suitable noise adsorbent materials		
6. Gain knowledge about the various noise pollution regulations		
Module: 1	Noise Pollution and Its Principles	8 Hours
Introduction – Sound as a wave – Sound Levels – Decibel Scale – A-Weighting – Noise Metrics – Measuring Noise – Outdoor Sound Propagation – Debates and Challenges.		
Module: 2	Noise Pollution and Health	8 Hours
Introduction – Noise-health problems – Noise-stress relationship & effects overview – Noise pollution & annoyance – Noise pollution & sleep disturbance – Noise pollution & cardiovascular disease – Noise pollution & cognitive impairment in children – Special case of low-frequency noise.		
Module: 3	Strategic Noise Mapping	8 Hours
Introduction – Indian noise policy and legislation – Environmental noise directive – Strategic noise mapping – Strategic noise mapping in Asian countries and European Union		
Module: 4	Transportation Noise	7 Hours
Introduction – Road traffic noise – Railway noise – Aircraft noise – Limitation and further considerations.		
Module: 5	Industrial and Construction type Noise	7 Hours
Noise criteria – Industrial noise – Port noise – Air ports as industrial sources – Wind farm noise – Construction noise – Mining mineral / extraction sites.		
Module: 6	Noise Mitigation Approaches and Future Directions	8 Hours
Introduction – Fundamental definitions – Strategic noise mitigation: the noise action planning process – Mitigation approaches – Source based abatement – Sound absorbent materials –Anti noise device – Propagation measures – Case studies in noise abatement – Cost-efficiency issues – Progress – Limitation and future research priorities.		
Total Lectures		45 Hours
Text Books		
1.	Bhatia, S.C., “Text Book of Noise Pollution and Its Control”, Atlantic publication, 2007.	
2.	Polak, K.J., “Noise Pollution and Its Control”, CBS, 2019.	
Reference Books		
1.	Milne, A., “Noise Pollution: Impact and Counter Measures”, David and Charles PLC, 2009.	
2.	Singal S. P., “Noise Pollution and Control Strategy”, Alpha Science International, 2005	
3.	Malcolm J. Crocker, “Noise and Noise Control”, Volume 2, CRC Press, 2018	
4.	Malcolm J. Crocker, “Handbook of Noise and Vibration Control”, John Wiley and Sons, 2007.	
5.	Peters R J, “Acoustics and Noise Control”, Routledge, 2011	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	ENVIRONMENTAL LAWS AND POLICY	L	T	P	C
20CE2038		3	0	0	3
Course Objective:					
1. To analyze the legislative and judicial responses to environmental problems 2. To apply environment advocacy and approaches for using litigation in environment protection will receive special attention 3. To expose to the administrative system of environment related laws such as air, water, land, and hazardous substances etc					
Course Outcome:					
At the end of the course students will be able to 1. Recall different policies and rules framed for the environmental protection 2. Recognize the formation of boards at different levels 3. Discuss the functions of central pollution board and the state pollution boards. 4. Know about different duties of pollution control boards 5. Assess about the actions taken by government for the violation of rules 6. Enumerate about the prevention of advanced pollution					
Module: 1	Water Act				8 Hours

Constitution, functions and powers of central and state boards - prevention and control of water pollution – penalties; prevention and control of pollution rules; Annual report.		
Module: 2	Air Act	8 Hours
Constitution, functions and powers of central and state boards - prevention and control of air pollution - penalties; prevention and control of pollution rules - annual report.		
Module: 3	Environmental (Protection) Act	7 Hours
General powers of the Central Government - prevention, control and abatement of environmental pollution – rules - recipient system - standards for emission - prohibition and restriction on location of industries - furnishing information to authorities and agencies - prohibition and restriction on handling hazardous substances		
Module: 4	Hazardous Wastes (Management And Handling) Rules	8 Hours
Tran boundary movement - responsibility of the occupier - grant of authorization - power to respond or cancel - packaging, labeling, transport, disposal or import - accident reporting – appeal - rules for manufacture, storage - mitigation of the major accident, safety reports - preparation of on-site and off-site emergency plans		
Module: 5	International Environmental Law	7 Hours
Introduction to International law - International humanitarian law and environment - sources of international law - law of treaties - signature ratification - evolution of international environmental law - customary principles - common but differentiated responsibility - kyoto-protocol		
Module: 6	Rules and Regulations	7 Hours
Bio-medical waste (Management and handling) rules - ozone depleting substances (Regulations and Control) rules - recycled plastics manufacture and usage rules - Noise pollution rules.		
Total Lectures		45 Hours
Text Books		
1.	Kaushik C P, Anubha Kaushik , “Perspectives in Environmental Studies”, 4th edition, New Age International Publishers Ltd., New Delhi, 2006	
2.	Layzer, J. “The Environmental Case: Translating Values into Policy”, 3rd edition, CQ Press 2012.	
Reference Books		
1.	Vig, N. J. and Kraft, M. E. “Environmental Policy: New Directions for the Twenty First Century”, 8th edition, CQ Press 2013.	
2.	Divan S. and Rosencranz A, “Environmental Law and Policy in India”, 2 nd edition, Oxford, New Delhi, 2005.	
3.	Leelakrishnan P, “Environmental Law in India”, 3rd edition, Lexis Nexis, India, 2008	
4.	Elizabeth Fisher “Environmental Law: A Very Short Introduction” Oxford University Press; 1 edition 2018	
5.	Angus Morrison-Saunders, “Advanced Introduction to Environmental Impact Assessment”, Edward Elgar Pub, April 27, 2018	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES	L	T	P	C
20CE2039		3	0	0	3
Course Objective:					
1. To impart knowledge about surface and ground water irrigation methods 2. To acquire ideas about different types of irrigation structures 3. To understand the operation of irrigation water management structures					
Course Outcome:					
At the end of the course students will be able to 1. state the concepts of duty, crop and crop seasons 2. classify the irrigation methods 3. demonstrate the irrigation methods 4. examine irrigation structures 5. appraise and design of impounding structures and cross drainage works 6. construct and operate the irrigation projects					

Module: 1	Introduction	8 Hours
Irrigation – Types of irrigation – Necessity of Irrigation – Merits and demerits of irrigation – Crop and crop seasons – Optimal use of water – consumptive use of water –Factors affecting crop water requirements – Irrigation water standards		
Module: 2	Water Application	8 Hours
Groundwater phases – Irrigation scheduling - Wilting point – Base period – Delta - Duty –Determination of irrigation and water requirements – Irrigation and water efficiencies - Factors affecting duty – Methods of improving duty.		
Module: 3	Irrigation Methods	7 Hours
Canal irrigation – Lift irrigation – Tank irrigation – Surface Irrigation – Merits and demerits –Sprinkler irrigation – Drip irrigation		
Module: 4	Diversion and Impounding Structures	8 Hours
Weirs – elementary profile of a weir – weirs on pervious foundations - Percolation ponds – Tanks and Sluices – Gravity dams – Earth dams – Arch dams – Spillways – Factors affecting location and type of dams – Forces on a dam – Hydraulic design of dams- safety monitoring sensors.		
Module: 5	Canal and Control Structures	7 Hours
Alignment of canals – Classification of canals – Canal drops – Hydraulic design of drops – Cross drainage works – Hydraulic design of cross drainage works – Canal Head works – Canal regulators – Aqueducts.		
Module: 6	Irrigation Water Management	7 Hours
Need for optimization of water use – Minimizing irrigation water losses – water pricing - On farm development works - Participatory irrigation management – Water users associations – Changing paradigms in water management.		
Total Lectures		45 Hours
Text Books		
1.	Punima B.C. & Pande B.B .Lal, “Irrigation and Water Power Engineering”, Laxmi Publishing, New Delhi 2007	
2.	Santhosh Kumar Garg, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, 2016.	
Reference Books		
1.	Dilip Kumar Majumdar, “Irrigation Water Management (Principles & Practices)”, Prentice Hall of India (P), Ltd, 2000	
2.	Basak, N.N, “Irrigation Engineering”, Tata McGraw-Hill Publishing Co. New Delhi, 1999.	
3.	Asawa, G.L., “Irrigation Engineering”, New Age International Publishers, 2000	
4.	Sharma S.K., “Irrigation Engineering and Hydraulic Structures”, S. Chand Ltd, 2017	
5.	Michael, A.M., “Irrigation – Theory and Practices”, Vikas Publishing House, New Delhi, 2017.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	HERITAGE SCIENCE AND TECHNOLOGY	L	T	P	C
20CE2040		3	0	0	3
Course Objective:					
1. To enable the students with the importance of the heritage, museums and historic buildings 2. To identify the actual tasks in Cultural Heritage preservation 3. To introduce the basic principles, concepts and philosophies of cultural heritage management					
Course Outcome:					
At the end of the course students will be able to 1. Critically examine and apply visual and narrative perspectives on cultural heritage 2. Highlight the fundamental principles of conservation 3. Identify the principal organizations involved with heritage protection in India 4. Manage heritage including planning, risk assessment and preparedness, disaster management, tourism, archaeology, sustainability and livelihoods 5. Suggest for the conservation and sustainability 6. Adopt digital preservation technology for Cultural Heritage					
Module: 1	Fundamentals of Heritage Conservation – Concepts:				8 Hours

Heritage - types of heritage (tangible, intangible and living) - Classification of cultural assets - History and development of conservation - Conservation principles and practices - Ethics in conservation - Degrees and measures of intervention		
Module: 2	Conserving heritage	8 Hours
Principles and Approaches of conservation - Heritage Conservation from global and local perspectives - Global environmental history and politics - Natural resource conflicts - Culture-nature linkages in Heritage - Ecology and the Human Interface - Heritage and Sustainable Tourism		
Module: 3	Cultural Heritage Management	7 Hours
Conservation plan - Management plan - Project management - Heritage economics - risk preparedness - Disaster management - Sustainable conservation - archaeology - community participation - cultural heritage management- City Development Plan - Smart City		
Module: 4	Management of Historic building	8 Hours
Requirement of regular maintenance - special repairs - annual repairs - challenges in historic buildings - visitor management - site infrastructure - Management of conservation projects – types of contract - specification for conservation		
Module: 5	Conservation Technology	7 Hours
Local material and techniques for conservation - eco-friendly approaches - global issues on heritage conservation - sustainable conservation - challenges of heritage preservation.		
Module: 6	Digitization of Cultural Heritage	7 Hours
Cultural heritage – fundamentals of digital preservation – cultural relics and ancient ruins – digitization of cultural heritage – rendering technology – methods of rendering – simulation technology - Impact of Industry 4.0 on Architecture and Cultural Heritage		
Total Lectures		45 Hours
Text Books		
1.	Rogerio Candelera M.A., “Science, Technology and Cultural Heritage”, CRC Press, 2014	
2.	Mukerjee S. and Chakraborty D. (Eds) “Environmental scenario in India”, Routledge, London, 2012	
Reference Books		
1.	Mingquan Zhou, Guohua Geng, Zhongke Wu, “Digital Preservation Technology for Cultural Heritage”, Springer Science & Business Media, 2012	
2.	George Pavlidis, “Applying Innovative Technologies in Heritage Science, Information Science Reference, 2020	
3.	Miguel Angel Rogerio-Candelera, Massimo Lazzari, Emilio Cano, “Science and Technology for the Conservation of Cultural Heritage”, CRC Press, 2013	
4.	Bolognesi, Cecilia Maria, Santagati, Cettina, “Impact of Industry 4.0 on Architecture and Cultural Heritage”, IGI Global, 2020	
5.	Sameer Kochhar, Deepak B. Phatak, H. Krishnamurthy, Gursharan Dhanjal, “Infrastructure and Governance”, Academic Foundation, New Delhi, 2008	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	BASICS OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
20CE2041		3	0	0	3
Course Objective:					
1. To introduce the basic concepts and principles of various components of remote sensing. 2. To understand the satellite image analysis and interpretation 3. To provide an exposure to GIS and its practical applications in civil engineering.					
Course Outcome:					
At the end of the course students will be able to					
1. Recall the principles of remote sensing and GIS 2. Describe the analysis methods RS and GIS data 3. Interpret the data for modeling applications 4. Distinguish sensors and satellites datas for specific applications 5. Appraise the usage of data models					

6. Formulate methods to solve issues related to environment using RS and GIS techniques		
Module: 1	EMR and its interaction with atmosphere and earth material	8 Hours
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein’s Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil		
Module: 2	Platforms and Sensors	8 Hours
Platforms types – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and spaceborne TIR and microwave sensors.		
Module: 3	Image interpretation and analysis	7 Hours
Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.		
Module: 4	Geographic Information System	8 Hours
Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS)		
Module: 5	Data Entry, Storage and Analysis	7 Hours
Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.		
Module: 6	Applications of GIS in Civil Engineering	7 Hours
Deformation studies of deflection - Dam deformation - structural movement - Pavement yield - shifting sand-bank and shoreline – Landslide Risk Analysis - Monitoring Urban Growth - traffic analysis - accident analysis - site suitability analysis for transport infrastructure – Vehicle routing – Highway maintenance system – Intelligent Transportation System - Flood damage assessment – Flood Modelling		
Total Lectures		45 Hours
Text Books		
1.	Anji Reddy M, “ <u>Textbook of Remote Sensing and Geographical Information Systems</u> ”, B S Publications, 2012.	
2.	C.P.Lo.Albert K.W.Yeung, “Concepts and Techniques of Geographic Information Systems”, 2nd edition, PHI Learning Private Limited, Delhi, 2014.	
Reference Books		
1.	Andrew N. Rencz, “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley & Sons Inc, April 2004	
2.	Basudeb Bhatta, “Remote Sensing and GIS”, 2nd edition, Oxford University Press 2011.	
3.	Kali Charan Sahu, “ <u>Textbook of Remote Sensing and Geographical Information Systems</u> ”, Atlantic Publishers, 2018.	
4.	Lillesand and Kiefer, “Remote Sensing and Image Interpretation”, Wiley Publications, 2011.	
5.	George Joseph and C Jeganathan, “Fundamentals of Remote Sensing”, Orient Blackswan Publishers, 2018.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	MECHANICAL, ELECTRICAL AND PLUMBING SERVICES	L	T	P	C
20CE2042		3	0	0	3
Course Objective:					
1. To enable the students on MEP services on construction 2. To facilitate to design HVAC system and latest technology development in air conditioning system 3. To identify the Fire system module, systematic design of Fire alarm and protection system standards					
Course Outcome:					
At the end of the course students will be able to					
1. Manage building services provisions in big construction sites.					

2. Design plumbing module for water distribution piping and water drainage system and recycling of water		
3. Synchronize the construction activities with installation of building services.		
4. Select the suitable electrical as well as mechanical services for particular requirements of buildings.		
5. Ensure green building applications to the new constructions		
6. Adopt the different safety procedures that can be used to ensure a safe worksite		
Module: 1	Mechanical Services	8 Hours
Introduction – mechanical services - Lift - Lift Types - Design Considerations - Location, Sizes - Component – Pit - Elevators - Escalators - elevators types – Conveyors – Conveyor types – Lighting and Ventilation services – Ventilation types		
Module: 2	HVAC System	8 Hours
Concept of HVAC - Classification of Air-Conditioning System - Heat load calculation - Air distribution system - commercial AC ducting system - Centralized air conditioning systems - chilled water system - working principles - Split/ Window AC - VRF air condition - heat pump system - ducts grills and diffusers - Energy Conservation Building Code (ECBC) in HVAC system		
Module: 3	Electrical Services	7 Hours
Electricity - electricity generation - codes for Electrical system – power plants - Electrical equipment - Transformers - Diesel generator - protection devices and circuit breakers - importance of capacitors - power factor - harmonic control – cable types - lighting types - design of lighting - electrical earthing systems		
Module: 4	Plumbing Services	8 Hours
Fundamentals of plumbing system - water distribution system - its working principle - water requirements as per NBC - water distribution system - water demand & storage calculations - overhead tanks - water treatment system – house drainage system - storm water drainage system – Manholes- wastewater sewage system		
Module: 5	Fire Alarm and Protection System	7 Hours
Basics of Fire Alarm - Protection System - causes of fire - preventive measures - fire resistance specification and requirements - application and usage - fire protection laws - fire protection system types - water storage calculation for fire protection - Fire alarm systems types - smoke detectors		
Module: 6	Building Management System	7 Hours
BMS System – importance in MEP services - working of the BMS system - Operational consideration - Maintenance - Energy Management through BMS system - solar PV power system - grid and off grid system - solar power system – green building components and services		
Total Lectures		45 Hours
Text Books		
1.	Paul Tymkow, Savvas Tassou, Maria Kolokotroni, Hussam Jouhara, “Building Services Design for Energy Efficient Buildings”, Routledge, 2013	
2.	Purnima B C, ‘Environmental Engineering-I-Water Supply Engineering’, Laxmi Publications (P) Ltd, New Delhi, 2005	
Reference Books		
1.	Ch’ing, Francis DK, Binggeli, Cork, “Interior Design Illustrated”, Wiley Publications, New Jersey, 2004.2.Hall, Fred, Greeno, Roger, “Building Services Handbook”, Butterworth Heinemann, UK, 2001	
2.	Rangwala SC, “Water Supply and Sanitary Engineering”, Charotar Publishing House Pvt. Ltd., 29 th edition, 2016	
3.	Gurucharan Singh, “Water Supply and Sanitation Engineering (Environmental Engineering)”, Standard Publishers Distributors, 2007	
4.	Roger Greeno, “Building Services, Technology and Design” CRC Press, 2014	
5.	Jackie Portman, “Building Services Design Management”, Wiley Publications, 2014	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
20CE2043		3	0	0	3
Course Objective:					
1. To impart fundamental knowledge of Ground Improvement Techniques					
2. To understand the importance of Ground Improvement method.					

3. To adopt appropriate method of Ground Improvement according to site conditions and requirement		
Course Outcome:		
At the end of the course students will be able to		
1. Understand the types of ground improvement techniques and soil distribution in India 2. Identify the different types of stabilization techniques 3. Classify various types of ground improvement techniques. 4. Investigate the performance of the technique adopted. 5. Choose the appropriate method of Ground improvement based on their construction methods. 6. Measure the benefits due to the adopted ground improvement method.		
Module: 1	Introduction	8 Hours
Introduction to engineering ground modification- classification of ground modification techniques- soil distribution in India-reclaimed soils- ground improvement potential		
Module: 2	Grouting	8 Hours
Grouting – aspects – groutability - grouting materials - suspension grouts and solution grouts - compaction grouting - procedure and applications of grouting.		
Module: 3	Chemical Stabilization	7 Hours
Chemical stabilization – granular admixtures - cement - calcium chloride - fly ash – bitumen - chemical admixtures - construction methods.		
Module: 4	Ground Anchors	8 Hours
Ground anchors – applications - types and components - anchor tests - rock bolts –applications and types- rock bolt action around an excavation - soil nailing – construction sequence –analysis of nailed soil		
Module: 5	Compaction	7 Hours
Compaction- moisture density relationship - shallow surface compaction-rollers – operational aspects - deep compaction – explosion - heavy tamping- vibro-compaction and vibro- replacement - properties of compacted soil - compaction control tests		
Module: 6	Hydraulic Modification	7 Hours
Hydraulic modification- Methods of dewatering- open sumps and ditches –wellpoint systems, deep well drainage - vacuum dewatering– electro osmosis – design of dewatering for excavations.		
Total Lectures		45 Hours
Text Books		
1.	Purushothamaraj P., “Ground Improvement Techniques” ,University Science Press, 2011	
2.	Bujang B.K. Huat, Arun Prasad, Sina Kazemian, Vivi Anggraini, “Ground Improvement Techniques”, CRC Press, 2019	
Reference Books		
1.	Peter G. Nicholson, “Soil Improvement and Ground Modification Methods, Elsevier, 2014	
2.	Peter G. Nicholson, “Soil Improvement and Ground Modification Methods”, Elsevier, 2014	
3.	Som, N and Das, S. P, “Theory and practice of Foundation Design”, Eastern Economy Edition, India, 2003	
4.	Rawlings,C G, Hellawell,E. E. and Kilkenny,W. M,. “Grouting for Ground Engineering”, Ciria, London, 2000.	
5.	Davics, M. C. and Schlosser, F. “Ground Improvement Geosystems”, Thomas Telford, London, 1997.	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	SUSTAINABLE DESIGN OF CAMPUS	L	T	P	C
20CE2044		3	0	0	3
Course Objective:					
1. To understand the importance of sustainability in Institute					
2. To learn the implementation of sustainability in the thrust areas					
3. To learn the design for sustainability for the Institute					
Course Outcome:					
At the end of the course students will be able to					
1. Identify the Waste management concepts in the institute					
2. Apply sustainability principles for Energy					

3. Analyze the importance of food and sustainability	
4. Apply Water related sustainability concepts	
5. Analyse the concepts related to health and sustainability	
6. Evaluate a strategy for developing sustainable institute	
Module: 1	Green Engineering for Waste Management in Institute
	8 Hours
Recycling program for University waste - Reduce the use of plastic and paper in campus - Organic and inorganic waste treatment - Sewerage disposal Case Study: University Gadjah Mada	
Module: 2	Sustainability Principles for Energy
	8 Hours
Energy flow analysis in buildings - Waste to energy in campus - Methods of conservation of energy - Case Study: Osaka University, Japan, NTU Singapore	
Module: 3	Sustainability in Food production
	7 Hours
Sustainable food systems and agriculture: Food security - Self-production with available resources - Food conservation methods - Case Studies: Illinios University	
Module: 4	Sustainability in Water Conservation
	8 Hours
Recycling and Reuse of Water - Water conservation methods - Efficient building operation - Low water landscape strategies - Case Study: George town University	
Module: 5	Sustainability in Health
	7 Hours
Design of Walkable/cycling spaces - Sick building syndrome - Thermal comfort in classrooms - Sanitation and Hygiene in campus - Air pollution control methods inside campus - Case Study	
Module: 6	Applications of sustainability concepts
	7 Hours
Design and Execute a sustainable concept in the campus focussing on the thrust areas on the University	
Total Lectures	
45 Hours	
Text Books	
1.	Abu Zahrim Yaser, “Green Engineering for Campus Sustainability”, Springer Singapore, 2019
2.	Andrew Braham , “Fundamentals of Sustainability in Civil Engineering”, CRC Press, 2017
Reference Books	
1.	Yates J. K., Daniel Castro-Lacouture, “Sustainability in Engineering Design and Construction”, CRC Press 2018
2.	Sivakumar Babu G.L., Sireesh Saride, B. Munwar Basha,” Sustainability Issues in Civil Engineering”, Springer Singapore 2018
3.	Jan Seidel,” Sustainability in Civil Engineering”, GRIN Verlag 2007
4.	Toolseeram Ramjeawon ,” Introduction to Sustainability for Engineers” CRC Press 2020
5.	Barbara A. Luke, Richard Newport Wright, William Edward Kelly ,”Engineering for Sustainable Communities Principles and Practices” ASCE, 2017
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	BUILDING AUTOMATION AND ADDITIVE MANUFACTURING	L	T	P	C
20CE2045		3	0	0	3
Course Objective:					
1. To understand the concept of automation in building					
2. Identify different areas of automation in construction Industry					
3. To understand 3D printing and its application					
Course Outcome:					
At the end of the course students will be able to					
1. Describe about building automation and its technologies					
2. Explain different areas of automation in construction					
3. Apply automation in different industry					
4. outline the importance of 3D printing in construction Industry					
5. Explain Different 3D printing technologies in construction industry					
6. Demonstrate application of 3D printing with different Case studies					
Module: 1	Introduction to automation in construction:				8 Hours

Advantages and Disadvantages – Need – adaptation of automation in construction industry- use of building information modelling technology – robotics in construction – programmable construction machines –Project management in Automation - Application.		
Module: 2	Areas of automation in Construction:	8 Hours
Roads & Runways construction – Structures - Buildings construction – Ports – Tunnels - Factories and industries – Glazing for façade - Case Studies and examples		
Module: 3	Applications of Automated Construction and Robotics	7 Hours
Automation and robotics in construction sector and precast concrete industry - prefabrication of masonry and on site masonry construction - the production of steel components - suggested automation concepts - digitalisation in construction automation- new equipment & latest machineries like SRP, Boom lift, spider-kit, manitou		
Module: 4	Applicability and Limitations of 3D Printing for Civil Structures:	8 Hours
Application of 3D printing in Concrete Construction – 3D printing for civil structures - challenges of 3D printing for civil structures - future directions of 3D printing for civil structures – Advantages and Disadvantages		
Module: 5	Current 3D Concrete Printing Technologies:	7 Hours
Extrusion based Technique - CONPrint3D: Concrete On-Site 3D printing - Large-Scale 3DCP using Ultra High-Performance Concrete - Powder based Technique - Dshape - Emerging Objects – Powder based 3DCP using Geopolymer		
Module: 6	Best Practices and Applications of 3D Printing in the Construction Industry	7 Hours
Application of 3D Printing - Time, Cost, and Materials Savings - Different Case Studies		
Total Lectures		45 Hours
Text Books		
1.	Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi, “3D Concrete Printing Technology: Construction and Building Applications” 1st Edition, Butterworth-Heinemann, 2019	
2.	Alan Chamberlain, “Automation and Robotics in Construction XI”, Elsevier, 2012	
Reference Books:		
1.	Anton weiberg, “Towards design Automation for additive manufacturing – A multidisciplinary optimization approach”, Lic-tricrk, 2019	
2.	John T wen, “Intelligent building control system”, Springer international Publishing , 2018	
3.	Roman Szweczyk, “Advances in Automation, robotics and measurement techniques”, Springer International Publishing , 2018	
4.	Balasubramanian K.R.. and.Sentil Kumar V, “Additive manufacturing application for metals and composites”, IGI Global Publishers, 2020	
5.	Hordijk D.A., Luković M., “High Tech Concrete: Where Technology and Engineering Meet”, Springer International Publishing, 2017	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	DATA ANALYTICS FOR CIVIL ENGINEERING	L	T	P	C
20CE2046		3	0	0	3
Course Objective:					
1. To use R Programming for analysis of data 2. To visualize outcome in the form of graphs, charts 3. To analysis data using various statistical tools like correlation and regression					
Course Outcome:					
At the end of the course students will be able to 1. State the capabilities of R and its data, variable types 2. Describe various operators, control statements and scoping rules in R 3. Apply R programming for manipulation of datasets 4. Produce various graphs using R 5. Obtain distribution plots using R 6. Analyse dataset using Statistical Tools available in R					

Module: 1	Statistical Data Analysis	7 Hours
Basic Statistics – Outlier - regression Analysis: Linear, Multiple, Logistic, Poisson - Survival Analysis - Nonlinear Models: Splines, Decision Tree, Random Forests - Support Vector Machine – Clustering – Correlation – Covariance - Statistical simulation - T-Tests.		
Module: 2	Probability Distribution	7 Hours
Populations and samples - Statistical modeling - Probability Distributions: Normal, Binomial, Poisson and Other Distributions		
Module: 3	Introduction to R	8 Hours
Data Science - Big Data and Data Science hype – Datafication – Statistical Inference - Intro to R - overview of R - elements and data structures - Sessions and Functions - Variables, Data Types - Vectors, Scalars - Data Frames – Lists – Classes - Data input/output - Data storage formats - Subsetting objects - Vectorization		
Module: 4	Programming in R	8 Hours
R Programming - Arithmetic and Boolean Operators and values – Structures - Control Statements – Loops - Pointers in R – Recursion - Scoping Rules - Loop functions - Array and Matrices		
Module: 5	Data Manipulation	7 Hours
Math and Simulation in R - Functions, Math Function - Probability Calculation - Cumulative Sums and Products- Minima and Maxima- Data sorting - Linear Algebra Operation on Vectors and Matrices - Set Operation		
Module: 6	Data Visualisation	8 Hours
Graphics - Creating Graphs - Customizing Graphs - lattice library – Visualization - Box plot – Histogram - Pareto charts - Pie graph - Line chart – Scatterplot - Developing graphs		
Total Lectures		45 Hours
Text Books		
1.	Norman Matloff, “The Art of R Programming, Cengage Learning”, Starch Press, US-Publisher, 2017	
2.	Larry Pace, Joshua Wiley, “Beginning R -An Introduction to Statistical Programming”, 2nd Edition, Apress, 2015	
Reference Books		
1.	Mark Gardener, “Beginning R -The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.	
2.	Chris Brunson, Lex Comber, “An Introduction to R for Spatial Analysis and Mapping”, 2 nd Revised Edition, Sage Publications Ltd (UK), 2019	
3.	Jared P. Lander, “R for Everyone Advanced Analytics and Graphics”, 2nd Edition, Addison- Wesley Professional PTG, 2017	
4.	Hamid Reza Pourghasemi, “Spatial Modeling in GIS and R for Earth and Environmental Sciences”, Elsevier (S&T), 2019	
5.	Michael J. Crawley, “The R Book”, 2nd Edition, Wiley-Blackwell, 2012	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	INTELLIGENT TRANSPORTATION SYSTEMS	L	T	P	C
20CE2047		3	0	0	3
Course Objective:					
1. To learn the fundamentals of ITS. 2. To study the ITS functional areas 3. To employ the ITS implementation in developing countries					
Course Outcome:					
At the end of the course students will be able to 1. understand the concept of its, with particular emphasis on advanced traffic management and traveler 2. information issues explain the human factor issues for its generalize the sensor and communication technologies 3. apply the various its methodologies 4. define the significance of its under Indian conditions 5. describe the elements of Vehicle Location, Route Navigation and Guidance concepts					

6.		
Module: 1	Introduction	8 Hours
ITS Objectives - Historical Background - Benefits of ITS - Architecture – ITS Architecture Framework – Dynamic Message Sign - ITS Data collection techniques – Detectors - Automatic Vehicle Location (AVL) - Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS) - Video data collection.		
Module: 2	Telecommunications in ITS	8 Hours
Importance of telecommunications in the ITS system, Information Management - Traffic Management Centres (TMC) - Vehicle – Road side communication – Vehicle Positioning System ITS functional areas – Advanced Traffic Management Systems (ATMS)		
Module: 3	Advanced Traveller Information Systems (ATIS)	7 Hours
Commercial Vehicle Operations (CVO) - Advanced Vehicle Control Systems (AVCS) - Advanced Public Transportation Systems (APTS) - Advanced Rural Transportation Systems (ARTS)		
Module: 4	ITS User Needs and Services	8 Hours
Travel and Traffic management - Public Transportation Management - Electronic Payment - Commercial Vehicle Operations - Emergency Management - Advanced Vehicle safety systems - Information Management - Incident Management		
Module: 5	Automated Highway Systems	7 Hours
Vehicles in Platoons – Integration of Automated Highway Systems - ITS Programs in the World – Overview of ITS implementations in developed countries -ITS in developing countries – Case studies		
Module: 6	Case Studies	7 Hours
Case studies on ITS – national – international - importance		
Total Lectures		45 Hours
Text Books		
1.	Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005	
2.	Kan Paul Chen, “ITS Hand Book 2000: Recommendations for World Road Association”, (PIARC) John Miles, 2000	
Reference Books		
1.	Henry F.Korth, and Abraham Siberschatz, “Data Base System Concepts”, McGraw Hill, 1992.	
2.	Turban E., “Decision Support and Export Systems Management Support Systems”, Maxwell Macmillan, 1998	
3.	Sitausu S. Mittra, “Decision Support Systems – Tools and Techniques”, John Wiley, New York, 1986.	
4.	Cycle W. Halsapple and Andrew B.Winston, “Decision Support Systems – Theory and Application”, Springer Verlag, New York, 1987	
5.	National ITS Architecture Documentation, US Department of Transportation, 2007 .	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	AIRPORT AND AEROTROPOLIS	L	T	P	C
20CE2048		3	0	0	3
Course Objective:					
1. To provide knowledge about the basic components of airports. 2. To describe the process and methods of operating and utilization of airport capacity 3. To impart basic understanding of the infrastructure of airports and Aerotropolis					
Course Outcome:					
At the end of the course students will be able to 1. Understand and apply basic concepts of aviation regulations, and financing structure for airports 2. Design the airfield geometric elements and runway 3. Understand and apply basic concepts of capacity analysis for airside and landside planning 4. Evaluate airport capacity, safety and security 5. Demonstrate basic principles of pavement design 6. Demonstrate basic concepts of airside and landside aviation infrastructure management					
Module: 1	Air Transport Characteristics:				8 Hours
Airport classification-airport planning: objectives, components, layout characteristics, socio-economic characteristics of the catchment area - typical airport layouts - case studies					

Module: 2	Runway Design & Capacity Determination:	8 Hours
Airport Site selection and ICAO stipulations - geometric design of the airfield: runway design- orientation, wind rose diagram – runway length – problems on basic and actual length - Determination of runway capacity and delay - taxiway and gate capacity - holding aprons - terminal aprons - airport drainage		
Module: 3	Airport Terminal Design:	7 Hours
Function of airport passenger and cargo terminal - design of air freight terminals - airport access - airport landside planning - capacity; parking and circulation area.		
Module: 4	Airfield Pavement Design and Passenger Facilities:	8 Hours
Configuration and pavement design principles – elements of taxiway design – airport zones – passenger facilities and services		
Module: 5	Airport and Aerotropolis:	7 Hours
Modeling cities after airports - Socio-Economic Benefits - Fit for Globalization - Eco-innovations and Economic perspectives - Design of Sustainable Aerotropolis - Defining the aerotropolis - Location Quotient Analysis - conceptual design - Strategic planning - Stakeholder management - Market and demand studies - Alignment with air traffic planning - Integrated land use plan		
Module: 6	Air Traffic Management:	7 Hours
Navigational aids: lighting, sign, markings - ground based systems - satellite based systems – air traffic control - surveillance facilities – airfield lighting - air traffic management		
Total Lectures		45 Hours
Text Books		
1.	Khanna S K, Arora M G and Jain S S, “Airport Planning and Design”, Nemchand and Brothers, Roorkee, 2014.	
2.	Subhash C. Saxena, “Airport Engineering: Planning and Design”, CBS Publisher, 2012	
Reference Books		
1.	Robert Horonjeff, Francis X. McKelvey, William J. Sproule, Seth B. Young “Planning and Design of Airports” 5th Edition	
2.	Planning and design guidelines for Airport terminal facilities, Advisory circular, department of transportation, Federal Aviation Administration 1988	
3.	Norman J. Ashford , Saleh A. Mumayiz, Paul H. Wright, “Airport Engineering: Planning, Design and Development of 21st-Century Airports” , John Wiley and Sons – 5 Sep 2012	
4.	Asheesh Kumar, “Planning and Design of Airport”, Vayu Education of India, 2015	
5.	Joaquin Romero, “Airport-Centric Development: The Aerotropolis Concept and Capacity Needs”, Nova Publishers, 2013	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	AIR POLLUTION AND ATMOSPHERIC CHEMISTRY	L	T	P	C
20CE2049		0	0	2	1
Course Objective:					
1. To introduce students to the most important issues in atmospheric chemistry. 2. To understand the coupling between air quality and climate change. 3. To learn the transport mechanisms and dispersion of air pollutants in the atmosphere.					
Course Outcome:					
At the end of the course students will be able to 1. Predict fate of molecules and radicals under typical atmospheric conditions. 2. Understand the basics of atmospheric structure, circulation and composition. 3. Understand the sources and sinks of aerosols and how they affect climate 4. Understand the Major surface air-quality issues and their associated control strategies 5. Explain basic principles of greenhouse effect and compute global warming potentials. 6. Predict major atmospheric degradation pathways of natural and anthropogenic trace gases					
Module	List of Experiments				30 hours
1. Air quality monitoring techniques; Monitoring of air pollutant using high volume					

sampler; 2. Ambient monitoring of particulate matter using cyclone based sampler, 3. Ambient monitoring of Bio-aerosol. 4. Chemical characterization of air sample using advanced instruments (i.e., IC, AAS, GC). 5. Monitoring and analysis of meteorological parameters. 6. Wind rose plotting based on the winds measurements. 7. Determination of link or relationship between meteorological parameters and ambient air quality 8. Determination of aerosol optical depth by using AERONET. 9. Determination of dispersion mechanism of particulate matter using drone technology. 10. Determination of organic compound (i.e., TVOC, formaldehyde etc) using advanced sensor.	
Text Books	
1.	James P. L., “Methods of air sampling and analysis”, Routledge, 2017.
2.	VarWork K., Warner C.F., and Davis W.T., “Air Pollution: Its Origin and Control”, Pearson, 1998.
Reference Books	
1.	Lodge J.P., “Methods of Air Sampling and Analysis”, CRC Press, 1988.
2.	IS 5182, Indian Standards-Methods for measurement of air pollution, Part-14 – Guidelines for planning the sampling for atmosphere, BIS, 2000.
3.	“Standard Methods for the Examination of Water and Waste Water”, APHA-AWWAPCF, latest Edn., Washington (D.C). 1995.
Recommended by Board of Studies	
Approved by Academic Council	25 th September 2021

Course code	AR/VR/MR FOR CIVIL ENGINEERING	L	T	P	C
20CE2050		0	0	2	1
Course Objective:					
1. To learn the concepts of AR,VR and MR 2. To understand the applications of XR 3. To learn to develop models using appropriate tools					
Course Outcome:					
At the end of the course students will be able to 1. Understand the concepts AR,VR, MR 2. Understand the application of XR in Civil Engineering 3. Create models using VR using appropriate tools 4. Create Models using AR using appropriate tools 5. Create Models using MR using appropriate tools 6. Apply the concepts to real time models					
List of Experiments:					
1. XR-Terminology, Concepts and Technology 2. Create basic VR scenes in WebXR or Unity. 3. Create immersive VR scenes in WebXR or Unity. 4. Create marker-based AR scenes in WebXR or Unity. 5. Create marker-less AR scenes in WebXR or Unity 6. VUFORIA STUDIO – Creation of AR/MR Content					
Reference Books					
1.	eLearning Industry, Step Into The Screen: AR/VR Technology's Role In The Future Of eLearning, 2020				
2.	Unity Manual, https://docs.unity3d.com/Manual/XR.html , 2019				
Recommended by Board of Studies					
Approved by Academic Council			25 th September 2021		

Course code	GLOBAL CLIMATE CHANGE AND ITS IMPACT	L	T	P	C
20CE2051		3	0	0	3
Course Objective:					
1. To enable to understand the global climate change scenario, causes and consequences					
2. To introduce the concepts about climate change modelling					
3. To familiarise the policies and protocols followed for mitigation of climate change					

Course Outcome:	
At the end of the course students will be able to	
1. Understand the climate and its change 2. List the factors affecting global climate change 3. Analyze the impacts of global climate change 4. Explain the importance of climate change in various fields 5. Develop Climate Change Models 6. Appreciate the importance of policies and regulations for mitigation of climate change	
Module: 1	Introduction
8 Hours	
Climate - the atmosphere - circulation - stability, chemistry of atmosphere - atmospheric and ocean circulation - concept of energy balance - monsoon rain – clouds – storms - climate - cloud formation and climate - global wind systems - storm - hurricanes	
Module: 2	Climate Change
8 Hours	
Causes - internal forcing mechanism- external forcing mechanism – El Nino and El Nina effects - physical evidences – tropical – desert – polar - mid-latitude climates and their role in global climate change.	
Module: 3	Greenhouse Gases
7 Hours	
Greenhouse gases - its impact – acid rains – causes – effects- solution- prevention – ozone layer – ozone depletion – ozone hole and global warming - CO ₂ Emissions.	
Module: 4	Impact on Agriculture
8 Hours	
Food security - land use – forestry - human health – water supply – sanitation - infrastructure and economy	
Module: 5	Impact on Water
7 Hours	
Importance of water – water resources- oceans- global ocean circulation - water-related adaptation to climate change in the fields of ecosystems and biodiversity- variations in past climates in ocean and lake sediment cores, ice cores, corals, tree rings - influences and feedbacks of hydrological changes on climate – climate modelling	
Module: 6	Role of Organization
7 Hours	
Mission of the inter-Governmental panel on climate change -International agreements and protocols - future use of energy and fossil fuels - role of Governments, industries and individuals - case studies: Antarctica – Greenland – North Pole – India.	
Total Lectures	
45 Hours	
Text Books	
1.	Singh, K. P., “Geomorphology and global climate change”, 2011.
2.	Alper Baba, Gökmen Tayfur, “Climate Change and Its Effects on Water Resources” Springer Publishers, 2010
Reference Books	
1.	Syed M. H., “Climate Change”, Daya Publishing House, 2009
2.	Syed M.H, Encyclopedia of SAARC Nations, Gyan Publishing House, 2003
3.	George Luber, Jay Lemery, “Global Climate Change and Human Health: From Science to Practice”, ISBN: 978-1-118-50557-1 November 2015
4.	Edmond Mathez “Climate Change: The Science of Global Warming and Our Energy Future”, Columbia University Press (1st edition, 2009)
5.	Thomas R Karl , Jerry Melillo., “ Global Climate Change Impacts in the United States”, U S Global Change Research. 2009
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	GREEN BUILDINGS	L	T	P	C
20CE2052		3	0	0	3
Course Objective:					
1. To know the concept of Green building and its features 2. To impart knowledge about Green building System 3. To inculcate the application of Green Project Management					
Course Outcome:					
At the end of the course students will be able to					

1. Understand the factors influencing Green building concept		
2. Identify and Compare different rating system		
3. Select proper site and adopt green building techniques		
4. Plan energy efficient building envelopes and reduce carbon foot print		
5. Select the Building material and reduce ,reuse and recycle waste		
6. Evaluate the performance of Green buildings and enhance indoor air quality		
Module: 1	Introduction to Green Buildings	8 Hours
Definition -Sustainable development, Features of green buildings, Benefits towards sustainable development- Green building rating systems – GRIHA, IGBC and LEED, overview of rating systems.		
Module: 2	Site Selection and Planning	8 Hours
Site selection-Landscape-Soil erosion control- heat island effect-Orientation - Day lighting - Ventilation- Water conservation -Rainwater harvesting- Irrigation systems-Water efficient Plumbing systems- Waste water treatment- recycle and reuse systems		
Module: 3	Energy Efficiency	7 Hours
Environmental impact-Building constructions- Operational energy - life cycle energy- -Energy efficient building envelopes-Lighting technologies–Heating and Air-conditioning systems - Zero ozone depleting potential (ODP) materials-Wind and solar energy harvesting- Net zero buildings.		
Module: 4	Building Materials	8 Hours
Local building materials: -Natural & renewable materials - Recycled content: agro and industrial waste-Reuse of waste and salvaged materials -Waste Management: Construction waste materials- Household waste-Organic waste management		
Module: 5	Indoor Environmental Quality	7 Hours
Causes and sources –Indoor air-Risks-Indoor Air Pollutant – ASHRAE guidelines-Air quality Models – Assessment - Occupant Comfort: Day lighting, air ventilation- exhaust systems- low VOC paints, materials & adhesives, building acoustics		
Module: 6	LEED Rated Buildings & Case Studies:	7 Hours
Energy Economics –Life Cycle Costing –Green project Management and Certification- Green Strategies – Documented Benefits –Cost Control Strategies- Case studies : Platinum / gold / silver building–trends in building rating systems –IGBC standards		
Total Lectures		45 Hours
Text Books		
1.	Md Zakiar Rahman, Most sharmin Islam. Md. Shahedur Rashid, “ Practice of Green Building Technologies and Water Conservation Process”, LAP, Lambet Academic Publishing, 2012	
2.	Charles J. Kibert, “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, Wiley, New Jersey, 2007	
Reference Books		
1.	Green building guidelines: Meeting the demand for low-energy, resource-efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004	
2.	Kibert, C. “Sustainable Construction: Green Building Design and Delivery”, John Wiley and Sons, 2005	
3.	GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.	
4.	IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.	
5.	SAM Kubba, (2012), Handbook of Green building Design and Construction: LEED, BREEAM, and Green Globes” Elsevier Science	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	SMART BUILDINGS	L	T	P	C
20CE2053		3	0	0	3
Course Objective:					
1. To enhance the knowledge of Smart Building Technologies					
2. To apply the concept of Building Automation					
3. To Evaluate the functioning of Smart Buildings					

Course Outcome:	
At the end of the course students will be able to	
1. Understand the system of Smart Technology 2. Implement the design principles and strategy in Smart buildings 3. Illustrate philosophy of building automation systems 4. Analyze the intelligent building design concepts 5. Design fire safety and security systems for intelligent buildings 6. Integrate the building management systems and adopt them in intelligent buildings	
Module: 1	Smart Buildings Technologies
8 Hours	
Introduction-Smart buildings-Internet of things (IoT)- Information and Communication Technologies-Mobile Applications, Cloud Application in Smart buildings- Building Management systems - Artificial Intelligence - Smart Sensors for facility Management	
Module: 2	Building Management System (BMS) and Automation
8 Hours	
Building automation system- Architecture and Components - Building Management System: IBMS - Integration: IBMS Architecture, Normal & Emergency operation. Advantages of BMS -EPBX System - Integration of systems –Design of BMS.	
Module: 3	HVAC & Lighting Controls Systems
7 Hours	
Human Comfort: Air Quality-Thermal comfort in buildings-Ventilation-Classification of HVAC - DDC applications - Control Panel: HVAC Control Panel, Networks, BACNet, Modbus, LON-Electrical Installation – Power Transmission -Smart Lighting Systems	
Module: 4	Fire Protection Systems
8 Hours	
Introduction –Causes-Stages of Fire-Fire Service Installation-Fire Alarm -Principles of Operation-Fire Sensors-Smoke detectors and their types- Fire control panels-Fire and Life safety-Fire Management in buildings	
Module: 5	Security Systems
7 Hours	
Introduction to Security Systems-Concepts-Perimeter Intrusion- Security Design- Access control system - RFID enabled access control- Computer system access control – CCTV-Components of CCTV system - Central alarm systems –Structural health monitoring systems	
Module: 6	Building Electronics & Case Studies
7 Hours	
Microprocessor based control -programmable logic controller – communication principles -Satellite communication - Fiber optic backbone - Smart Buildings - IoT, Cloud Computing and Digital Ceiling Application - Case Studies	
Total Lectures	
45 Hours	
Text Books	
1.	Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.
2.	Derek Clements and Croome, “Intelligent Buildings: An Introduction”, Routledge, 2013 Civil Engineering.
Reference Books	
1.	Derek Clements and Croome, “Intelligent Buildings: An Introduction”, Routledge, 2013
2.	James Sinopoli “ Advanced Technology for Smart Buildings”, Artech House, 2016
3.	James.M.Sinopoli, Smart Buildings Systems for Architects, Owners and Builders Publishers:” Butter worth Heinemann, 2009
4.	James Kachadorian “ Passive Solar House: the complete Guide to Heating and cooling Your Home “ Chelsa Green Publishing: Revised and expanded Second edition, 2006
5.	Ron Bakker, “Smart Buildings: Technology and the Design of the Built Environment”, RIBA Publishing, 2020
Recommended by Board of Studies	
Approved by Academic Council	
25 th September 2021	

Course code	INTERIOR DESIGN	L	T	P	C
20CE2054		3	0	0	3
Course Objective:					
1. To introduce the principles of Interior Design					
2. To develop skill required for Interior Design					

3. To handle Interior Design Projects				
Course Outcome:				
At the end of the course students will be able to				
1. Interpret functionality requirement in Interior Design				
2. Distinguish functional value from those of aesthetic value				
3. Apply visual elements and principles in designing interiors				
4. Analyze designs in various contexts of Color and Lightings				
5. Evaluate design criteria involved in the design of furniture and landscaping elements				
6. Appraise the applications in Commercial interiors				
Module: 1	Conceptual Design			8 Hours
Interior design and interior decoration -Philosophy of art-Type of arts -Interiors in China-Japan-American – African Interiors- History of Interior Indian Tradition - Cultural and ethnic influence - Functions & Qualities of a good designer - Perception of Interior Design- Interior Design and integration with architecture				
Module: 2	Elements and Principles of Interior Design			8 Hours
Point or mark, line, form and shape, two dimensional & three dimensional categories- size, color, texture, pattern, space, light-Harmony, Balance, Rhythm, Emphasis, proportion.-Application of design principles in interiors				
Module: 3	Colour and Lighting			7 Hours
Concept & significance of color - interiors and exteriors-Dimensions of color -Color systems – Prang Colour System- Munsell Colour System-Application of color harmonies - interiors and exteriors –Effects of light on color- Artificial lighting - Light sources-Types and uses-specific factors– Lighting accessories				
Module: 4	Spatial Layout of Furniture			8 Hours
Human Factors- Furniture Design-Room Plan And Furniture Arrangement- Furniture types -Graphical Compositions in Wall, Flooring - Furniture and Ceiling Details - Design Project-Illumination False Ceiling - Wall Paneling - Air Conditioning features - Traffic Pattern and Furniture Layout: Residential, Commercial, Office				
Module: 5	Landscape Design			7 Hours
Interior Landscaping-Physical requirement of plants- Interior landscaping elements-Pot culture-Indoor Plants-Roof and Deck Landscaping- design of Courtyard, Outdoor design, Terrace design				
Module: 6	Commercial Interiors			7 Hours
Interior Design– restaurants and hotels, public utility services – Airport, Educational Institution, Hospitals Shopping Complex, Exhibition, Schools, Malls, Universities and trade Fairs				
Total Lectures				45 Hours
Text Books				
1.	Chaudhari, S.N, “Interior Design”, Jaipur: Aavishkar Publishers, India. 2005			
2.	Kasu, A.A, “Interior Design”, Delhi: Ashish Book Centre,Delhi, 2005			
Reference Books				
1.	Ireland, Jeannie. “History of Interior Design”, New York: Fairchild Books, Inc., 2009.			
2.	Newton,D.&Hayes, K. “Kitchen and bath drawing. Hackettstown”, New Jersey: The National Kitchen & Bath Association, 2006			
3.	Simon Dodsworth, Stephen Anderson, “The Fundamentals of Interior Design”, Blooms bury Publishing, 2015			
4.	Gupta, C.B., Dr. Nair, Rajan, “Marketing Management”, Sultan Chand & Som, New Delhi, 2003			
5.	Choudhury, A.K.R., “Modern Concepts of Colour and Appearance”, Oxford and IBH Pubhsning Co. Pvt. Ltd., New Delhi, 2000			
Recommended by Board of Studies				
Approved by Academic Council		25 th September 2021		

Course code	DOCKS AND HARBOUR	L	T	P	C
20CE2055		3	0	0	3
Course Objective:					
1. To Study the basics of docks and harbour					
2. To import knowledge on various marine structures and navigation aids at port					
3. To Understand various design elements in docks and harbor					

Course Outcome:		
At the end of the course students will be able to		
1. Recognize the importance of water transport with proper planning and designing of harbour and docks 2. Impart diverse knowledge of Docks and Harbour 3. Identify various component parts of dock and harbour 4. To give knowledge of maintenance techniques at Harbour and docks 5. Know importance of navigation aids at harbor and docks 6. Design components of Harbor and docks		
Module: 1	Introduction	7 Hours
Water transportation history - International and national level development and policy - classification of harbours - natural and artificial - Major ports in India - administrative set up - harbour economics.		
Module: 2	Harbour Planning	8 Hours
Harbour components - ship characteristics - characteristics of good harbour - principles of harbour planning - harbour size - site selection criteria - layout of harbours - harbor planning surveys		
Module: 3	Marine Structures	7 Hours
General, breakwaters – function - types general design principles - wharves, quays, jetties, piers, pier heads, dolphin, fenders - mooring accessories and function – types – suitability - design and construction features		
Module: 4	Docks and Locks	8 Hours
Tidal basin - wet docks – purpose - design consideration - operation of lock gates and passage - repair docks - graving docks - floating docks - marine railway.		
Module: 5	Port Amenities, Navigation Aids and Harbour Maintenance	8 Hours
Ferry - transfer bridges - floating stages and transit sheds – warehouses - cold storage – aprons - cargo handling equipment - purpose and general description - Navigation Aids - Channel and entrance demarcation - buoys, beacons, lighthouse - electronic communication devices		
Module: 6	Harbour Maintenance	7 Hours
Costal protection - purpose and devices – dredging – dredger types – suitability - disposal of dredged materials - mechanical and hydraulic dredgers.		
Total Lectures		45 Hours
Text Books		
1.	Srinivasan R., “Harbour, Dock and Tunnel Engineering”, Charotar Publishing House Pvt. Ltd.; 28th Edition. 2016	
2.	Kadiyali L.R. “Transportation Engineering”, Khanna Publishing, 2016	
Reference Books		
1.	Bindra S. P., “A Course in Docks and Harbour Engineering”, Dhanpat Rai & Sons, New Delhi. 1992	
2.	Brysson Cunningham, “The Dock and Harbour Engineer's Reference Book”, 2 nd edition, ICE Virtual Library, 2011	
3.	Subramanian K.P., “Highways, Railways, Airport and Harbour Engineering”, V Scitech Publications (India), Chennai, 2010	
4.	Adrian Jarvis, “Port and Harbour Engineering”, Taylor and Francis, 2016	
5.	John W. Gaythwaite, “Design of Marine Facilities: Engineering for Port and Harbor Structures”, Third Edition, ASCE Press (2016)	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Industry (L & T) Course

Course code	LTCC-CE-001 ADVANCED DESIGN OF REINFORCED CONCRETE BUILDINGS	L	T	P	C
20CE3025		0	0	0	3
About the Course:					
1. Industry-led application-oriented courses for enhancing the employability of students					
2. A tailor-made course curated by the Subject Matter Experts of L&T, covering design concepts and practical aspects for the design & construction of reinforced concrete buildings.					
3. Interactive e-Learning Virtual Instructor-led Training (VILT) Collaborative tools & Assessment					
Industry Knowledge & Skills covering:					

This course on new-age technologies is a must for every engineer who is keen to have a career in Geospatial Industry. The course captures the fundamentals of location technology and gives a glimpse of the various geospatial components that are used for solving real-world problems. Also, the students would get insights into the tools & techniques that are applied across various projects		
Modules / Week		
1	Introduction & Codes	Course overview Introduction to National Building Code (NBC), IS 456, IS 1343 Codes for reinforcement detailing Codes for loads International codes Reference Handbooks
2	Design Basis Parameters – Part 1	Geometric parameters Occupancy categories Site location & association parameters Design life Material specifications
3	Design Basis Parameters – Part 2	Exposure & cover requirements Fire rating Load combinations Serviceability requirements Analysis tools & other items
4	Building Load Types – Part 1	Introduction Dead Loads Super imposed Dead Loads Live Loads Wind Loads
5	Building Load Types – Part 2	Earthquake Loads Hydrostatic Loads Earth Pressure Conclusion
6	Setting the Structural Scheme – Part 1	Introduction Coordination with other trades Columns Floor system
7	Setting the Structural Scheme – Part 2	Lateral system Basement layout Global stability considerations Foundations Conclusion
8	Mid Course Assignment / Project	
9	Structural Models – Part 1	Introduction 3D global structural model
10	Structural Models – Part 2	Floor system – Hand methods Floor models modelling Foundation model Conclusion
11	Design of Structural Elements – Part 1	Introduction Design of Beams & RC slabs
12	Design of Structural Elements – Part 2	Design of PT Slabs & Columns
13	Design of Structural Elements – Part 3	Design of Shear walls, Retaining walls, Water tanks, Foundations & Conclusion
14	Detailing of Structural Elements – Part 1	Introduction Detailing of Reinforcement, Slabs, Beams, Columns & Shear walls
15	Detailing of Structural Elements – Part 2, BOQ & Conclusion	Detailing of Retaining Walls & Foundation Bill of Quantities Conclusion
16	End Course Project	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	LTCC-PM-001 PROJECT MANAGEMENT FOR ENGINEERS	L	T	P	C
20CE3026		0	0	0	3
About the Course:					
1. Industry-led application-oriented courses for enhancing the employability of students 2. This unique course curated by the Subject Matter Experts of L&T, covers all the aspects of project management that are critical for the implementation of projects. 3. Interactive e-Learning Virtual Instructor-led Training (VILT) Collaborative tools & Assessment					
Industry Knowledge & Skills covering:					
This course has been designed to help the students get an understanding of the importance of project management during the life-cycle of projects. The students would get insights on the end-to-end process from planning to execution of large projects which would be explained by way of case studies. This course is a must for every engineer who aspires to become a Project Manager.					
Modules / Week					
1	Introduction to Project Management	About projects & examples Significance of projects in nation building About project management Project organizations (Asset owner & contractor) Project acquisition & execution			

2	Project Acquisition & Handover	Project Acquisition & Handover: Business development & sales Tendering & cost estimation L1 & contract award Project hand over to execution team
3	Project Initiation	Understanding the project & its objectives Project stakeholders Setting communication protocols Identifying key project team members Project kick-off process
4	Overall Project Management Plan	Scope of work Key deliverables & project requirements Completion time & key milestones Project cost & budget Performance parameters & guarantees
5	Scope Management	About scope management Developing scope management plan Understanding technical specifications & Project requirements Work break down structure Creating scope baseline Controlling scope
6	Project Planning & Scheduling – Part 1	About schedule management Developing schedule management plan Understanding contractual schedule & milestones Estimation of activities' duration, sequencing & relationships
7	Project Planning and Scheduling – Part 2	Techniques in planning & scheduling Bar chart, Gantt chart, networks PERT & PERT analysis CPM network Baseline, monitor & control schedule
8		Mid Course Assignment / Project
9	Costing & Budgeting	Review pre-tender cost estimation Preparation of detailed cost estimate Budget & approval process Cost baseline Monitor & control costs Variance analysis Earned value analysis
10	Quality Management	Objectives Quality control & assurance Tools used in quality control Quality management Perform quality assurance activities Monitor & control quality
11	Project Risk Management – Part 1	Introduction Different types of risks Risk management Risk appetite & threshold limit Risk profile Risk management process Risk identification
12	Project Risk Management – Part 2	Risk analysis (Qualitative & quantitative) Risk Response Execute risk response Monitor risks Prepare & update risk register
13	Contracts & Claim Management	Basic concepts & definitions Contract classifications Understanding contract clauses contract administration & interpretation Change management Claims management Dispute resolution
14	Supply Chain Management	About subcontracting Benefits & risks Subcontracting strategy & plan Subcontract formation & administration Performance monitoring Procurement process Procurement contracts, risks & benefits Digitization
15	Project Closure	Completion of key deliverables Closure of purchase orders & subcontracts Commercial closure Demobilization of resources Project hand-over Closure of main contracts
16		End Course Project
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	LTCC-DE-001 APPLIED INDUSTRIAL IoT	L	T	P	C
20CE3027		0	0	0	3
About the Course:					
1. Industry-led application-oriented courses for enhancing the employability of students					
2. This niche course curated by the Subject Matter Experts of L&T, gives an insight into the latest digital technology – Internet of Things used across various industries. This course gives an overview on the application of IoT in Construction.					
3. Interactive e-Learning Virtual Instructor-led Training (VILT) Collaborative tools & Assessment					
Industry Knowledge & Skills covering:					
This specialized course on Industrial Internet of Things is one of the emerging courses that has a high demand in today’s industry. This course gives an overview of the IoT technology and its application in the construction industry through interesting case studies and simulations. This course will open new job opportunities for the students in the emerging technology space.					

Modules / Week		
1	Introduction to Industrial IoT	About IoT Difference from standard IoT & its impact on industries Examples
2	Industrial IoT Architecture – Part 1	Difference between OT & IT Overview of various layers in IIoT architecture Functions of each layer
3	Industrial IoT Architecture – Part 2	IIoT Platform overview Architectural components Introduction to Cloud & Onprem architecture
4	Data Acquisition – Part 1	Fundamentals of Sensors Types of Sensors Choice of Sensors
5	Data Acquisition – Part 2	Working principles of some types Types of measurements (Direct, Indirect, Derived)
6	Data Acquisition – Part 3	Exercise in choosing the right sensors for a given IIoT situation
7	The Edge – Part 1	About Edge Types of Gateways Features required Choice of Gateway Examples Gateway programming fundamentals
8	Mid Course Assignment / Project	
9	The Edge – Part 2	DIY - Exercise to choose the right gateway and develop a gateway program for a given problem
10	Connectivity & Protocols - Part 1	Connectivity - Wired / WiFi / GSM Standard industrial protocols (HTTP, MQTT, XMPP, AMQP, CoAP, Modbus, Websockets, Node)
11	Connectivity & Protocols - Part 2	Choice of protocol Protocol conversions & Adapters
12	Platform Architecture – Part 1	Types of Architecture Choices available (Cloud, On-prem) Lambda Architecture - Hot Path/ Cold Path Data Ingestion Stream processing
13	Platform Architecture – Part 2	Data storage Types of storage Choice of right storage Data processing
14	Platform Architecture – Part 3	Data Analytics Visualization Examples of Use case-based Analytics
15	Security	Security concerns Device security Connection security Platform / Cloud Security Threat modeling
16	End Course Project	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	LTCC-DE-002 GEOSPATIAL PRACTICES FOR ENGINEERS	L	T	P	C
20CE3028		0	0	0	3
About the Course:					
1. Industry-led application-oriented courses for enhancing the employability of students 2. This niche course curated by the Subject Matter Experts of L&T, covers the surveying methodologies and mapping of geographical features. It also gives an insight into the latest technology and tools that are used in the industry 3. Interactive e-Learning Virtual Instructor-led Training (VILT) Collaborative tools & Assessment					
Industry Knowledge & Skills covering:					
This course on new-age technologies is a must for every engineer who is keen to have a career in Geospatial Industry. The course captures the fundamentals of location technology and gives a glimpse of the various geospatial components that are used for solving real-world problems. Also, the students would get insights into the tools & techniques that are applied across various projects					
Modules / Week					
1	Introduction to Geospatial Technology	About geospatial technology & it's importance Components of geospatial technology			
2	Geospatial in Construction	Usage in construction sector Classification of geospatial technology			
3	Fundamentals of Geospatial Engineering – Part 1	Introduction to surveying & mapping			
4	Fundamentals of Geospatial Engineering – Part 2	Introduction to sensors & scanners			
5	Fundamentals of Geospatial Engineering – Part 3	Introduction to Platforms, GNSS & CoRS			
6	Fundamentals of Geospatial Engineering – Part 4	Stockpile quantity estimation			

7	Fundamentals of Geospatial Engineering – Part 5	Subsurface investigation & bathymetry survey
8	Mid Course Assignment / Project	
9	Geographic Information System – Part 1	Introduction to GIS GIS data models
10	Geographic Information System – Part 2	Components of Map CAD to GIS conversion
11	Geographic Information System – Part 3	Spatial analysis GIS database management
12	Geospatial Information Technology – Part 1	Introduction to enterprise GIS Components
13	Geospatial Information Technology – Part 2	Web & Mobile GIS System integration
14	Geospatial Information Technology – Part 3	DSS Customization of desktop GIS Role of open source
15	Future trends of Geospatial Technologies	Geospatial standardization Benefits of geospatial technology Future trends
16	End Course Project	
Recommended by Board of Studies		
Approved by Academic Council		25 th September 2021

Course code	ENGINEERING MECHANICS	L	T	P	C
21CE1001		3	0	0	3
Course Objective:					
1. To provide knowledge about statics with emphasis on force equilibrium and free body diagrams.					
2. To understand the concept stresses and response of elements.					
3. To understand the mechanical behaviour of materials under various load conditions.					
Course Outcome:					
At the end of the course students will be able to					
1. Illustrate the concepts of mechanics					
2. Identify the principles of dynamics					
3. Examine the concepts of kinetics					
4. Analyse the stresses in the members					
5. Apply the equilibrium concepts in analysis of members					
6. Apply the basic principles to solve problems in mechanics					
Module: 1	Basics of Statics	8 Hours			
Fundamental Principles – Coplanar forces – Resolution and Composition of forces and equilibrium of particles – Forces of a particle in space – Equivalent system of forces – Principle of transmissibility – Single equivalent force – Free body diagram – Equilibrium of rigid bodies in two dimensions and three dimensions.					
Module: 2	Analysis of Structures	8 Hours			
Types of supports and their reactions – Plane trusses and frames - Analysis of forces by method of joints and method of sections.					
Module: 3	Friction	7 Hours			
Characteristics of dry friction – simple contact friction – Wedges and Ladder friction.					
Module: 4	Properties of Surfaces and Solids	8 Hours			
Centroid - First moment of area – Second moment of area – Moment and product of inertia of plane areas – Transfer Theorems - Polar moment of inertia – Principal axes – Mass moment of inertia.					
Module: 5	Kinematics	7 Hours			
Displacements, Velocity and Acceleration – Rectilinear motion – Curvilinear motion – Tangential and Normal components – Radial and Transverse components.					
Module: 6	Energy and Momentum Methods	7 Hours			
Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion –Conservation of momentum.					

		Total Lectures	45 Hours
Text Books			
1.	Irving H. Shames, “Engineering Mechanics”, 4th Edition, Prentice Hall, 2006		
2.	Beer F. P and Johnston E. R, “Vector Mechanics for Engineers Statics & Dynamics”, 9th Ed, Tata McGraw Hill, 2011		
Reference Books			
1.	Egor, P.Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi, 2003		
2.	Hibbler R. C., “Engineering Mechanics: Principles of Statics and Dynamics”, Pearson Press. 2006		
3.	Andy Ruina and Rudra Pratap, “Introduction to Statics and Dynamics”, Oxford University Press, 2011		
4.	Shanes and Rao, “Engineering Mechanics”, Pearson Education, 2006		
5.	Bansal R.K, “A Text Book of Engineering Mechanics”, Laxmi Publications, 2010		
Recommended by Board of Studies			
Approved by Academic Council		25 th September 2021	

Course code	FOUNDATIONS OF BUILDING INFORMATION MODELLING	L	T	P	C
21CE3001		3	0	0	3
Course Objective:					
1. To gain experience in how to work in teams, in which they are exposed to holistic view of the building industry. 2. To learn different aspects of collaborative modeling, BIM based scheduling and estimating 3. To integrate personal and group knowledge to achieve positive results in complex engineering and construction tasks.					
Course Outcome:					
At the end of the course students will be able to 1. Apply knowledge of mathematics, science, and engineering 2. Design a system, component, or process to meet desired needs within realistic constraints 3. Identify, formulate, and solve engineering problems 4. Understanding of professional and ethical responsibility 5. Acquire the skills necessary for using BIM 6. Analyze the building operations using software tools					
Module: 1	An overview of BIM	8 Hours			
Introduction to Building Information Modelling (BIM) – BIM benefits – Construction benefits – Building lifecycle of BIM – BIM workflow process – Basic principles of Level of Development (LOD) – Differences between the Level of Details.					
Module: 2	Implementation of BIM	7 Hours			
BIM roles and responsibilities – Impact of BIM in design – benefits of BIM Dimensions – Managing BIM in different sectors of AEC Industry – BIM Practices in foreign countries – Real time buildings that are built with BIM model.					
Module: 3	BIM Modelling	8 Hours			
Application of Revit in BIM Modelling – Creation of Architectural models – Development of site systems – Structural systems – Modelling of Structural elements – Material management – Creation of family components and editing – Placing electrical and plumbing fixtures – Modelling mechanical duct systems.					
Module: 4	Working with BIM data	8 Hours			
Quantification – Performing and managing virtual takeoff data – Mapping of Material data for Schedules – Quantity schedule preparation – Creating Sheets – Revision Manager – Adding Detailing components and drafting views.					
Module: 5	BIM Design Co-ordination and Management	7 Hours			
BIM in clash detection checks – Generating clash detection reports – Linking file between disciplines – Managing shared positioning – Monitoring changes and Project co-ordination – Creation of Central Model and enabling work-sharing between the team.					
Module: 6	Case Studies	7 Hours			
BIM for Operations & Maintenance for Network Rail – BIM in renovation and execution Plan for Pollution control Plant Project – LOD 400 BIM Model for an Airport – 3D Laser Scan to BIM and inspecting the Quality and Quantity of the Project.					

		Total Lectures	45 Hours
Reference Books			
1.	Pittard, S., & Sell, P. (Eds.). (2016). BIM and Quantity Surveying. Routledge.		
2.	Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.		
3.	Issa, R. R., & Olbina, S. (Eds.). (2015, May). Building Information Modeling: Applications and Practices. American Society of Civil Engineers.		
4.	BIM Handbook (2011): A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors- Chuck Eastman, et al.		
5.	Kymmell, W. (2007). Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations (McGraw-Hill Construction Series). McGraw Hill Professional.		
Recommended by Board of Studies			
Approved by Academic Council			

Course code	DIGITAL AGE CONSTRUCTION WITH BIM	L	T	P	C
21CE3002		3	0	0	3
Course Objective:					
1. To integrate personal and group knowledge to achieve positive results in complex engineering and construction tasks. 2. To learn real time data monitoring 3. To Optimize the Construction of Precast Buildings using BIM.					
Course Outcome:					
At the end of the course students will be able to 1. Apply knowledge of BIM Workflow in Concept development and Model Development. 2. Identify and formulate the time and cost attributes. 3. Design a system, component, or process to meet desired needs within realistic constraints 4. Evaluate the design system of precast Engineering 5. Develop the workflow process and integrating using different tools 6. Analyze and predict the structure using real time data monitoring					
Module: 1	Structural BIM	8 Hours			
Introduction to Structural systems – Initial Preliminary design of structure – Determining the Internal forces – Iterative design – Integrated generation of reinforcement detailing drawings and rebar schedules – Visual Programing for Parametric Structures.					
Module: 2	BIM in Construction Management	7 Hours			
Construction Engineering and Management – BIM based quantity and cost estimation – Project Scheduling – Construction based 4D simulations – Tracking construction stage – Advanced Cost Management techniques.					
Module: 3	Green Facility BIM	8 Hours			
Early phase conceptual model – Insight Energy Analysis – Visualizing the Solar Impact – Modelling and Energy Analysis for Parametric Structures – Natural Ventilation Analysis – Carbon Footprint analysis data – Cloud based Green Building Studio.					
Module: 4	Optimization of Precast construction planning using BIM	8 Hours			
Modelling and Creation of Precast Elements – Configuration of Precast Connections – Essential Precast Design – Generation of Precast Concrete Reinforcement detailing drawings – Planning and Monitoring the Precast Fabrication with Collaborated team.					
Module: 5	BIM Interoperability	7 Hours			
Open data exchange within AEC workflows – Common data environments – Integrations and APIs of BIM – Data exchange through IFC files – BIM Interoperability tools – Study on BIM interoperability between Autodesk-Bentley-Trimble Products.					
Module: 6	BIM Optimization and Digital Twin	7 Hours			
Role of Digital Twins and its levels – BIM vs Digital Twin – Assent Information model and management – Real time data monitoring and prediction – Automation of Decision making based on future prediction – AI based reinforcement optimization.					

		Total Lectures	45 Hours
Reference Books			
1.	Pittard, S., & Sell, P. (Eds.). (2016). BIM and Quantity Surveying. Routledge.		
2.	Hardin, B., & McCool, D. (2015). BIM and construction management: proven tools, methods, and workflows. John Wiley & Sons.		
3.	Brad Hardin ,Dave McCool,(June 2015) BIM and Construction Management, Proven tools, Methods and workflow, 2nd Edition.		
4.	Issa, R. R., & Olbina, S. (Eds.). (2015, May). Building Information Modeling: Applications and Practices. American Society of Civil Engineers.		
5.	Kymmell, W. (2007). Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations (McGraw-Hill Construction Series). McGraw Hill Professional.		
Recommended by Board of Studies			
Approved by Academic Council			

**DEPARTMENT OF
CIVIL ENGINEERING**

LIST OF NEW COURSES (2020)

Sl. No	Code No.	Name of the Course	Credits			
			L	T	P	C
1	19CE2004	Field Practices III (Smart Materials and Systems)	0	0	1	0.5
2	19CE2005	Engineering Solutions for Real World Problems	1	0	4	3
3	19CE2006	Field Practices – IV (Sustainable Design Practices)	0	0	1	0.5
4	19CE2007	Field Practices – V (Green Technology In Construction)	0	0	1	0.5
5	19CE2008	Field Practices – VI (Building Information Modelling)	0	0	1	0.5
6	19CE2009	Field Practices – VII (Interior Design)	0	0	1	0.5
7	19CE2010	Building Information Modelling	3	0	0	3
8	19CE2011	Building Automation and 3D Printing	3	0	0	3
9	19CE2012	Applications of IoT in Civil Engineering	3	0	0	3
10	19CE2013	Applications of Artificial Intelligence in Civil Engineering	3	0	0	3
11	19CE2014	Applications of Machine Learning and Deep Learning in Civil Engineering	3	0	0	3
12	19CE2015	Interior Design and Landscaping	3	0	0	3
13	19CE2016	Occupational Health and Safety	3	0	0	3
14	19CE2017	Environmental Management System	3	0	0	3
15	19CE2018	Geographic Information Systems Laboratory	0	0	2	1
16	19CE2019	Drone Survey and Mapping Laboratory	0	0	2	1
17	19CE2020	Construction Safety	3	0	0	3
18	20CE1001	Building Science and Engineering	3	0	0	3
19	20CE1002	Engineering Mechanics	3	0	0	3
20	20CE1003	Green Design and Life Cycle Assessment	2	0	0	2
21	20CE1004	Sustainable Building Materials	2	0	0	2
22	20CE1005	Applied Mechanics Laboratory	0	0	2	1
23	20CE1006	Design Studio - 2D Drafting	0	0	2	1
24	20CE1007	Design Studio - 3D modelling	0	0	4	2
25	20CE3001	Advanced Structural Analysis	3	0	2	4
26	20CE3002	Design of Concrete Structural Systems	3	0	4	5
27	20CE3003	Structural Dynamics and Earthquake Engineering	3	0	0	3
28	20CE3004	Finite Element methods in Civil Engineering	3	0	2	4
29	20CE3005	Advanced Design of Steel Structures	3	0	4	5
30	20CE3006	Design of Substructures	3	0	0	3
31	20CE3007	Structural Art: Principles and Practice	3	0	0	3
32	20CE3008	Theory and Applications of Cement Composites	3	0	0	3
33	20CE3009	Design of Industrial Structures	3	0	0	3
34	20CE3010	Structural Optimization	3	0	0	3
35	20CE3011	Structural Health Monitoring	3	0	0	3
36	20CE3012	Design of High Rise Structures	3	0	0	3
37	20CE3013	Design of Formwork	3	0	0	3
38	20CE3014	Risk Assessment and Probabilistic Analysis	3	0	0	3
39	20CE3015	Bridge Engineering	3	0	0	3
40	20CE3016	Condition Assessment of Existing Structures	3	0	0	3
41	20CE3017	Fracture Mechanics of Concrete Structures	3	0	0	3
42	20CE3018	Design of Prestressed Concrete Structures	3	0	0	3
43	20CE3019	Experimental techniques and instrumentation	3	0	0	3

44	20CE3020	Fire resistant design of structures	3	0	0	3
45	20CE3021	Analysis and design of precast concrete structures	3	0	0	3
46	20CE3022	Cement and concrete chemistry	3	0	0	3
47	20CE3023	Design of Composite structures	3	0	0	3
48	20CE3024	Sustainable Construction	3	0	0	3

19CE2004	FIELD PRACTICES – III (Smart Materials and Systems)	L	T	P	C
		0	0	1	0.5

Course Objectives:

1. To understand the smart materials available in market
2. To identify the use of smart material in civil applications
3. To understand the use of smart materials for civil applications

Course Outcomes:

Student will be able to

1. Identify the smart materials for civil applications.
2. Use Smart material for various HVAC systems
3. Develop smart systems for electronic items
4. Develop smart systems for electrical items
5. Develop a smart systems for services
6. Develop a smart home integrating the components

Descriptions:

1. To identify the various smart materials and sensors that can be used for buildings
2. Develop a smart room for weather mapping and HVAC systems
3. Develop the smart room for lighting control
4. Develop the smart room to control doors ,Electronic gadgets,
5. Develop a system to monitor water levels
6. Develop a system to automatically control motor

Reference Books:

1. A. H Robbins, W.C. Miller, "Circuit Analysis: Theory and Practice", Fifth Edition, Delmar. Cengage Learning, New York, 2013.
2. Robert B, Northrop, "Introduction to Instrumentation and Measurements", CRC press, Taylor and Francis group, Second Edition 2011
3. J Larminie J, Lowry, "Electric Vehicle Technology Explained", John Wiley, & Sons, New York 2013
4. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, Sussex, 2014.
5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.

19CE2005	ENGINEERING SOLUTIONS FOR REAL WORLD PROBLEMS	L	T	P	C
		1	0	4	3

Course Objectives

1. To help students to identify the need for developing newer technologies for industrial / societal needs
2. To train students to propose and implement relevant technology for the development of the prototypes / products
3. To make the students to learn the use the methodologies available for analysing the developed prototypes / products

Course Outcomes

At the end of the course, the student will be able to

1. Identify real life problems related to society
2. Formulate the objectives for the problem identified
3. Formulate the methodology for the problem
4. Design the components/solution procedure
5. Fabricate/Analyze the components/solution
6. Evaluate the efficiency of the developed solutions

Modules of the course

1. Identification of real life problems
2. Field visits can be arranged by the faculty concerned
3. 4-5 students can form a team
4. Minimum of four hours on self-managed team activity
5. Appropriate scientific methodologies to be utilized to solve the identified issue
6. Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies)
7. Consolidated report to be submitted for assessment
8. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility

References:

1. Kristi Lew, “Solving Real World Problems with Environmental and Green Engineering”, Britannica Educational Publishing, 2015.
2. Maja Bystrom, Bruce Eisenstein, “Practical Engineering Design”, CRC Press, 2017.
3. Jeff Butterfield, “Problem-Solving and Decision Making: Illustrated Course Guides”, Cengage learning, 2012.

19CE2006	FIELD PRACTICES – IV (SUSTAINABLE DESIGN PRACTICES)	L	T	P	C
		0	0	1	0.5

Course Objective

1. To make the students understand the concepts of sustainability
2. To understand the variation in the use of materials, design in various buildings

Course Outcomes

At the End of the course students will be able to

1. Identify various building materials used over a period of time
2. Identify the spatial and environmental concepts in design
3. Design of buildings based on climatic response
4. Apply the concepts of ambience and comfort in buildings
5. Compare the sustainable practices in various time frame
6. Incorporate sustainable practices in modern construction.

Case Study 1

To identify and document a building or a group of buildings from a pre-industrial, vernacular, traditional settlement in India and

- To comprehensively study the building in terms of its layout, use of materials, spatial and environmental concepts, user comfort, ambience, distinct features etc.,
- understand its climate responsive design strategies, sustainable practices and their contemporary relevance.

Case Study 2

To identify a modern building or a group of buildings built within the last decade and

- document and analyze their layouts, use of materials, spatial and environment concepts, ambience, user comfort etc.,

Comparison of Case Studies 1 and 2

1. To compare and contrast case studies 1 and 2 to understand the shift in societal values and their subsequent effect on sustainability

Reference Books

1. Gurucharan Singh Kainth, "Climate Change, Sustainable Development and India", LAP Lambert, 2011
2. Janis Birkeland, "Positive Development: From Vicious Circles to Virtuous Cycles through Built Environment Design", Routledge, 2008
3. Sustainable Building - Design Manual: sustainable building design practices- TERI 2004
4. Ross Spiegel, "Green Building Materials: A Guide to Product Selection and Specification", 3rd Edition, John Wiley & Sons, 2010
5. K.S. Jagadish, "Alternative building materials and technologies", New Age International, 2013
6. The Barefoot Architect: A Handbook for Green Building, Shelter Publication, 2007

19CE2007	FIELD PRACTICES – V (GREEN TECHNOLOGY IN CONSTRUCTION)	L	T	P	C
		0	0	1	0.5

Course Objective

1. To understand the green building concept
2. To understand the various green materials and its properties

Course Outcomes

At the end of the course students will be able to

1. Identify the green building concepts for buildings
2. Identify alternate materials for construction
3. Determine the properties of available materials
4. Determine the properties of low cost green materials
5. Determine the properties of recycle materials
6. Suggest suitable alternate solution for modern construction

Experiments

1. Concepts of Green building and LEED rating
2. Comparison of bricks and laterite blocks
3. Properties of stabilized mud blocks
4. Green rating analysis of a building
5. Comparison of fibre reinforced beam with RCC beams
6. Study on properties of bamboo reinforced beam
7. Studies on properties of bamboo reinforced column
8. Studies of Plastic fibres in concrete
9. Ferro-cement panels compared to normal panels
10. Preparation of recycled materials for usable raw materials
11. Compressive strength of concrete with recycled materials

References:

1. Abe Kruger, Carl Sevilla, "Green Building: Principles and Practices in Residential Construction", Cengage Learning, 2012.
2. Charles J. Kibert, "Sustainable Construction: Green Building Design and Delivery", Wiley 2012.

19CE2008	FIELD PRACTICES – VI (BUILDING INFORMATION MODELLING)	L	T	P	C
		0	0	1	0.5

Course Objectives

1. To understand the principles of BIM
2. To make the students familiarize with the use of REVIT BIM

Course outcomes

1. Use tools of the software to create models
2. Model the components of the buildings
3. Model the non-structural components in buildings
4. Apply the materials to the model.
5. Create schedules for the models
6. Create walkthrough of the models developed

Experiments

1. Introduction to Revit Software & the workflow of BIM
2. Modelling of Walls and to Floors
3. Modelling of Roofs and Adding Structural Component
4. Modelling of Staircase and Creating Ramps & Railings
5. Placing of Components and Modelling Components In-Place
6. Material Management and Working with Sections
7. Creating Ceilings and Including Night lights in the project
8. Modelling the Site and Creating Schedules
9. Working with Conceptual Mass and Rendering the Views
10. Creating a Walkthrough video and Documentation work

Reference Books:

1. ASCENT, Autodesk Revit 2021 Structure Fundamentals, 2020, SDC Publications
2. Elise Moss, Autodesk Revit 2021 Architecture Basics, 2020, SDC Publications
3. Jeff Hanson, Daniel John Stine AIA, CSI, CDT, Autodesk Revit 2021 Architectural Command Reference, 2020, SDC Publications

19CE2009	FIELD PRACTICES – VII (INTERIOR DESIGN)	L	T	P	C
		0	0	1	0.5

Course Objectives:

1. To impart visualizer and create 3D Model
2. To acquire knowledge on interior designs and decorations
3. To train and to design perfect interiors by using industry-standard 3D software.

Course Outcomes:

At the end of the course, student will be able to

1. apply knowledge related to interiors in construction
2. bring technical solutions to evoke or reflect on clients requirements.
3. design and decorate for the growing population
4. apply basic design concepts to technical concepts
5. adopt the spurt in demand for Interior Designers
6. create the attractive interiors

Experiments:

1. Introduction to 3D Modelling software
2. Hands on training using Tools and Techniques of the software
3. Working with Props
4. Architectural modelling of the building
5. Creating Objects and Props
6. Creating Interiors and furniture

7. Use of Colour theory and its effect
8. Camera & Lighting effect on a building
9. Render Final Output of the building
10. Real time rendering with walk through

Reference Books

1. Gary Gordon and Jamco L. Nuckolls, "Interior lighting for Designers", Third edition, John Wiley and Sons, New York, 1995.
2. Jack E. Ingels, "Landscaping Principles and Practices", Delmar Publishers. 2002
3. Tutorials: Animation - Autodesk | 3ds Max Design, Engineering
4. Autodesk 3ds Max 2017: Fundamentals

19CE2010	BUILDING INFORMATION MODELLING	L	T	P	C
		3	0	0	3

Course Objective:

1. To provide an introduction to Building Information Modeling
2. To familiarize with the Project performance and produce better outcome
3. To demonstrate design solutions and objectives and share design feasibility studies for construction.

Course outcome:

Student will be able to

1. utilize the tools to design Building information models
2. design the components for BIM workflow
3. formulate the structural systems using tools
4. design the accessories for the structural systems
5. demonstrate the coordination of various elements based on defined standards.
6. exhibit the design solutions and feasibility for Construction

Module 1: Introduction (6 hours)

Introduction to Building Information Modeling (BIM) -BIM Benefits- Construction and fabrication Benefits- Design Benefits - Roles and Impacts of BIM in Design - Tools - hardware system requirements

Module 2 : BIM Workflow (7 hours)

Quantification - Virtual Take off - Perform 2D takeoff - Manage Takeoff Data - Update and Analyze data - Export Takeoff Data - Autodesk Rendering - Autodesk Rendering Overview - Adding Materials to a Model - Creating and Editing Materials - Material Mapping - Lighting - Sun and Skylights - Exposure Control - Ground Planes - Photorealistic Rendering

Module 3: BIM Modelling – Architecture, Structure (8 hours)

Creation of Architectural and Structural models - application of Revit Architecture - Structure and MEP - Creating Sets - Building Elements - Structural Systems - Planning and Design - Intrusion detection - Lighting Control - Retrofit - Indoor Air quality services - Elevators/ escalators - parking lot monitoring system - card and keypad access - fire safety - Hands on training

Module 4: Electrical and Plumbing (8 hours)

Electrical Design - spaces and lighting - lighting analysis - light Fixtures - site lighting - Power and Communication - modeling - creating circuits - Creating fire alarm system model - creating power distribution systems - modelling conduits – wiring - heating and cooling load analysis - report - logical systems - air systems - mechanical system & duct work - mechanical piping system - pipe fittings - filters - plumbing and water monitoring - Hands on training

Module 5: BIM Design Coordination, Clash Analysis and Navis Works (8 hours)

BIM and clash detection- BIM and elements of cost estimation - clash detection - over view of clash detective tool - clash detective window - working with clash tests - use clash tests - set clash rules - select object for clashing - view clash results - produce clash reports - hands on training

Module 6: Construction Management (8 hours)

Project Management- construction engineering and management - facility management - BIM based quantity and cost estimation - BIM 4D Simulation: Project scheduling and construction-based monitoring - construction cost estimating and scheduling - BIM 360 – cloud based BIM Management - Hands on training

Text Books:

1. Eastman, C., Teicholz, P., Sacks, R., Liston, C, “BIM handbook: A guide to building information”, John Wiley & Sons., 2011
2. Hardin, B., & McCool, D, “BIM and construction management: proven tools, methods, and workflows”, John Wiley & Sons, 2015

References:

1. Teicholz, P. (Ed.), “BIM for facility managers”, John Wiley & Sons. 2013
2. Eynon, J. “Construction Manager's BIM Handbook”, John Wiley & Sons, 2016
3. Pittard, S., & Sell, P., “BIM and Quantity Surveying”, Routledge. 2016
4. Duell, R., Hathorn, T, and Hathorn, T.R., “Autodesk Revit Architecture 2016 Essentials”, Wiley and Sons, Inc. 2015
5. Karen M. Kensek, “Building Information Modeling”, Routledge, 2014

19CE2011	BUILDING AUTOMATION AND 3D PRINTING	L	T	P	C
		3	0	0	3

Course Objective:

1. To understand the concept of automation in building
2. To identify different areas of automation in construction Industry
3. To understand 3D printing and its application

Course Outcome:

Student will be able to

1. describe building automation and its technologies
2. explain different areas of automation in construction
3. apply automation in construction industries
4. outline the importance of 3D printing in construction industry
5. explain 3D printing technologies in construction industry
6. demonstrate application of 3D printing with different case studies

Module 1: Introduction to Automation in Construction (7 hours)

Automation concepts - advantages and disadvantages – need – adaptation of automation in construction industry- use of building information modelling technology – robotics in construction – programmable construction machines – Project management in Automation application.

Module 2: Areas of Automation in Construction (7 hours)

Roads - Runway construction – Building construction – Ports – Tunnels - Factories and industries – Glazing for façade - Case Studies and examples

Module 3: Applications of Automated Construction and Robotics (8 hours)

Automation and robotics in construction sector - precast concrete industry - prefabrication of masonry - on site masonry construction - the production of steel components - digitalisation in construction automation - new equipment and latest machineries like SRP, Boom lift, spider-kit, manitou

Module 4: Applicability and Limitations of 3D Printing for Civil Structures (8 hours)

Application of 3D printing in concrete construction – 3D printing for civil structures - challenges of 3D printing for civil structures - future directions of 3D printing for civil structures – advantages and disadvantages

Module 5: 3D Concrete Printing Technologies (8 hours)

Extrusion-Based Technique - Contour Crafting - Concrete Printing - CONPrint3D: Concrete on-site 3D printing - Large-Scale 3DCP using Ultra - High Performance Concrete - Current Examples of Extrusion-based 3DCP Elements/Structures

Powder based Technique - Dshape - Emerging Objects – Powder based 3DCP using Geopolymer

Module 6: Best Practices and Applications of 3D Printing in the Construction Industry (7 hours)

Application of 3D Printing - Time, Cost, and Material Savings - case studies

Text Books:

1. Jay G. Sanjayan, Ali Nazari, Behzad Nematollahi, “3D Concrete Printing Technology: Construction and Building Applications”, 1st Edition Butterworth-Heinemann Publishers, 2019
2. Alan Chamberlain, “Automation and Robotics in Construction XI”, Newnes, 2012

References:

1. Thomas Bock, Thomas Linner, “Site Automation”, Cambridge University Press, 2016
2. Arnaud Perrot, “3D Printing of Concrete: State of the Art and Challenges of the Digital Construction evolution”, John Wiley & Sons. 2019
3. Hermann Merz, Thomas Hansemann, Christof Hübner, “Building Automation: Communication systems with EIB/KNX, LON and BAC net”, Springer, 2018
4. Thomas Bock, Thomas Linner, “Robot Oriented Design”, Cambridge University Press, 2015
5. Abraham Warszawski, “Industrialized and Automated Building Systems: A Managerial Approach”, Routledge, 2003

19CE2012	APPLICATIONS OF IoT IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objective:

1. To learn the concepts of IoT
2. To identify the different techniques and applications in IoT
3. To apply the IoT in Civil Engineering projects

Course outcome:

Student will be able to

1. understand the concepts of IoT
2. recognize the frameworks for IoT
3. identify the different techniques in IoT
4. relate IoT in Transportation and Environmental Engineering
5. apply IoT in infrastructure projects
6. design and develop a smart city in IoT.

Module 1: Introduction to the Internet of Things (7 hours)

Definition and Basic Foundation - IoT Vision from an Opportunistic Networking Perspective - Architecture Framework for Designing IoT Systems - Integration of Cloud Computing and IoT, Big Data, Data Analytics: Opportunities and Challenges

Module 2: Frameworks for the Internet of Things (8 hours)

Data store process - Communication Layer - Mapping Layer - Storage Layer- data-retrieval process - Data Retrieval - Data Interoperability and Integration - cloud-based implementation - cloud Computing Environment: IoT security, Industry 4.0, Smart factories

Module 3: IoT in Environment and Transportation Engineering (8 hours)

Real-Time observation - Highway safety of Smart Cities - Connected Bicycles: Research Opportunities in Wireless Sensor Network - Connected Cars - IoT application in Environment Water resources Engineering

Module 4: IoT in Infrastructure (8 hours)

Construction Management - Corrective to preventive maintenance - Tracking labour hours – Sensohive Maturix, Doka Concremote and Giatec Smart Rock - Unmanned aerial vehicles (UAVs) and autonomous vehicles - smart vid, Egnyte, Dodge Data and Analytics and PCL Construction, waste reduction and safety.

Module 5: IoT In Smart City (7 hours)

Enabling Smart Cities through IoT: The ALMANAC Way -Smart City Concept - Smart Streets - Smart Buildings - Waste Management and Structural Health Monitoring - BIM Optimization and Digital Twins – Supply Chain management - Self-Adaptive Cyber - City System

Module 6: Case Studies (7 hours)

Implementation of IoT in Construction Industry - civil infrastructure monitoring application – City Automation.

Text Books:

1. Ricardo Armentano, Robin Singh Bhadoria, Parag Chatterjee, Ganesh Chandra Deka, “The Internet of Things Foundation for Smart Cities, ehealth, and Ubiquitous Computing”, CRC Press Taylor & Francis Group, 2018.
2. Samuel Greengard, “The Internet of Things”, MIT Press Essential Knowledge series, 2015

References:

1. Cuno Pfister “Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud” Maker Media, Inc 2019
2. Rowan Trollope, David Hanes, Patrick Grossetete, Jerome Henry, Rob Barton, Gonzalo Salgueiro “IoT Fundamentals - Networking Technologies, Protocols and Use Cases for the Internet of Things” Cisco Press, 2016
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-On Approach”, Bahga & Madisetti, 2014
4. Fadi Al-Turjman, “Intelligence in IoT-enabled Smart Cities”, CRC Press, 2018
5. Umit Isikdag, “Enhanced Building Information Models: Using IoT Services and Integration Patterns”, Springer, 2015

19CE2013	APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the principles and concepts of Artificial intelligence
2. To comprehend the Neural Network and Fuzzy Logic systems
3. To study the application of AI in Civil Engineering Problems

Course Outcome:

The Student will be able to

1. identify the problems in Civil Engineering and solve using AI
2. formulate problems and make decisions
3. explain various search algorithms for problem solving
4. apply Artificial Intelligence in real time problems
5. participate in the design of systems that act intelligently and learn from experience
6. assess the applicability, strengths and weaknesses of the basic knowledge representation

Module 1: Introduction to Artificial Intelligence (8 hours)

Artificial Intelligence - Machine Learning-Learning from Data-Research in Machine Learning-Artificial Neural Network-Fuzzy Logic – Population based search

ANN concept – Model of ANN - Back Propagation - Counter Propagation - Working Principles

Module 2: Fuzzy Logic (8 hours)

Introduction - Membership functions - Rule Base - Fuzzy decision Making -Control systems - Merits and Demerits - Fuzzy Inference system

Module 3: AI Application in Infrastructure Engineering (8 hours)

AI in Smart infrastructures – highways – bridges – airports – railroads – buildings - dams– Earthquake-Induced Liquefaction- AI in Transportation planning - Pavement Maintenance -AI in traffic Management - Accident Prevention

Module 4: AI Application in Water Resources Engineering (7 hours)

Rainfall Forecasting– Storm water and ground water management –Water quality- Waste management- Recharge ground water

Module 5: AI Application in Construction Management (7 hours)

AI in Decision-Making - Resources Optimization - Construction cost- Construction budget - Maintenance - Construction Demand- Labour Productivity.

Module 6: AI Application in Geotechnical Engineering (7 hours)

Bearing capacity-settlement-stability of slopes-different soil properties-Earth retaining structures

Text Books:

1. Krishnamoorthy C.S., Rajeev S, “Artificial Intelligence and Expert Systems for Engineers”, CRC Press, 2018
2. Pijush Samui, “Artificial Intelligence in Civil Engineering”, LAP LAMBERT Academic Publishing , 2012

References:

1. Rajesaekaran S, Vijayalakshmi Pai G.A, “Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and Applications”, Prentice Hall of India New Delhi 2003
2. Rich E, K Knight, “Artificial Intelligence”, Tata McGraw Hil, 2009.
3. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning. 2011
4. Paresh Chandra Deka, “A Primer on Machine Learning Applications in Civil Engineering”, CRC Press Book, Taylor and Francis Group, 2019
5. Russell, Norvig, “Artificial intelligence, A Modern Approach”, Pearson Education, 2nd edition, 2004

19CE2014	APPLICATIONS OF MACHINE LEARNING AND DEEP LEARNING IN CIVIL ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives:

1. To introduce The Students to state-of-the-art methods and modern programming tools for data analysis.
2. To introduce the computer applications in civil engineering
3. To explore various paradigms for knowledge encoding in computer systems.

Course Outcome:

The Student will be able to

1. illustrate the concepts of machine learning and deep learning
2. understand complexity of machine and deep learning algorithms and their limitations
3. comprehend modern notions in data analysis oriented computing
4. apply common algorithms in practice and implement it
5. perform distributed computations
6. execute experiments in Machine Learning using real-world data.

Module 1: Introduction to Machine Learning and Deep Learning (7 hours)

Unsupervised and Supervised – Reinforcement – Hybrid models, Crisp and non-crisp – Optimization problems – Examples of unsupervised and supervised learning – Design of construction – Analysis in monitoring construction health.

Module 2: Neural Networks (8 hours)

Introduction to Neural Networks – Multi-Layer Perceptron; Conventions, restricted non-linearity – Basic Perceptron – Optimisation – Estimating network parameters for a regression problem – flow prediction – Pipeline and discrete optimization – Damage detection in structure – Environmental modelling.

Module 3: SVMS (Support Vector MachinE) (7 hours)

Introduction –Basic optimization problem: margin maximization – Basic SVM optimization – Kernel trick – Lagrange multipliers - Soft-Margin SVM – SVM in road projects and liquefaction.

Module 4: Deep Unsupervised Learning (8 hours)

Auto-encoders; standard, sparse, enoising, contractive variational - Auto-encoders – Adversarial generative networks – Dynamic memory networks – Deep unsupervised learning in structural engineering.

Module 5: Deep Learning in Civil Engineering (8 hours)

Quality Management – Safety Management – Measure interior floor plans– 3D Interior Constructional

Module 6: Case Studies (7 hours)

Applications: Construction – Transportation – Infrastructures – Surveying – Water resources – Environmental engineering.

Text Books:

1. Bishop C.M., “Pattern Recognition and Machine Learning”, Springer, 2015
2. Paresh Chandra Deka, “A Primer on Machine Learning Applications in Civil Engineering”, CRC Press., 2019

Reference Books:

1. Flach P., “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, Cambridge University Press; First Edition, 2012.
2. Russell S.J., and Norvig P., “Artificial Intelligence: A Modern Approach”, Prentice-Hall; 3rd Edition, 2010.
3. Mohssen Mohammed, Muhammad Badruddin Khan, Eihab Bashier Mohammed Bashier “Machine Learning: Algorithms and Applications”, CRC Press. 2016
4. Pedro Larrañaga, David Atienza, Javier Diaz-Rozo, Alberto Ogbechie, Carlos Esteban Puerto-Santana, Concha Bielza, “Industrial Applications of Machine Learning”, CRC Press., 2018
5. Charles R. Farrar, Keith Worden, “Structural Health Monitoring: A Machine Learning Perspective”, John Wiley & Sons., 2012

19CE2015	INTERIOR DESIGN AND LANDSCAPING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart visualizer and 3D modeler
2. To acquire knowledge on Interior designs and decorations
3. To design perfect interiors by using industry-standard 3D software.

Course Outcome:

Student will be able to

1. apply interior knowledge in the interior design projects
2. adopt technical solutions to evoke or reflect on clients requirements.
3. design and decorate for the requirement of the project
4. implement basic design concepts to technical concepts
5. adapt workflow to complete the multiple projects concurrently
6. create the attractive interiors

Module 1: Principles and Elements of Design (7 hours)

Architectural effects on wall planes - roof planes - visual impact – Ratio: proportions – golden section - relationships – design principles - unity - variety – rhythm - doors, windows and ventilators etc. - room plans and furniture arrangement – soft furnishings - modular, knockdown and economy furniture - traffic pattern and furniture layout for residence, commercial and office areas

Module 2: Usage of Space: (7 hours)

Interior space - spatial qualities: form, scale, outlook; structuring space with interior design elements - spatial form - spatial dimension - Overview of Construction Materials - Functionalities of Interior Elements

Module 3: Color Theory and Lighting (7 hours)

Point, line, volume, shape, texture and colour - lighting and colour in interiors - artificial lighting - effect of color in lighting - Digital Sketching - 3D Modeling - Texturing - Light shelves to reduce - increase the light flux level - reflection inside the building - Rendering

Module 4: Flooring, wall panelling and ceiling services (8 hours)

Floorings and floor coverings – walls – wall finishes and ceilings - Interior services - air-conditioning system and applications - fire safety - acoustics and sound insulation - electrical systems

Module 5: Landscaping (6 hours)

Interior landscaping – definition - classification of plants, indoor plants and their functions

Module 6: Quantity analysis (8 hours)

Architecture and Interior works at site - Quantity take-offs for interior finishes - Methods of Measurements - Ratios and Analysis - Profit and Loss Analysis - Labour and Machinery deployed at Construction Site - Post construction billing.

Text Books:

1. Simon Dodsworth, Stephen Anderson, “The Fundamentals of Interior Design”, Bloomsbury Publishing, 2015
2. Jack E. Ingels, “Landscaping Principles and Practices”, Delmar Publishers. 2002

Reference Books:

1. Fiona Leolie, “Designs for 20th century Interiors”, VH Publications, London. 2000
2. Torquil Barker, “Concepts of lighting, Lighting design in Architecture”, 2001
3. Premavathy Seetharaman and Parveen Pannu, “Interior Design and Decorations”, CBS Publishers, 2009
4. Jain V.K, “Fire Safety in Buildings”, New age International (Pvt Ltd) publishers, Chennai, 2007
5. Linda O'Shea, Chris Grimley, Mimi Love “The Interior Design Reference and Specification Book: Everything Interior Designers Need to Know Every Day”, Rockport Publishers, 2013

19CE2016	OCCUPATIONAL HEALTH AND SAFETY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge on health problems and safety measures associated with occupations aspects of workers.
2. To identify a conceptual framework for the practice of occupational health and safety.
3. To impart the toxicological properties of materials.

Course Outcome:

Student will be able to

1. illustrate the concepts of occupational health safety
2. identify the diseases related to occupation
3. examine the standard analysis like HAZOP, FMEA, ETA, FTA.
4. analyse the hazards in industrial operation and propose prevention measures.
5. identify the toxic materials and quantify its toxicity.
6. illustrate the safety management in industries by suggesting safety measures.

Module 1: Occupational Health (7 hours)

Introduction – Occupational health hazards and its classification – Hazardous chemical properties and health effects – Exposure: Occupational diseases due to metals & dusts, fumes & chemical compounds, Permissible limits and threshold values - Dose and response evaluation – lethal dose and lethal concentration – Introduction to Ergonomics and its constituents –Application of ergonomics occupational health.

Module 2: Safety (7 hours)

Interlocution and Concept – Nature – philosophy – psychology of safety – Total safety – Available safety terminology – Factors: accident relevant factors and psychological factors.

Module 3: Accident Prevention and Safety Management (7 hours)

Accident types – Causation – Available reasons for prevention – prevention for accident – Impending safety factors – safety management and its responsibilities – Safety functions and its organization – Management principles – Concept and element of management.

Module 4: Electrical Safety, Fire and Explosion (9 hours)

Electricity hazards – Indian standards – Assessment of effects of electrical parameters on human body – Available safety measures for electric works – Fire and explosion phenomena – Classification of fire and extinguishers fire prevention & protection system – Control devices – fire awareness and signs – Underwater safety and precautions; well sinking, caissons underwater concreting, cofferdams - special operations connected with irrigation work - Safety in use of machinery and equipment's related to underwater portions – Height of discharge; Discharge (Liquid/Gas/Vapour) - Incidence of accidents - Safety features associated with design, construction and use of stairways, ramps - Other safety requirements working at heights

Module 5: Hazards Identification and Control Techniques (8 hours)

Hazards and detection techniques – Risk assessment – Preliminary hazards analysis (PHA) – Hazards and Operability (HAZOP) study – Failure Mode Effect Analysis (FMEA) – Fault tree analysis – Event tree analysis – Hazards control – Onsite – offsite emergency plans.

Module 6: Personal Protective Equipment and Case Studies (7 hours)

Introduction and importance of personal protective equipment – Indian standards – Selection factor of PPE – Respiratory and non-respiratory equipment – Safety in different industries / factories as case study.

Text Books:

1. Irving H. Shames, "Occupational Health and Safety Management: A Practical Approach", 3rd Edition, CRC Press, 2015
2. Foster J. and Barnetson B., "Health and Safety in Canadian Workplaces", Athabasca University Press, 2016.

Reference Books:

1. Kohn L. and Friend M.A., "Fundamentals of Occupational Safety and Health", Bernan Press; Sixth edition, 2014
2. Mishra R. K., "Occupational Health Management", Aitbs Publishers and Distributors, Delhi, 2015
3. Charles D. Reese, "Occupational Health and Safety Management: A Practical Approach", CRC Press, 2008
4. Sharon Clarke, "Occupational Health and Safety", CRC Press. 2016
5. Robert H. Friis, "Occupational Health and Safety for the 21st Century", Jones & Bartlett Publishers, 2014

19CE2017	ENVIRONMENTAL MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on systems approach to Environmental Management.
2. To acquire knowledge of Environmental System Management Implementation
3. To get practice in introducing Environmental Management Systems

Course Outcome:

Student will be able to

1. describe, develop and interpret methods of the Environmental Management Systems according to ISO 14001 standards.
2. critically evaluate methods and possibilities within Environmental Management Systems from a system perspective.
3. conduct Environmental Auditing for various Industries / Projects.
4. appreciate the elements of Corporate Environmental Management systems complying to international environmental management system standards
5. lead pollution prevention assessment team and implement waste minimization options
6. develop, Implement, maintain and Audit Environmental Management systems for Organisations

Module 1: Introduction to Environmental Management Systems (EMS) (7 hours)

Introduction to Environmental Management System: Definitions and terms - Environmental Management Systems Framework – approach to develop an Environmental Management System

Module 2: Introduction and Implementation of ISO 19011 (7 hours)

Environmental management system audits as per ISO 19011 - Roles and qualifications of auditors - Environmental performance indicators and their evaluation – waste audits and waste minimization planning.

Module 3: Introduction and Implementation of ISO 14001(7 hours)

Introduction and implementation of ISO 14001: environmental policy – planning - implementation and operation – checking - management review.

Module 4: Applications of EMS (8 hours)

Applications - EMS in terms of Process flow chart - effluent generation - composition and treatment of effluents from industries: sugar, pulp and paper, electroplating, dairy, oil refineries - cement industries, Ready mixed concrete plant, crushing industries

Module 5: Introduction to Environmental Auditing (7 hours)

Introduction to Environmental Auditing Category ‘A’ and ‘B’ types of projects - Procedures and Guidelines - Environmental Audit.

Module 6: Applications (9 hours)

Applications of EMS, Waste audits and pollution prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Tanning industry, Dairy, Cement, Chemical industries.

Text Books

1. Philip J. Stapleton “Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations”, United States Environmental Protection Agency, 2001
2. Paul L Bishop, “Pollution Prevention: Fundamentals and Practice”, McGraw- Hill International, Boston, 2000.

References:

1. Christopher Sheldon and Mark Yoxon, “Installing Environmental management Systems – a step by step guide” Earthscan Publications Ltd, London, 2012.
2. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004
3. ISO 19011: 2002, “Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002
4. Stephen Tinsley, Ilona Pillai, “Environmental Management Systems: Understanding Organizational Drivers and Barriers”, Taylor & Francis., 2012
5. Philipp Weiß, Jörg Bintlage “Environmental Management Systems and Certification”, Baltic University Press., 2006

19CE2018	GEOGRAPHICAL INFORMATION SYSTEM LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To introduce the fundamentals and components of Geographic Information System
2. To provide details of spatial data structures, input, management and output processes.
3. To enable the conduction of spatial analysis and preparation of output maps

Course Outcome:

Student will be able to

1. apply the techniques used for storage and management of spatial data
2. understand the geospatial basic concepts
3. edit the database and perform analysis

4. process the images and apply classification techniques to the satellite imageries
5. provide solutions through maps for specific problems
6. generate maps integrating BIM and ArcGIS maps

Experiments

1. Introduction to ArcGIS and Geo-spatial concepts (1 hour)
2. Spatial and Non-spatial data types (1 hour)
3. Map Projection and datum concepts (1 hour)
4. Creation of spatial database and editing (1 hour)
5. Working with the satellite data (2 hours)
6. Conversion and export of different maps to ArcGIS (1hour)
7. Spatial analysis with geo-processing tools (2hours)
8. Integration of field survey data in ArcGIS (2hour)
9. Integration of SAP and BIM with ArcGIS (1 hour)
10. Creating maps, Exporting and printing maps (3hour)

Text Books:

1. Anji Reddy, M. “Textbook of Remote Sensing and Geographical Information System” 2nd edition. BS Publications, Hyderabad, 2012.
2. Chandra A.M., “Geoinformatics”, New Academic Science, 2015.

Reference Books:

1. Lo Albert C.P. Yeung K.W. Concepts and Techniques of Geographic Information Systems, Prentice Hall of India Publishers, 2006
2. Peter A. Burrough, Rachael A. McDonnell, “Principles of GIS”, Oxford University Press, 2000
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, 2nd Edition, Pearson Education, 2007.

19CE2019	DRONE SURVEYING AND MAPPING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To understand the basics of drone technology with reference to land surveying
2. To provide training on collecting GPS waypoints along with flight planning
3. To provide exposure to collect data and to carry out the post processing of images/data

Course Outcome:

The Student will be able to

1. use drones for land surveying
2. decide the payloads according to the survey
3. plan the flight as per regulations
4. collect the data after deployment of the drone
5. integrate the survey data along with GIS and other softwares
6. conduct 3D modelling and generate surface maps/outputs/reports

Experiments

1. Introduction to land surveying and usage of drones (1 hour)
2. Types of drones, Payloads and multi-rotor components (1 hour)
3. Application of Drones in civil engineering (1 hour)
4. UAV regulations and flight planning (1 hour)
5. Drone deployment and capturing data (2 hours)
6. Flight simulation (2hours)
7. Field work for collecting waypoints, site observation, data collection (2 hours)
8. Integration of Drone data with GIS (1hour)
9. Digital surface modelling and Generation of contours (2 hours)
10. Generation of outputs and reports (2 hours)

Text Books:

1. George Dekoulis, "Drone Applications", Inteltech Open ltd., UK, June 2018
2. Reg Austin, "Unmanned Aircraft Systems", Wiley International ltd., 2010

References:

1. Syed Omar Faruk Towaha, "Building Smart Drones with ESP8266 and Arduino", Packt Publishing Ltd. 2018
2. Daniel R. Faust, "Civilian Drones", Rosen Publishing Group, Inc, 2016

19CE2020	CONSTRUCTION SAFETY	L	T	P	C
		3	0	0	3

Course Objective:

1. To establish and maintain a safety and health program for all workers
2. To improve safety and health for small contracts, the self-employed and all working on small projects
3. To participate in the program and provide input and report safety or health concerns.

Course Outcome:

Student will be able to

1. ensure the security of the workers and protect the firm against lawsuits and damages
2. develop the essential aspects of health and safety in construction
3. adopt the management tools for structural Safety, Environment and Occupational Health
4. interprets the local technical standards and regulations on labour risks prevention, environmental management applicable to construction works.
5. implement the safety and health issues in construction works and the typical hazards of the construction activity.
6. select the most effective personal and collective safety equipment, based on the risks in construction activities

Module 1: Accident Prevention (7 hours)

Safety during project execution - Training project staff and operation staff - stages of project construction - safety during receiving, unloading, shifting and storage - safety guidelines for storage – general safety facilities at construction sites - emergency rescue equipments - exhaust gases.

Module 2: Safety in Cutting and Brazing (7 hours)

Welding and cutting in tank vessels and drums - confined spaces - personal protection - health hazards - Safety in Concrete construction - formworks and shoring - bar bending schedules - concrete placement - general requirements for vertical and tubular welded frame shoring - safety in use of power tools.

Module 3: Formworks Safety (7 hours)

Assembling and dismantling and their safety – Scaffolding - types of scaffolding- design and inspection of scaffolding - scaffolding erection procedure - safety precaution while erecting scaffolding - dismantling of scaffolding.

Module 4: Safety in Handling Construction Machineries (8 hours)

Heavy/ Long Items - Earth Movers equipment's - Hazardous Materials - Material handling equipment's machineries for lead & lifting of the materials like Hoist - Tower crane - Bobcat Mobile tower crane - concrete pumps- Boring machineries.

Module 5: Statutory Obligations (8 hours)

Labour act – ESI, PF, law & regulations - Labour license -Fitness certificate – Minimum wages Act - Occupation certificate – FSI – General guidelines for building approvals

Module 6: Safety in Demolition Operations (8 hours)

Planning and Permit - Planning the sequence of demolition - Safety Precautions during demolition, carrying out repairs, additions and alterations – Case study.

Text Books:

1. Basudev Panda, “Industrial Safety, Health Environment and Security”, Laxmi Publications, 2012
2. Safety Management in the Construction Industry Publishers: A Guide Published by National Institute of Construction Year: 2005

References:

1. Allan St. John Holt, “Principles of Construction Safety”, John Wiley & Sons. 2001
2. John Schaufelberger and Ken-Yu Lin, “Construction Project Safety”, John Wiley & Sons, 2013
3. Bhattacharjee S. K “Safety Management in Construction (Principles and Practice)”, Khanna Publishers, 2008
4. Poonia M P, Sharma S C, “Industrial Safety and Maintenance Management”, Khanna Publishing, 2018.
5. Grundy. J, “Construction Technology”, Viva Books Pvt. Ltd. 2006

Course code	BUILDING SCIENCE AND ENGINEERING	L	T	P	C
20CE1001		3	0	0	3
Course Objective:					
1. To introduce the students to the fundamental principles of building physics 2. To understand the functional efficiency in the built environment. 3. To learn the practical applications in the design of built environment					
Course Outcome:					
At the end of the course students will be able to 1. Identify the climate responsive design of buildings 2. Illustrate the thermal comfort and energy efficiency requirements 3. Illustrate acoustics, in the design of buildings 4. Demonstrate the principles of noise control 5. Design for visual quality and day lighting 6. Appraise the design principles in real time environment					
Module: 1	Climatology	8 Hours			
Climate geographical and physical factors - Temperatures, Rainfall, Wind, Sky, ground, Vegetation - Micro climate and Macro climate – seasons - movement of buildings - sun protection devices					
Module: 2	Thermal comfort in buildings	8 Hours			
Low energy use and high thermal comfort in buildings- thermal performance targets - basics of heat transfer mechanisms, - thermal comfort parameters and regulations - performance of building envelope - thermal balance of buildings - basic thermal calculations and simulations - Active and passive technologies for thermal comfort.					
Module: 3	Energy efficiency in buildings	8 Hours			
Energy flow - natural energy gains - energy use – indicators - indoor comfort - technical and economic feasibility - cultural values - energy supply and environmental aspects - energy neutral and energy positive building.					
Module: 4	Building acoustics	7 Hours			
Fundamentals of building acoustics – room acoustics and reverberation - Sound Absorption- Quality indicators - Acoustic materials – Design principles of auditorium.					
Module: 5	Day Lighting	7 Hours			
Visual quality in built environment - Effective day lighting design - Integrated design approach- Static daylighting metrics -context of LEED -solar shading.					

Module: 6	Case studies	7 Hours
Building with thermal comfort - energy efficiency - auditorium for acoustic study - natural day lighting.		
Total Lectures		45 Hours
Text Books		
1.	Jens Pohl, “Building Science: Concepts and Application”, Wiley – Blackwell, 2011	
2.	Tor Erik Vigran, “Building Acoustics”, CRC Press, 2014	
Reference Books		
1.	Egan, M. D., & Olgyay, V. “Architectural lighting”, McGraw-Hill. 2002	
2.	Szokolay, S. V. “Introduction to architectural science: the basis of sustainable design”. Routledge. 2014	
3.	Marshall Long, “Architectural Acoustics”, Elsevier Science, 2005	
4.	Hugo Hens, Building Physics, Heat, Air and Moisture, Wiley Publishers, 2017	
5.	Anson M., Ko J.M., Lam E.S.S, “Advances in Building Technology”, 2002	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	ENGINEERING MECHANICS	L	T	P	C
20CE1002		3	0	0	3
Course Objective:					
1. To provide knowledge about statics with emphasis on force equilibrium and free body diagrams. 2. To understand the concept stresses and response of elements. 3. To understand the mechanical behaviour of materials under various load conditions.					
Course Outcome:					
At the end of the course students will be able to 1. Illustrate the concepts of mechanics 2. Identify the principles of dynamics 3. Examine the concepts of kinetics 4. Analyse the stresses in the members 5. Apply the equilibrium concepts in analysis of members 6. Apply the basic principles to solve problems in mechanics					
Module: 1	Introduction:				8 Hours
Centroid - centre of gravity - moment of inertia of plane sections - theorems of moment of inertia - composite sections - mass moment of inertia of circular plate, cylinder, cone, sphere, hook.					
Module: 2	Dynamics:				8 Hours
Particle dynamics- rectilinear motion - plane curvilinear motion - relative and constrained motion - newton’s second law: rectangular, path, and polar coordinates - work-kinetic energy, power and potential energy - impulse-momentum- impact - direct and oblique					
Module: 3	Kinetics of rigid bodies:				7 Hours
Principles in dynamics - types of motion - D’Alembert’s principle: plane motion and connected bodies - work energy principle: plane motion and connected bodies - kinetics of rigid body rotation					
Module: 4	Elasticity and Elastic Constants				8 Hours
Introduction – Stress and strain – Hooke’s law – Three types of Elasticity – Rigidity modulus – Young’s modulus – Bulk modulus – Relation connecting elastic constants – Poisson’s Ratio – Torsional pendulum					
Module: 5	Basic Structural Analysis:				7 Hours

Stability of equilibrium - equilibrium in three dimensions - method of sections - method of joints - simple trusses - beams - types of beams- member forces		
Module: 6	Simple stresses and strains:	7 Hours
St. Venant’s principle - types of stresses and strains, Hooke’s law – stress – strain diagram for mild steel – working stress – factor of safety – lateral strain, Poisson’s ratio and volumetric strain – relation between moduli – bars of varying section – composite bars– temperature stresses		
Total Lectures		45 Hours
Text Books		
1.	Irving H. Shames, “Engineering Mechanics”, 4th Edition, Prentice Hall, 2006	
2.	Beer F. P and Johnston E. R, “Vector Mechanics for Engineers”, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2011	
Reference Books		
1.	Egor, P.Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi, 2003	
2.	Hibbler R. C., “Engineering Mechanics: Principles of Statics and Dynamics”, Pearson Press. 2006	
3.	Andy Ruina and Rudra Pratap, “Introduction to Statics and Dynamics”, Oxford University Press, 2011	
4.	Shanes and Rao, “Engineering Mechanics”, Pearson Education, 2006	
5.	Bansal R.K, “A Text Book of Engineering Mechanics”, Laxmi Publications, 2010	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	GREEN DESIGN AND LIFE CYCLE ASSESSMENT	L	T	P	C
20CE1003		2	0	0	2
Course Objective:					
1. To understand the concepts of carbon emission by the construction industry 2. To learn the mitigation methods to reduce carbon footprint 3. To study the LCA and green design techniques					
Course Outcome:					
At the end of the course, student will be able to 1. Identify the carbon emission from the buildings 2. Illustrate the energy efficiency principles 3. Apply the energy analysis models 4. Analyze the sustainability of buildings 5. Apply the social and economic aspects in green buildings 6. Formulate techniques for green design in buildings					
Module: 1	Green Energy Concepts:	5 Hours			
Greenhouse gases – Global warming – climate change – global change – life cycle assessment – embedded carbon – other footprints - Energy consumption in different sectors - Carbon emission from energy use in buildings.					
Module: 2	Benefits of energy:	5 Hours			
Environmental benefits – economic benefits – corporate Image benefits – Personal and social benefits - Energy efficiency principles - building energy management systems - GHG mitigation in buildings.					
Module: 3	Green analysis:	5 Hours			

Standards – Product based standards – Activity based standards – Iterative carbon management steps – Carbon footprint analysis – rating systems - Green analysis - Low carbon refurbishment process - embodied energy considerations for existing buildings in different sectors		
Module: 4	Carbon Footprint Measurement:	5 Hours
Greenhouse gas emission measurement – business and financial measurement – customer and stakeholder satisfaction measurement – Energy analysis in construction		
Module: 5	Life Cycle Assessment (LCA) :	5 Hours
Life cycle inventory analysis - cost-benefits analysis - Economic input-output life cycle assessment - Social and economic aspects – sustainability assessment – Environmental Impact assessment		
Module: 6	Green Design Techniques:	5 Hours
Environmental impacts during construction - low carbon materials - green transport - case study - aspects of sustainability		
Total Lectures		30 Hours
Text Books		
1.	Matthew John Franchetti and Defne Apul , “Carbon Footprint Analysis: Concepts, Methods”, CRC Press, 2012	
2.	Giri N.K, “Alternate Energy (Sources, Applications and Technologies)”, Khanna Publishers, 2012	
Reference Books		
1.	Linda Reeder, “Guide to Green Building Rating Systems”, John Wiley & Sons, 2010	
2.	Olivier Jolliet, Myriam Saade-Sbeih, Shanna Shaked, “Environmental Life Cycle Assessment”, CRC Press, 2015	
3.	Francesco Pomponi, Catherine De Wolf, Alice Moncaster Embodied Carbon in Buildings”, Springer, 2018	
4.	Sunil Shah, “Sustainable Refurbishment”, Wiley – Blackwell, 2012	
5.	Xianguo Li , “Green Energy: Basic Concepts and Fundamentals” McGraw-Hill, 2011	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	SUSTAINABLE BUILDING MATERIALS	L	T	P	C
20CE1004		2	0	0	2
Course Objective:					
1. To understand the properties of building materials 2. To get a comprehensive overview of materials used for sustainable buildings. 3. To understand the effects of technology on materials and the way they are used with respect to sustainability					
Course Outcome:					
At the end of the course, student will be able to 1. Identify the sustainable building materials 2. Distinguish between conventional and modern construction materials 3. Define the concepts of embodied carbon or carbon footprint 4. Identify the different sustainable construction techniques 5. Analyze the usage of waste materials for construction 6. Analyze the use of smart materials					
Module: 1	Conventional Building Materials	5 Hours			

Rocks - Stones - characteristics of stones – material property – Bricks and blocks - Properties of clay bricks - material test – Timber - Cement - Concrete – Steel – Aluminium - Rubber - plastics – Glass - Foundations – plinth – sill – Lintels – Arches - stair cases - Flooring - Roofs and roof covering - Damp proofing – Termite proofing - Plastering and Pointing - Joinery - Painting		
Module: 2	Sustainable Building Materials	5 Hours
Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials, bio materials - Salvaged and recycled materials - Nontoxic materials: low VOC paints, coating and adhesives		
Module: 3	Sustainable Construction Techniques	5 Hours
Alternative construction techniques such as SMB, CSEB, and steam cured blocks, composite beam and panel, funicular shells, filler slabs, reinforced concrete masonry, vaulted roofs, ferro-cement walls etc., - Case studies		
Module: 4	Innovations in Construction Materials:	5 Hours
Geopolymer concrete – ICF materials - recycled materials – Nano materials in construction – 3D Printing materials		
Module: 5	Innovative use of Materials	5 Hours
Use of waste materials - paper, glass bottles, tires, shipping containers - use of post-consumer and industrial waste - fly-ash - building demolition waste – use of salvaged materials from flooring, columns, beams, timber, glass, etc		
Module: 6	Smart Materials:	5 Hours
Piezoelectric material – shape memory alloy – light emitting concrete – photochromotic materials - ER and MR rheological fluids - fiber optics - pollution absorbing bricks – smart concrete – bacterial concrete – biomimics – thermochromic materials		
Total Lectures		30 Hours
Text Books		
1.	Jamal Khatib, “Sustainability of Construction Materials”, Woodhead Publishing, 2016	
2.	Ross Spiegel.G, “Green Building Materials A Guide to Product Selection and Specification”, 3rd Edition, John Wiley & Sons, 2010	
Reference Books		
1.	Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004	
2.	Traci Rose Rider, Stacy Glass, Jessica McNaughton, “Understanding Green Building Materials”, W.W.Norton and Company, 2011	
3.	Johan van Lengen, “The Barefoot Architect: A Handbook for Green Building”, Shelter Publication, 2008	
4.	Fernando Pacheco-Torgal, Luisa F. Cabeza, Joao Labrincha, “Eco-efficient Construction and Building Materials”, Woodhead Publishing, 2014	
5.	Michelle Addington, Daniel Schodek, “Smart Materials and Technologies in Architecture” Architectural Press, 2012	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	APPLIED MECHANICS LABORATORY	L	T	P	C
20CE1005		0	0	2	1
Course Objective:					
1. To impart knowledge on the basics of the vector and scalar representation of forces and moments 2. To acquire knowledge on linear momentum, friction and rotation of particles 3. To impart knowledge on the concept of stress strain and elasticity					
Course Outcome:					
At the end of the course students will be able to 1. Demonstrate the ability to solve the problems based on modulus of elasticity 2. Demonstrate the ability to solve the moment of Inertia 3. Demonstrate the rigidity modulus 4. Determine the reactions of simply supported beam with various loads 5. Determine the reactions of simple truss 6. Solve the forces in truss elements					
List of Experiments					
1.	Young's Modulus – Uniform bending				
2.	Young's Modulus –Non-Uniform bending				
3.	Young's Modulus - Cantilever				
4.	Moment of Inertia of different bodies - Torsional pendulum				
5.	Rigidity Modulus – Torsional Pendulum				
6.	Reactions of a simply supported beam with point load				
7.	Reactions of a simply supported beam with udl				
8.	Reactions of a simply supported beam with uvl				
				Total Lectures	16 Hours
References:					
1.	Irving H. Shames, "Engineering Mechanics", 4th Edition, Prentice Hall, 2006				
2.	Beer F. P and Johnston E. R, "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2011				
Recommended by Board of Studies					
Approved by Academic Council		12 th September 2020			

Course code	DESIGN STUDIO - 2D DRAFTING	L	T	P	C
20CE1006		0	0	2	1
Course Objective:					
1. To adopt the principles of building planning bye laws in drawing 2. To draft the plan, elevation and section of various structures 3. To create the drawing using modern software					
Course Outcome:					
At the end of the course students will be able to 1. Understand the basic commands of the 2D drafting 2. Define the principles of civil engineering drawing and planning 3. Apply the building bye-laws for planning of buildings 4. Develop plan, elevation and section and site plan of various types of residential buildings 5. Develop plan, elevation and section and site plan of various types of Commercial buildings 6. Prepare the layout for the approval submission.					
List of Experiments					

1.	AutoCAD Commands
2.	Bye laws to be followed for planning of buildings
3.	Preparation of plan, elevation and section of residential buildings-single storey buildings (load bearing)
4.	Preparation of plan, elevation and section of residential buildings-one storey buildings(framed structure)
5.	Preparation of plan, elevation and section of residential buildings-two storey buildings (load bearing)
6.	Preparation of plan, elevation and section of residential buildings-single storey buildings (Framed structure)
7.	Preparation of plan, elevation and section of institutional buildings - school (framed structure)
8.	Preparation of plan, elevation and section of industrial buildings- workshop (steel structure)
9.	Preparation of plan, elevation and section of hospital building
10.	Preparation of plan, elevation and section of auditorium building
Total Lectures 16 Hours	
References:	
1.	Balagopal Prabhu, T. S., “Building Drawing and Detailing”, Spades Publishing, KDFA Building, Calicut, 2012
2.	AUTO CAD Tutorials and Manual- Autodesk Work Book on AUTO CAD Level I and II CAD/CAM centre, Coimbatore
Recommended by Board of Studies	
Approved by Academic Council	
12 th September 2020	

Course code	DESIGN STUDIO - 3D MODELLING	L	T	P	C
20CE1007		0	0	4	2
Course Objective:					
1. To understand the concepts of 3D modelling 2. To create various elements of building using 3D software 3. To create walkthrough and demonstrate the models					
Course Outcome:					
At the end of the course students will be able to 1. Use tools of the software to create models 2. Model the components of the buildings 3. Model the non-structural components in buildings 4. Apply the materials to the model. 5. Create schedules for the models 6. Create walkthrough of the models developed					
List of Experiments					
1.	a) Introduction to Revit Software & the workflow of BIM b) Starting up with Revit				
2.	a) Introduction to Walls b) Introduction to Floors				
3.	a) Introduction to Roofs b) Adding Structural Component				

4.	a) Modelling Staircase b) Creating Ramps & Railings
5.	a) Placing of Components b) Modelling Components In-Place
6.	a) Material Management b) Working with Sections
7.	a) Creating Ceilings b) Including Night lights in the project
8.	a) Modelling the Site b) Creating Schedules
9.	a) Working with Conceptual Mass: b) Rendering the Views
10.	a) Creating a Walkthrough video b) Documentation work
Total Lectures	
16 Hours	
References:	
1.	ASCENT, Autodesk Revit 2021 Structure Fundamentals, SDC Publications, 2020
2.	Elise Moss, Autodesk Revit 2021 Architecture Basics, SDC Publications, 2020
Recommended by Board of Studies	
Approved by Academic Council	
12 th September 2020	

Course code	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
20CE3001		3	0	2	4
Course Objective:					
1. To idealize, formulate, and analyze, determinate and indeterminate structures using matrix structural analysis methods. 2. To determine the force distribution and deformed shapes of structures. 3. To understand the stability concept of frames.					
Course Outcome:					
At the end of the course students will be able to 1. Identify the degrees of freedom and formulate flexibility and stiffness matrix 2. Analyze the truss using stiffness methods 3. Analyze the beams elements using appropriate methods 4. Analyze the elements using advanced methods 5. Evaluate the structural stability of frames 6. Analyze the elements using software tools					
Module: 1	Matrix methods	8 Hours			
Introduction- static indeterminacy and kinematic indeterminacy – degree of freedom – coordinate system – structure idealization stiffness and flexibility matrices – suitability element stiffness equations – elements flexibility equations – mixed force – displacement equations – for truss element, beam element and tensional element. Transformation of coordinates – element stiffness matrix – and load vector – local and global coordinates					
Module: 2	Stiffness Methods	7 Hours			

Assembly of stiffness matrix from element stiffness matrix – direct stiffness method – general procedure – band matrix – semi bandwidth – direct stiffness matrix method		
Module: 3	Analysis of Plane Truss	8 Hours
Plane Trusses - Coordinate Systems - Degrees of Freedom - Member Stiffness and Local Coordinates - Coordinate Transformations - Member Stiffness and Global Coordinates - Assembly of Structure Stiffness - Direct Stiffness and Code Number Methods - Analysis		
Module: 4	Analysis of Beams	8 Hours
Formation of the Global Analysis Equations for Beams - Member Stiffness: Local and Global Coordinates - Assembly of Structure Stiffness - Analysis Procedure		
Module: 5	Special analysis procedures:	7 Hours
Static condensation and sub structuring – initial and thermal stresses. Analysis of grid by matrix methods.		
Module: 6	Stability of Frames	7 Hours
Various Boundary Conditions – Differential equations – Slope Deflection method		
Total Lectures		45 Hours
List of Experiments (MATLAB)		
1.	B.M, Slope and deflections in beams – Simultaneous equations	
2.	Shear, Moment and deflection of beams - Trapezoidal and Simpson’s rule	
3.	Analysis of continuous beam -flexibility methods	
4.	Analysis of plane truss-stiffness methods	
5.	Analysis of space truss-stiffness methods	
6.	Analysis of grid by matrix methods	
	Total Practical hours	14 hours
Reference Books		
1.	Gianluca Ranzi, Raymond Ian Gilbert, “Structural Analysis: Principles, Methods and Modelling”, 2018	
2.	Manolis Papadrakakis, Evangelos Sapountzakis, “Matrix Methods for Advanced Structural Analysis”, Butterworth Heinemann, 2017	
3.	Devdas Menon, “Advanced Structural Analysis”, Alpha Science International, 2009	
4.	Srinivasan Chandrasekaran, “Advanced Structural Analysis with MATLAB®”, CRC Press, 2018	
5.	Igor A. Karnovsky, Olga Lebed, “Advanced Methods of Structural Analysis”, CRC Press, 2010	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	DESIGN OF CONCRETE STRUCTURAL SYSTEMS	L	T	P	C
20CE3002		3	0	4	5
Course Objective:					
1. To understand the behavior of reinforced concrete structures 2. To understand the design of various structural elements 3. To understand the failure of buildings in field and improvement procedures					
Course Outcome:					

At the end of the course students will be able to		
1. Identify the behavior of structural elements 2. Calculate the loads acting on a RC structure according to codal provisions. 3. Design the RC structures for its behavior. 4. Design and detail the structural drawings using IS codes. 5. Apply the structural systems based on the field requirement. 6. Apply suitable techniques for failure of structures		
Module: 1	Basic Design Concepts:	8 Hours
Limit state - serviceability – deflection and crack width - short term deflection – long term deflection - mechanism of flexural cracking - crack width: IS, BS and ACI Codes – Shrinkage and thermal cracking		
Module: 2	Frame Analysis and Design	7 Hours
Static and Dynamic loading on structures - Analysis and design of multistory RCC frame- Optimal design of structural elements		
Module: 3	Slabs:	8 Hours
Grid floor – Yield line theory- flat slabs – Post tensioned stress distribution – Design of PT slabs		
Module: 4	Inelastic Behaviour of Beams:	8 Hours
Inelastic behaviour –Moment curvature behavior - concept of plastic hinges – moment redistribution - Check on rotation capacity		
Module: 5	Special Structures:	9 Hours
Design of Bunkers – Design of Silo – Design of shear wall framed structure – Deep beams and corbels		
Module: 6	Field Practices:	6 Hours
Building failure - Structural Integrity - Design of Beam column joints - connections under special situations - Fire resistance of structural members – Quality control of concrete		
Total Lectures		45 Hours
List of Projects		
1.	Comparison of design of RCC roof and PT slab system	
2.	Design of RC Shear Walls subjected to Seismic forces	
3.	Influence of orientation of shear walls on structural behavior of RC buildings	
4.	Design of flat slab for a commercial building	
5.	Comparison of design of RCC roof and grid slab system	
6.	Design of a corbel for an industrial building	
Total Practical hours		30 hours
Reference Books		
1.	Bhavikatti S.S, “Advanced RCC Design”, New age International Pvt. Ltd. 2006	
2.	Subramanian. N., “Design of Reinforced Concrete Structures”, Oxford University Press, New Delhi. 2013	
3.	Krishna Raju, “Advanced Reinforced Concrete Design”, CBS Publishers and distributors, New Delhi, 2016	
4.	Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.	
5.	Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007	

Recommended by Board of Studies	
Approved by Academic Council	12 th September 2020

Course code	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	L	T	P	C
20CE3003		3	0	0	3
Course Objective:					
1. To understand the basic principles of free and forced vibration of SDoF and MDoF 2. To analyze the forces in the members as per IS 1893 and ductile detailing as per IS 13920 3. To understand the principles of vibration control methods and retrofitting techniques					
Course Outcome:					
At the end of the course students will be able to 1. Identify the elements of vibratory system and develop mathematical models 2. Determine the fundamental frequency and mode of vibration of structural elements 3. Estimate the response of structures subjected to dynamic forces 4. Apply theory of dynamics to structures subjected to seismic forces 5. Illustrate the codal provisions for seismic resistant design 6. Recommend suitable alternate techniques and retrofitting methods					
Module: 1	Principles of Dynamics	7 Hours			
Principles of vibration analysis: D'Alembert's principle - Hamilton's principle – principle of virtual work -idealization of a structure as SDOF system - Equation of motion - damped and undamped free vibrations - critical damping - logarithmic decrement - un-damped forced vibration. Response to support motion - response to harmonic excitation, response to arbitrary periodic loading- Duhamel's integral					
Module: 2	Free Vibration of MDOF System:	8 Hours			
MDOF system (Lumped mass): Mathematical model of MDOF system - free vibration of undamped MDOF systems - natural frequencies and mode shapes – orthogonality conditions - analysis for natural frequencies and mode shapes - solution of the Eigen value problems. Identification of natural frequency and Mode shape using accelerometers and shake table in laboratory					
Module: 3	Forced Vibration of MDOF System:	8 Hours			
Idealizations of multi-storeyed building frames for dynamic analysis - Shear buildings – stiffness, flexibility and mass matrices - Free and forced vibration with and without damping – solution by step by step direct integration - central difference method - Houbolt method - Wilson- θ -method - Newmark method. Mathematical model for continuous system					
Module: 4	Earthquakes and Ground Motion:	8 Hours			
Engineering seismology - seismic zoning of India- microzonation- peak horizontal acceleration (PHA) - response spectra - evaluation of earthquake forces as per codal provisions – static and dynamic methods- lessons learnt from past earthquakes					
Module: 5	Earthquake Resistant Design of Structures:	8 Hours			
Structural systems - building types - causes of damage - planning considerations - philosophy and principle of earthquake resistant design - guidelines for earthquake resistant design - earthquake resistant					

masonry buildings - design consideration - Earthquake resistant design of R.C.C. Buildings – ductile detailing of structures – rigid frames – shear walls		
Module: 6	Vibration Control Techniques:	6 Hours
Vibration control - principles and application - Case studies - methods of retrofitting		
Total Lectures		45 Hours
Reference Books		
1.	Anil K Chopra, “Dynamics of structures” Prentice-hall, 2015	
2.	Paz Mario, “Structural Dynamics - Theory and Computation”, CBS Publishers and Distributors Pvt. Ltd., 2012	
3.	Duggal,S.K. “Earthquake Resistant Design of Structures”, Oxford University Press, 2007	
4.	Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2009.	
5.	Paulay,T and Priestley, M.J.N., “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1992.	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	FINITE ELEMENT METHODS IN STRUCTURAL ENGINEERING	L	T	P	C
20CE3004		3	0	2	4
Course Objective:					
1. To understand the concept of finite element procedures 2. To understand the concepts of Shape function, Stiffness matrix and Load vector for one, two and three dimensional finite elements 3. To give an exposure to mesh generation techniques and working of commercial software.					
Course Outcome:					
At the end of the course students will be able to 1. Identify the principles for the development of finite element models 2. Develop shape function, strain displacement relation, stiffness matrix and consistent load vector matrix 3. Explain the finite element procedure for structural element 4. Analyze one, two and three dimensional problems 5. Choose appropriate finite element for analysis depending on the nature of problem 6. Develop finite element models using suitable software					
Module: 1	Introduction and Finite Element Formulation :	7 Hours			
Concept of Finite element –Introduction to elasticity-Strong and Weak Formulations -Variational Principles-Virtual work and Galerkin’s Weighted residual method - Finite element method : displacement approach					
Module: 2	Element Properties:	7 Hours			
Concept of Shape Function - Plane Stress and Plane strain, Natural coordinates, Triangular Elements, Rectangular elements - Langrange and Serendipity elements - Hermitian family-Solid elements - Isoparametric Formulation - Stiffness matrix of isoparametric formulation -Numerical Integration: Two and three dimensional					

Module: 3	Analysis of Structural Elements:	8 Hours
Global, Local and Natural coordinate systems- Consistent load vector -Stiffness of Truss member- Analysis of Truss-Stiffness of beam member-Finite element analysis of continuous beam-Plane Frame analysis-Analysis of Grid and Space frame		
Module: 4	Two and Three Dimensional Solids:	8 Hours
Constant Strain Triangle - Linear Strain Triangle - Rectangular elements - Numerical evaluation of element stiffness - Gaussian Quadrature - Weights and Gauss points - Selective and reduced integration- Axis symmetric element - Tetrahedron element family - Parallelepiped element - Hexahedron Element family - ZIB 8 and ZIB 20 elements.		
Module: 5	Analysis of Plates and Shells	7 Hours
Analysis of Plates: Introduction to Kirchhoff and Mindlin Plate theories- Triangular and rectangular Plate elements - BFS Element, Mindlin plate element; Analysis of Shells: Faceted element for shells - Semi-loof elements - Degenerated shell elements – 4 noded bilinear shell element-Axisymmetric shell elements – shear and membrane locking; Finite strip method: Development of stiffness matrix and consistent load vector		
Module: 6	Meshing and Applications of FEM	7 Hours
Auto and adaptive mesh generation-Mesh Refinement technique- P and H mesh refinement –Commercial Software-Modeling and analysis using Software- Finite element model Vibrational Buckling- Application to folded plates and bridge decks, Elastic stability-Dynamics-Fluid Mechanics		
Total Lectures		45 Hours
List of Experiments (ANSYS)		
1.	Analysis of an assembly of bar elements	
2.	Analysis of a plane truss	
3.	Analysis of a space truss	
4.	Analysis of a 2D frame	
5.	Analysis of a 3D frame	
6.	Analysis of a grid	
Total Practical hours		14 hours
Reference Books		
1.	Reddy, J.N., “ An Introduction to Finite Element Method”, McGraw-Hill International edition, 2008	
2.	Tirupathi, R.Chandrupatla and Ashok, D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India Private Limited.,New Delhi 2004	
3.	Bathe, K.J., “Finite Element Procedure”, Prentice Hall of India, New Delhi, 2014	
4.	Chandrakant, S.Desai and John, F.Abel, "Introduction to the Finite Element method, A numerical Method for Engineering. Analysis", CBS Publishers and Distributors Pvt. Ltd., New Deli, 2005	
5.	Cook R.D., “Concepts and Applications of Finite Element Method”, Wiley John & Sons, 2014	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	C
20CE3005		3	0	4	5

Course Objective:		
1. To understand the behavior of steel connections 2. To familiarize with the analysis and design of the industrial buildings 3. To evaluate the performance of light gauge steel structures		
Course Outcome:		
At the end of the course students will be able to 1. Identify appropriate structural steel section 2. Explain the behavior of different steel structural elements 3. Perform analysis of steel structures 4. Design the components of steel structural elements and connections 5. Appraise on the quality parameters for steel structures 6. Investigate the reasons for failure of a steel structure		
Module: 1	Structural Steel:	8 Hours
Properties of steel: Mechanical properties, Hysteresis, ductility – Hot rolled sections: compactness and non-compactness, slenderness, residual stresses - Moment rotation behaviour - Cross-section yielding and member instability - Durability - fire resistance and corrosion		
Module: 2	Design of Steel Elements:	7 Hours
Limit state method - Built-up section - members subjected to combined forces - Shear buckling strength - Post-critical method - Shear moment interaction — column base - Axial and moment resisting base plates - Lateral stability		
Module: 3	Design of Connections:	8 Hours
Types of connections – Design of Bolts and Welds - Strength under combined stresses - Prying action - simple and eccentric joints and frame connections - seated connections – moment resistant connections – clip angle connections - split beam connections – Standardization of connections		
Module: 4	Design of Industrial Buildings:	8 Hours
Types of roof system - loads (wind/seismic) - Metal walls: Design of girts, sag rods, and wind posts, crane load specifications, Euro code and AISC provisions - modeling concepts - sway and non-sway frames - analysis and design of roof truss - Minimum weight design for truss members – pre-engineered buildings – seismic design and detailing - purlins		
Module: 5	Seismic Design of Steel Structures	7 Hours
Seismic Analysis Procedures - Seismic loading Principles - Behaviour of steel components-Moment frame systems-Concentrically braced frames- Eccentrically braced frames		
Module: 6	Design of Cold formed Steel Structures:	7 Hours
Types - Effective area - Effective stress - behaviour of unstiffened and stiffened elements – design of beams – flexural members – lateral buckling of beams – Behaviour of compression elements - design of compression members – wall studs		
Total Lectures		45 Hours
List of Projects (Any two can be taken for each student. Each topic can be divided into 5 modules)		
1.	Design of a steel Industrial Building	
2.	Design of a Steel hanger building	
3.	Design of a Steel Space Structures	
4.	Design of a Steel parking Structure	
5.	Analysis and design of transmission tower	

6.	Analysis and design of steel chimney	
	Total Practical hours	30 hours
Reference Books		
1.	Jayagopal, L.S. and Tensing.D, “ Design of Steel structures”, Vikas Publishing, Chennai, 2015	
2.	Subramanian. N, “Design of Steel Structures”, Oxford University Press, 2008	
3.	Narayanan.R., “Teaching Resource on Structural steel Design”, INSDAG, Ministry of Steel Publishing, 2000	
4.	W.F. Chen, I. Sohal, ‘Plastic Design and Second-Order Analysis of Steel Frames’, Springer, 2013	
5.	Cheng Yu, “Recent Trends in Cold-Formed Steel Construction”, Woodhead Publishing, 2013	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	DESIGN OF SUBSTRUCTURES	L	T	P	C
20CE3006		3	0	0	3
Course Objective:					
1. To understand the principles of subsoil exploration 2. To understand the procedure for design of substructures 3. To familiarize in the evaluation of soil shear strength parameters.					
Course Outcome:					
At the end of the course students will be able to 1. Identify the methods of subsoil exploration 2. Evaluate the soil shear strength parameters. 3. Determine the load carrying capacity of different foundation types. 4. Analyze the concepts of settlement analysis. 5. Select appropriate foundations type based on available soil conditions. 6. Design suitable foundations based on the soil conditions					
Module: 1	Shallow Foundations:				8 Hours
Subsurface exploration: Planning- Drilling and sampling –In situ testing. Ultimate bearing capacity of strip foundations-Bearing capacity of rectangular and circular foundations in cohesive soils-Effect of Water Table on Bearing Capacity- Settlements of footings and rafts - proportioning of foundations using field test data					
Module: 2	Pile Foundations:				7 Hours
Classification of piles - General considerations of static analysis - Ultimate bearing capacity of single piles under axial load - Settlements of pile foundations – Group Effects – Under-reamed pile foundations - Design of pile caps – Negative skin friction					
Module: 3	Well Foundation:				8 Hours
IS and IRC code provisions - Elastic theory and ultimate resistance methods - design principles - well construction and sinking					
Module: 4	Special Foundations:				8 Hours
Foundation on expansive soils – choice of foundation – Raft foundation - Mat foundation-Combined piled and raft foundation - Design of cantilever and basement retaining walls					

Module: 5	Machine Foundations:	7 Hours
Introduction – types of machine foundation – basic principles of design of machine foundation – vibration analysis of machine foundation – design of foundation for Reciprocating machines and Impact machines – vibration isolation		
Module: 6	Tunnels, Open Cuts and Coffe-Dams:	7 Hours
Tunnels and arching in soils - pressure computations around tunnels - open cuts - sheeting and bracing systems in shallow and deep open cuts in different soil types - coffe dams: various types - analysis and design - foundations under uplifting loads		
Total Lectures		45 Hours
Reference Books		
1.	Swamy Saran, "Analysis and Design of substructures", Oxford and IBH Publishing Co. Pvt. Ltd., 2006	
2.	Varghese.P.C, “Design of Reinforced Concrete Foundations” –PHI learning private limited, New Delhi, 2009	
3.	Nainan P. Kurian, “Design of foundation system”, Narosa Publishing House, 2005	
4.	Kamesware Rao N. S. V, “Foundation Design: Theory and Practice”, Wiley, 2010	
5.	An-Bin Huang, Hai-Sui Yu, “Foundation Engineering Analysis and Design”, CRC press, 2018	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	STRUCTURAL ART: PRINCIPLES AND PRACTICE	L	T	P	C
20CE3007		3	0	0	3
Course Objective:					
1. To learn the principles and design of innovative structures 2. To model and analyse the structures using relevant software 3. To understand the implementation techniques					
Course Outcome:					
At the end of the course students will be able to 1. Identify the type of the shell to be employed for the structure 2. Develop equations and design different type of shells 3. Model shells using software knowledge 4. Analyse the shells to determine the resultant stresses 5. Determine the effective techniques for construction 6. Design innovative structures to suite the modern day construction					
Module: 1	INTRODUCTION	7 Hours			
Need for the study, History of architecture in India, Design principles for unique system- form, functions and structure					
Module: 2	TYPES OF SHELLS	8 Hours			
Types of shells- Shells of revolution and shells of translation- Techniques of shell construction- cast-in-situ, pre-stressed, precast, Formwork/Shuttering, effective thickness, reinforcement, durability aspects.					
Module: 3	DESIGN OF SHELLS OF DOUBLE CURVATURE	8 Hours			

Membrane theory of doubly curved shells- Design of Spherical dome, Parabolic dome and Conical roof- Deriving the equations and transferring into structural models		
Module: 4	DESIGN OF CYLINDRICAL & NORTH LIGHT SHELLS:	8 Hours
Design of R.C. cylindrical shell with edge beams-theory for long shells – Beam theory-Arch theory - Design of shells with ASCE manual –Design of North Light Shell		
Module: 5	CREEP IN SHELLS	7 Hours
Creep- Creep buckling and stability analysis- Case study on failure of shells under creep		
Module: 6	CONSTRUCTION OF SHELLS	7 Hours
Intrications in the design of shells and plate structures- Construction methods and techniques - Case Study Buildings: Felix Candela, Sundaram Architects etc		
Total Lectures		45 Hours
Reference Books		
1.	Ramaswamy G S., “Design Construction, Concrete Shell Roofs”, CBS Publishers, 2005.	
2.	Subramanian Narayanan “Space Structures: Principles and Practice”, Multi-Science Publishing, 2006	
3.	Billington, D. “Thin Shell Concrete Structures”, Mc-Graw Hill Book Co., New York, 2000.	
4.	Varghese.P.C., “Design of Reinforced Concrete Shells and Folded Plates”, PHI Learning Pvt. Ltd., 2010.	
5.	Ramasamy.G.S, Mick Eekhout, Suresh.G.R, “ Analysis, Design and Construction of Steel space Frames”, Thomas Telford 2002	
6.	ASCE Manual No.31, Design of Cylindrical Shells.	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	THEORY AND APPLICATIONS OF CEMENT COMPOSITES	L	T	P	C
20CE3008		3	0	0	3
Course Objective:					
1. To impart knowledge on various type of Composite materials 2. To understand the mechanical behavior of cement composites 3. To develop new cement composites					
Course Outcome:					
At the end of the course, students will be able to 1. Classify the materials as per orthotropic and anisotropic behaviour 2. Formulate constitutive behaviour of composite materials 3. Estimate strain constants using theories applicable to composite materials 4. Compare the mechanical behavior based on the approaches to stiffness. 5. Adopt nanomaterials in cement composites 6. Develop the new cement composites.					
Module: 1	CEMENT COMPOSITES:	8 Hours			
Cement composites types – terminology - constituent materials - their properties - Fiber-reinforced cementitious composites – high-strength cementitious composites - ferrocement - SIFCON – polymers in concretes - preparation of reinforcement - casting and curing - shrinkage-compensating concrete - engineered cementitious composites					

Module: 2	CHARACTERISTICS OF CEMENT COMPOSITE	7 Hours
Classification - characteristics of composite materials - basic terminology - advantages – pore size distribution - orthotropic and anisotropic materials - engineering constants for orthotropic materials - restrictions on elastic constants		
Module: 3	MECHANICAL PROPERTIES OF CEMENT COMPOSITES	8 Hours
Behavior of ferrocement - fiber reinforced concrete: tension, compression, flexure, shear, fatigue and impact - durability - corrosion mechanism – corrosion test		
Module: 4	BEHAVIOUR OF COMPOSITE MATERIAL	8 Hours
Mechanics of materials approach to stiffness – determination of relations between elastic constants - Elasticity approach to stiffness – bounding techniques of elasticity – exact solutions - Elasticity solutions with contiguity – Halpin – Tsai equations – comparison of approaches to stiffness.		
Module: 5	NANO MATERIALS IN CEMENT COMPOSITES	7 Hours
Nano materials in cement – dispersion – microstructure – characteristics of Nanoparticles in cement - Potential of Carbon Nanotube – Graphene oxide - recycled cellulosic waste		
Module: 6	APPLICATION OF CEMENT COMPOSITES	7 Hours
Fiber reinforced concrete and ferrocement: Housing, water storage, boats - miscellaneous structures - case studies – learning from failures		
Total Lectures		45 Hours
Reference Books		
1.	Ronald F. Gibson “Principles of Composite Material Mechanics”, 3rd Edition CRC Press, 2011	
2.	Andrzej M. Brandt, “Cement-Based Composites: Materials, Mechanical Properties and Performance”, Routledge, 2009	
3.	Isaac M. Daniel and OriIshai - Engineering Mechanics of Composite Materials, Oxford University Press, Second Edition, New Delhi, 2007	
4.	Chris L Page, M M Page “Durability of Concrete and Cement Composites”, Woodhead Publishing, 2007	
5.	Antoine E. Naaman, “Ferrocement and Laminated Cementitious Composites” Techno Press, 2000	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	DESIGN OF INDUSTRIAL STRUCTURES	L	T	P	C
20CE3009		3	0	0	3
Course Objective:					
1. To impart knowledge on the requirements and functional planning of industrial structures 2. To give exposure on analysis of the industrial structures 3. To train in the design of towers and chimneys					
Course Outcome:					
At the end of the course students will be able to 1. Identify the suitable industrial roofing system 2. Explain the requirements of industrial building 3. Analyse transmission towers with required foundations					

4. Design various components of industrial buildings		
5. Discuss the behaviour of machine foundation		
6. Plan industrial structures for functional requirements		
Module: 1	PLANNING AND FUNCTIONAL REQUIREMENTS	7 Hours
Classification of industries and industrial structures - planning for layout requirements regarding lighting, ventilation and fire safety - Protection against noise and vibration - guidelines of factories act.		
Module: 2	PORTAL FRAMES	8 Hours
Design of portal frame with hinge base - design of portal frame with fixed base - gable structures - IS 1893 Part IV provisions - Special design considerations - Vibrations and noise - Details of slabs on grade		
Module: 3	INDUSTRIAL BUILDINGS	8 Hours
Steel and RCC - Gantry girder - crane girders - design of Corbels and nibs – mezzanine floor - crack control, joints, form deck, permanent forms, openings, Mass concrete - Erection and handling stress		
Module: 4	POWER PLANT STRUCTURES	8 Hours
Types of Power plants – containment structures - cooling towers - bunkers and silos - pipe supporting structures		
Module: 5	TRANSMISSION LINE STRUCTURES AND CHIMNEYS	7 Hours
Analysis and design of transmission line towers - sag and tension calculations - testing of towers – design of self-supporting chimney - design of chimney bases.		
Module: 6	FOUNDATION	7 Hours
Design of foundation for Towers, chimneys and cooling towers - machine foundation - design of turbo generator foundation		
Total Lectures		45 Hours
Reference Books		
1.	Jurgen Axel Adam, Katharina Hausmann, Frank Juttner, Klaus Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers, 2014.	
2.	Manohar S.N., “Tall Chimneys - Design and Construction”, Tata McGraw Hill, 2014	
3.	Santhakumar A.R. and Murthy S.S., “Transmission Line Structures”, Tata McGraw Hill, 2017.	
4.	K.G. Bhatia , “Foundations for Industrial Machines: Handbook for Practising Engineers”, Taylor and Francis, 2009	
5.	Julian Weyer, Sergio Baragaño, “Industrial Building Planning and Design”, Design Media Publishing Limited, 2014	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	STRUCTURAL OPTIMIZATION	L	T	P	C
20CE3010		3	0	0	3
Course Objective:					
1. To understand the fundamental of optimization technique 2. To differentiate various optimization algorithm 3. To apply the optimization methods to decision making problems					

Course Outcome:		
At the end of the course, students will be able to		
1. Identify different optimization Techniques 2. Use appropriate method for a particular problem 3. Formulate objective function and constraints 4. Apply to real time construction management problems 5. Solve the problems using optimization Techniques 6. Compute the optimization techniques to structural design		
Module: 1	INTRODUCTION	8 Hours
Definition - Variables - Objective Function - Constraints - Design space - Feasible and infeasible - Convex and Concave - Local and global optima - Formulation of structural optimization problems		
Module: 2	LINEAR PROGRAMMING	7 Hours
Formulation of Linear optimization models, Civil engineering applications. Simplex method, special cases in simplex method, Method of Big M, Two phase method, duality, sensitivity analysis.		
Module: 3	DYNAMIC AND NON LINEAR PROGRAMMING	8 Hours
Dynamic programming: Multi stage decision processes, Principle of optimality, Recursive equation, Application of D.P. Non-Linear programming: Single variable unconstrained optimization –Local & Global optima, Uni-modal Function- Sequential Search Techniques: Dichotomous, Fibonacci, Golden Section methods.		
Module: 4	GEOMETRIC AND DYNAMIC PROGRAMMING PROBLEMS:	8 Hours
Polynomials - degree of difficulty - reducing G.P.P to a set of simultaneous equation-Unconstrained and constraint problems with zero difficulty - concept of solving problems with one degree of difficulty - Bellman's principle of optimality - representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods-Design of Truss members for minimum weight		
Module: 5	MULTIVARIABLE OPTIMIZATION	7 Hours
Multivariable optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method. Multivariable optimization with equality constraints-Lagrange Multiplier Technique.		
Module: 6	APPLICATION	7 Hours
Methods for optimal design of structural elements, continuous beams - single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multi-storey buildings, water tanks and bridges. Structural optimization for transient (dynamic) problems.		
Total Lectures		45 Hours
Reference Books		
1.	Rao S.S. "Engineering Optimization Theory & Practice", Wiely, 2009	
2.	J.K.Sharma "Operations Research (3 Edition) : Theory And Applications", 3 rd Edition, Macmillan India Limited, 2006	
3.	Hamdy A.Taha, "Operations Research", Pearson Education Limited, 2017	
4.	Ravindran, K. M. Ragsdel, G. V. Reklaitis, "Engineering Optimization: Methods and Applications", Wiely, 2006	

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Approved by Academic Council	12 th September 2020

Course code	STRUCTURAL HEALTH MONITORING	L	T	P	C
20CE3011		3	0	0	3
Course Objective:					
1. To impart knowledge on distress diagnosis 2. To understand various methods of health monitoring 3. To apply various methods for repair and rehabilitation					
Course Outcome:					
At the end of the course students will be able to 1. Understand the concepts of Structural health 2. Diagnosis the distress in the structure understanding the causes and factors. 3. Assess the health of structure using static field methods. 4. Assess the health of structure using dynamic field tests. 5. Apply techniques of Remote monitoring using IoT 6. Suggest repairs and rehabilitation measures of the structure					
Module: 1	STRUCTURAL HEALTH	7 Hours			
Factors affecting Health of Structures, Causes of Distress, Regular Maintenance					
Module: 2	STRUCTURAL HEALTH MONITORING:	8 Hours			
Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.					
Module: 3	STATIC FIELD TESTING	8 Hours			
Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement					
Module: 4	DYNAMIC FIELD TESTING	8 Hours			
Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems,					
Module: 5	REMOTE STRUCTURAL HEALTH MONITORING	7 Hours			
Importance and Advantages – Methodology – IoT applications in SHM – Application Machine learning Techniques in SHM					
Module: 6	REPAIRS AND REHABILITATIONS OF STRUCTURES	7 Hours			
Local and Global retrofitting techniques- Case Studies .					
Total Lectures					45 Hours
Reference Books					
1.	Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, “Structural Health Monitoring”, John Wiley and Sons ltd., 2006				
2.	Douglas E Adams “Health Monitoring of Structural Materials and Components_Methods with Applications”, John Wiley and Sons, 2007.				
3.	J. P. Ou, H. Li and Z. D. Duan, “Structural Health Monitoring and Intelligent Infrastructure”, Voll, , Taylor and Francis Group, London, UK, 2006				

4.	Victor Giurgutiu, “ Structural Health Monitoring with Wafer Active Sensors”, Academic Press Inc,2007
Recommended by Board of Studies	
Approved by Academic Council	
12 th September 2020	

Course code	DESIGN OF HIGH RISE STRUCTURES	L	T	P	C
20CE3012		3	0	0	3
Course Objective:					
1. To understand the behaviour of tall buildings 2. To carry out analysis of the resultant forces in various structural forms 3. To understand the stability behavior of tall buildings					
Course Outcome:					
At the end of the course students will be able to 1. Identify the loads on tall buildings 2. Illustrate the behaviour of various structural forms 3. Adopt suitable techniques for analysis 4. Analyse the forces in the structures 5. Assess the long term effects in tall buildings 6. Assess the model for Analysis					
Module: 1	EVOLUTION OF TALL BUILDINGS	7 Hours			
Introduction - Design criteria for structural design of Tall building - Concept of premium for height - Development of high rise architecture					
Module: 2	REQUIREMENTS AND SITE INVESTIGATION	8 Hours			
Building performance –cost, quality and time - Environmental requirements - Introduction to safety and Health Management System - Stages of site Investigation - Site Reconnaissance & Ground investigation - Field tests & Laboratory tests - foundation systems					
Module: 3	MATERIAL HANDLING AND MECHANIZATION	8 Hours			
Material handling considerations - Earthmoving equipment’s - Horizontal and vertical movements - Selection & Utility of Cranes (Tower Cranes & Climbing Cranes) – Industrialization - Robotics in Construction					
Module: 4	WIND & SEISMIC EFFECTS ON BEHAVIOR OF TALL STRUCTURES	8 Hours			
Outlook of Design considerations and Characteristics of wind, Codal wind loads and cladding pressures on behavior of tall buildings - Tall building behavior - seismic design philosophy - Second order effects					
Module: 5	STRUCTURAL FORMS & FLOORING SYSTEMS	7 Hours			
Introduction of Various structural forms and their importance to high rise architecture - Introduction to various Flooring Systems in concrete & steel structures.					
Module: 6	MODELING FOR ANALYSIS	7 Hours			
Approaches for analysis - Assumptions involved in modeling - Reduction techniques..					

Total Lectures		45 Hours
Reference Books		
1.	Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.	
2.	Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 2012	
3.	Mehmet Halis Günel, Hüseyin Emre Ilgin, “Tall Buildings: Structural Systems and Aerodynamic Form” Taylor and Francis 2014	
4.	Beedle, L.S.; Ali, M.M.; Armstrong, P.J. “The Skyscraper and the City: Design, Technology, and Innovation”; The Edwin Mellen Press: Lewiston, NY, USA, 2007	
5	Lynn S. Beedle. “Second Century of the Skyscraper” Springer US 2012	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	DESIGN OF FORMWORK	L	T	P	C
20CE3013		3	0	0	3
Course Objective:					
1. To understand the requirements for design of formwork 2. To compare and select the type of formwork materials 3. To analyse and design various types of formwork					
Course Outcome:					
At the end of the course students will be able to 1. Analyse the requirements for design of formwork 2. Select proper formwork, accessories and material. 3. Evaluate the strength of form work of RC elements. 4. Design the form work for Special Structures. 5. Understand the working of flying formwork. 6. Investigate the formwork failures through case studies					
Module: 1	INTRODUCTION	7 Hours			
Requirements - selection of formwork – need for formwork - temporary structure – formwork types					
Module: 2	FORMWORK MATERIALS	7 Hours			
Timber, plywood, steel, aluminium, plastic and accessories. Horizontal and vertical formwork supports - loads and pressure on formwork - Vertical load - Lateral pressure - load test					
Module: 3	FORMWORK DESIGN	8 Hours			
Concepts - Factors affecting the design strength of formwork- Safety factor - formwork systems and design for foundations, walls, columns, slab and beams - Struts and ties - bracing					
Module: 4	FORMWORK DESIGN FOR SPECIAL STRUCTURES	8 Hours			
Special structures: shells, domes, folded plates, overhead water tanks, natural draft cooling tower, bridges.					
Module: 5	FLYING FORMWORK	8 Hours			
Table form, tunnel form, slip form - formwork for precast concrete - formwork management issues –pre-and post-cure.					

Module: 6	CASE STUDIES	8 Hours
Formwork failures: causes and case studies in formwork - failure formwork issues in multi-storey building construction		
Total Lectures		45 Hours
Reference Books		
1.	Peurify , “Formwork for Concrete Structures,” , Mc Graw Hill India, 2015.	
2.	Kumar Neeraj Jha , “Formwork for Concrete Structures” , , Tata McGraw Hill Education, 2012	
3.	Christopher Souder, “Temporary Structure Design”, John Wiley and Sons, 2014	
4.	Garold (Gary) D. Oberlender, Robert L. “Peurifo Formwork for Concrete Structures” McGraw Hill Professional, 2010	
5	IS 14687: 1999, “False work for Concrete Structures – Guidelines”, BIS	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	RISK ASSESSMENT AND PROBABILISTIC ANALYSIS	L	T	P	C
20CE3014		3	0	0	3
Course Objective:					
1. To understand the basic concepts of risk analysis and the relationship between probability theory and modeling, risk analysis, and decision analysis					
2. To understand probabilistic modeling, in the evaluation of risk					
3. To learn the interpretation of the basic tools of risk analysis					
Course Outcome:					
At the end of the course students will be able to					
1. Identify the uncertainty in structural systems					
2. Extend reliability analysis concepts from structural elements to structural systems					
3. Interpret the tools of risk analysis.					
4. Use appropriate tools for decision making					
5. Estimate the cost-benefit analysis					
6. Application in real time problems					
Module: 1	INTRODUCTION TO STRUCTURAL SAFETY AND RELIABILITY				8 Hours
Concept of uncertainty in reliability based analysis and design - Random variables- Concept and definition, Probability axioms and probability functions - Conditional probability - Common probability density and distribution functions and its descriptors - Correlation between random variables.					
Module: 2	JOINT PROBABILITY DISTRIBUTIONS				7 Hours
Functions of random variables -Expectation and moments of functions of random variables - Concept of failure of a structure - Reduced variable space					
Module: 3	RELIABILITY INDEX				8 Hours
Basic definition of reliability index - First order second moment index - Hasofer-Lind reliability index - Rackwitz - Fiessler reliability index - Second order reliability method.					
Module: 4	SYSTEM RELIABILITY				8 Hours
Simulation techniques in reliability estimation - Importance sampling / Variation reduction techniques - Time variant reliability					

Module: 5	PROBABILISTIC RISK ASSESSMENT AND DECISION ANALYSIS	8 Hours
Probabilistic risk assessment - risk management - Multistage decision model - value of perfect information - Axioms of rationale behavior - introduction to utility, risk aversion - multivariable utility theory - decision analysis - risk management		
Module: 6	COST-BENEFIT ANALYSIS (CBA)	7 Hours
Background and fundamental premises - time value of money - basis for comparison of alternatives - including uncertainty - evaluating public activities - Case studies		
Total Lectures		45 Hours
Reference Books		
1.	Thuesen, G. J., and Fabrycky, W. J. “Engineering Economy”. 9th ed. Englewood Cliff, NJ: Prentice-Hall, Inc., 2000.	
2.	Alfredo H-S. Ang, Wilson H. Tang, “Probability Concepts in Engineering”, Wiley 2007	
3.	William DeCoursey, “Statistics and Probability for Engineering Applications” Elsevier Science, 2003	
4.	Terrance Reilly, Clemen, Robert T. “ <i>Making Hard Decisions</i> ”. South-Western College Publishing, 2013	
5	Lee Ostrom, Cheryl Wilhelmsen, “Risk Assessment: Tools, Techniques, and Their Applications”, John Wiley & Sons, Inc. July 2019	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	BRIDGE ENGINEERING	L	T	P	C
20CE3015		3	0	0	3
Course Objective:					
1. To impart knowledge of the loading standards of IRC 2. To familiarize the design principles of bridges 3. To analysis understand the analysis and design of different types of bridges.					
Course Outcome:					
At the end of the course students will be able to 1. Classify bridges according to loading and site conditions 2. Explain the behavior of different types of bridges 3. Analyze different types of bridges 4. Design the different components of bridges 5. Appraise on the quality investigation of bridge structures 6. Investigate the reasons for the failure of bridge structures					
Module: 1	SHORT SPAN RC BRIDGES:	8 Hours			
Types of bridges and loading standards - IRC: 112, IRC: 6, Special vehicle loading and Fatigue load for bridge design - choice of type - I.R.C. specifications for road bridges – design of RCC solid slab bridges - analysis and design of slab culverts, Tee beam and slab bridges.					
Module: 2	LONG SPAN RC BRIDGES	7 Hours			
Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – arch bridges – box culverts - cable stayed and suspension bridges.					

Module: 3	PRESTRESSED CONCRETE BRIDGES	8 Hours
Flexural and torsional parameters – Courbon’s theory – design of girder section – maximum and minimum prestressing forces – eccentricity – live load and dead load shear forces – cable zone in girder – check for stresses at various sections – check for diagonal tension – diaphragms – End block		
Module: 4	STEEL BRIDGES	8 Hours
General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – vertical and horizontal stiffeners.		
Module: 5	BEARINGS AND SUBSTRUCTURES	7 Hours
Different types of bearings – design of bearings – design of piers and abutments of different types – types of bridge foundations – design of foundations.		
Module: 6	CASE STUDIES	7 Hours
IS 1893 PIII provisions - special design considerations - composite bridges - health monitoring techniques - application of sensor - case studies- learning from failures		
Total Lectures		45 Hours
Reference Books		
1.	Jagadeesh.T.R. and Jayaram. M.A., “Design of Bridge Structures”, Prentice Hall of India Pvt. Ltd. 2014.	
2.	Johnson Victor, D. “Essentials of Bridge Engineering”, Oxford and IBH Publishing Co. New Delhi, 2001.	
3.	Krishna raju N, “Design of Bridges”, Oxford and IBH Publishing, New Delhi, 2010	
4.	Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, New Delhi, 2008.	
5.	IRC 6:2016, Standard Specifications and Code of Practice for Road Bridges, Indian Road Congress	
6.	IRC 112: 2014, Code of Practice for Concrete Road Bridges, Indian Road Congress	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	CONDITIONAL ASSESSMENT OF EXISTING STRUCTURES	L	T	P	C
20CE3016		3	0	0	3
Course Objective:					
1. To understand the various assessment procedures 2. To impart knowledge on evaluation of structural materials and systems 3. To classify the use destructive and non destructive techniques					
Course Outcome:					
At the end of the course students will be able to 1. Understand the procedure for identifying the structure exposed to aggressive environment. 2. Apply the guidelines for structural condition assessment of existing buildings 3. Identify techniques for evaluating concrete masonry and wood 4. Select the destructive and non destructive techniques to suite the projects 5. Interpret and use destructive and nondestructive test results 6. Evaluate and report the conditional assessment of existing structure					
Module: 1	INTRODUCTION AND PRELIMINARY METHODS	7 Hours			

Objectives- causes of building distress-purpose of report - authorization-need for analysis- steps in conditional assessment-preliminary evaluation methods - Onsite investigation and off site investigation-Rapid(visual) investigation - Details of visual investigation - Performing structural condition assessment - study of document and other evidence - preliminary numerical analysis-reporting-decision on immediate action - Recommendation of detailed assessment		
Module: 2	ASSESSMENT PROCEDURE & NON-DESTRUCTIVE TECHNIQUES	8 Hours
Detailed assessment- mandated or damage or deterioration-professional competence-professional responsibility and liability-professional requirement - detail documentation search and review-building examination-forms and check list- Role of Non-Destructive Techniques in Condition Assessment - Non-destructive testing: Rebound Hammer, Ultrasonic Pulse Velocity Tests test in condition assessment – Corrosion- Carbonation - Destructive Vs Non-destructive-guidelines-structural systems – concrete wood-masonry and Metals		
Module: 3	STRUCTURAL MATERIALS ASSESSMENT	8 Hours
Collection of existing data: design/construction Phase - repair interventions-inspections-Analyzing existing data-data quality assessment-Probability of Detection (PoD)-Planning evaluation techniques- Inspection Procedure-condition survey: concrete, masonry, wood and metal structures- survey inspection checklist- Design materials evaluation program- Selection of destructive and nondestructive testing-identify the limitations of NDT techniques - interpreting tests results -Diagnose problems- assess strengths and weaknesses of structural materials		
Module: 4	EVALUATION OF STRUCTURAL MATERIALS AND SYSTEMS	8 Hours
Project-Planning group-Identifying hazard- proactive strategies –reactive strategies- economic considerations-deterioration modeling-mechanisms planning the evaluation-statistical procedures-destructive and nondestructive test on concrete-evaluate cracks in concrete and masonry- analyze wet masonry walls – evaluate Heritage structures - evaluating corrosion -interpret test results - develop inspection checklist - condition assessment projects - evaluating test data- Assessing damage - suitability for future use-recommendation-implement action		
Module: 5	REPORT OF STRUCTURAL CONDITION ASSESSMENT	7 Hours
Quality Assurance report - existing conditions - summary- list of components reviewed -observations and findings - structural integrity- structural capacity checks - interpretations and findings - photographic documentation - rehabilitation recommendations - field measurements.		
Module: 6	CASE STUDIES	7 Hours
Structural systems: columns damaged condition - columns damaged condition & seepage through basement – kitchen -wash area floor condition (first floor) - walls dampness & chajja condition (ground floor)- spalling of concrete in columns- spalling of concrete in beams- chajjas/ fins damaged Condition- Chajjas/ Parapet and Columns Damaged Condition-HVAC-Pumping-Electrical systems-Parking structures-Chimneys-Bridges		
Total Lectures		45 Hours
Reference Books		
1.	Cairns, J., Gehlen, C., Andrade, C., Bartholomew, M., Gulikers, J., Leon, F. J., Matthews, S., McKenna, P., Osterminski, K., Paeglitis, A., & Straub, D. "Condition Control and Assessment of Reinforced Concrete Structures Exposed to Corrosive Environments". (fib Bulletin; Vol. 59). International Federation for Structural Concrete (fib), 2011)	
2.	Guideline for Structural Condition Assessment of Existing Buildings SEI/ASCE11-99	

3.	Robert T. Ratay, “Structural Condition Assessment” Wiley, 2005
4.	R. Dodge Woodson, “Concrete structures, protection repair and rehabilitation,” Butterworth-Heinemann, 2009
5.	Mark G. Alexander, Hans-Dieter Beushausen, Frank Dehn, “Concrete Repair, Rehabilitation and Retrofitting”, CRC Press, 2008
Recommended by Board of Studies	
Approved by Academic Council	
12 th September 2020	

Course code	FRACTURE MECHANICS OF CONCRETE STRUCTURES	L	T	P	C
20CE3017		3	0	0	3
Course Objective:					
1. To understand of the types of cracks 2. To impart knowledge on crack models 3. To apply damage mechanics for concrete					
Course Outcome:					
At the end of the course students will be able to 1. Classify the various types of cracks 2. Comprehend the fundamentals of fracture mechanics 3. Identify the cracking of concrete structures based on fracture mechanics. 4. Implement stress intensity factor for notched members 5. Apply fracture mechanics models to high strength concrete and FRC structures. 6. Ascertain the associated and non-associated flow cracks					
Module: 1	BASICS OF FRACTURE MECHANICS:	7 Hours			
Fundamentals of fracture mechanics – types of cracks – stress intensity factor - Crack in a structure - Mechanisms of fracture - crack growth					
Module: 2	STRUCTURAL CRACKS:	7 Hours			
Crack in a structure - mechanisms of fracture in structural concrete - crack growth - cleavage fracture - ductile fracture - fatigue cracking - environment assisted cracking - service failure analysis					
Module: 3	STRESS AT CRACK TIP:	8 Hours			
Stress at crack tip - linear elastic fracture mechanics, Griffith’s criteria - stress intensity factors - crack tip plastic zone - Erwin’s plastic zone correction - R curves – compliance - concept of CTOD and CMD					
Module: 4	MATERIAL MODELS:	8 Hours			
General concepts – Material models - crack models - band models - models based on continuum damage mechanics - modeling of quasi brittle materials					
Module: 5	APPLICATIONS:	8 Hours			
Applications to high strength concrete - fibre reinforced concrete - crack concepts – numerical modeling					
Module: 6	NONLINEAR FRACTURE MECHANICS:	7 Hours			
Discrete crack concept - Smeared crack concept - Size effect - Plasticity models for concrete – Associated and non-associated flow - Failure surfaces for quasibrittle materials - Crack tip element - finite element model for crack tip					

		Total Lectures	45 Hours
Reference Books			
1.	Suri C. T. and Jin Z.H., “Fracture Mechanics”, 1 st Edition, Elsevier Academic Press, 2012.		
2.	Alberto Carpinteri, “Applications of Fracture Mechanics to Reinforced Concrete”, CRC Press, 2014		
3.	Prashant Kumar, “Elements of fracture mechanics”, 1st Edition McGraw Hill Education; 2017.		
4.	Simha K R Y, “Fracture Mechanics for Modern Engineering Design”, Universities Press 2001.		
5.	Anderson L, “Fracture Mechanics: Fundamentals and Applications”, 4th Edition, CRC Press; 2017		
Recommended by Board of Studies			
Approved by Academic Council		12 th September 2020	

Course code	DESIGN OF PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
20CE3018		3	0	0	3
Course Objective:					
1. To understand the principles of pre-stressing 2. To learn the analysis and design of the prestressed concrete elements 3. To understand the concepts of prestressing techniques					
Course Outcome:					
At the end of the course students will be able to 1. List the prestressing techniques 2. Understand the concepts of prestressing techniques 3. Analyse prestressed concrete structures 4. Design prestressed concrete structural elements 5. Appraise on the quality parameters of PSC structures 6. Investigate the rationale for failure of a PSC structure					
Module: 1	INTRODUCTION	7 Hours			
Review - basic concepts of prestressing- IS 1343-2012 code provisions - factors affecting strength and deflection - layout of cables - risk of extreme events; including blast, impact, seismic and fire effects - introduction to ACI and BS code provisions					
Module: 2	FLEXURE, SHEAR AND TORSION	8 Hours			
Behaviour of flexural members - determination of ultimate flexural strength – code provisions - design of flexural members - design for shear, bond and torsion - design check list					
Module: 3	CONTINUOUS BEAM	8 Hours			
Analysis and design of continuous beams - methods of achieving continuity - concept of linear transformations - concordant cable profile and gap cables –design of cantilever beams					
Module: 4	POST TENSIONED CONCRETE SLAB	8 Hours			
Design of one way and two way spanning floors - flexure in flat slab - tendon profile - anchorage bursting reinforcement					
Module: 5	PIPES AND COLUMNS	8 Hours			
Types, IS 783 guidelines, Analysis and design of prestressed concrete pipes - compression members - tensions members - sleepers					

Module: 6	DESIGN OF COMPOSITE MEMBERS	7 Hours
Composite beams - applications - analysis and design, ultimate strength - partial prestressing - design for circular prestressing - advantages and applications.		
Total Lectures		45 Hours
Reference Books		
1.	Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2009.	
2.	Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.	
3.	Lin.T.Y, and Burns.H, “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, New York, 2009	
4.	RajagopalanN, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.	
5.	Sinha N.C and Roy.S.K, “Fundamentals of Prestressed Concrete, S. Chand Publishing, 1985	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	L	T	P	C
20CE3019		3	0	0	3
Course Objective:					
1. To inculcate knowledge on the principles of measurements of static and dynamic response of structures 2. To illustrate the construction and working principles of various devices 3. To formulate complex structures for static and dynamic load					
Course Outcome:					
At the end of the course students will be able to 1. Implement the principles of measurements for static and dynamic response of structures 2. Plan various experiments and the instruments 3. Adopt the various measuring devices for various parameters 4. Choose the appropriate data recorders and improve data interpretation 5. Evaluate the distress in structures 6. Analyze the structure by non-destructive testing methods and model analysis					
Module: 1	EXPERIMENTAL DATA ANALYSIS:	7 Hours			
Measurement systems, statistical and error analysis - Test planning - design and implementation - testing sequence and experimental plan – model accuracy - reliability of results - Characteristics of measuring devices					
Module: 2	LOADING SYSTEMS AND INSTRUMENTATION:	8 Hours			
Loading principles - Methods of load application - loading framesc - Load distribution arrangement - safety considerations - Loading Devices - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Pressductor - Principles and operations of UTM actuators - control - mechanical, electrical, electronic system – calibration					
Module: 3	STATIC AND DYNAMIC MEASUREMENTS:	8 Hours			
Displacement, rotation and curvature measurements - Linear Variable Differential Transformer (LVDT) – Deflectometer - Strain measurement systems - principle – classification - performance and uses – strain					

Rosette analysis - Photo elasticity - principle and applications - Characteristics of Structural Vibrations –Vibration exciter - mode shapes, natural frequency - damping factors from free and forced vibrations - Pseudo-dynamic tests - shake table tests - Transducers for velocity and acceleration measurements - Vibration meter – Seismographs - wind tunnels – Flow meters – Venturimeter		
Module: 4	SENSING AND MONITORING:	7 Hours
Fiber optics - sensors types for displacement, velocity, acceleration, pressure, loads, strains, full-field measurements – Display and recording of signals – Cathode Ray Oscilloscope - Data Acquisition - analog and digital systems - Computerized data processing - Data archiving and curating - data quality control - Principles of data analysis		
Module: 5	MODEL ANALYSIS:	8 Hours
Similitude and structural models: dimensional analysis - Buckingham's Pi theorem - scale factors and dynamic similitude - uses and applications of models - types of model investigation - indirect and direct models - elastic and inelastic models - size effects - physical modeling – Similitude - dimensional analysis - principles of model analysis		
Module: 6	DISTRESS MEASUREMENTS:	7 Hours
Diagnosis of distress in structures – Crack observation - crack measuring devices – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring - corrosion mechanism in reinforced concrete – Half cell potentiometer – rebar locator - impulse radar techniques - Holography - Ground penetrating radar		
Total Lectures		45 Hours
Reference Books		
1.	Hollman J. P, “Experimental Methods for Engineers”, 7th edition, McGraw Hill Education Pvt. Ltd. 2007	
2.	Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.	
3.	Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.	
4.	Jack Philip Holman, “Experimental Methods for Engineers”, McGraw-Hill, 2001	
5.	Eroglu, “Experimental Methods in Measurement and Instrumentation for Electrical and Mechanical Engineers”, Universal Publishers, 2010	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	FIRE RESISTANT DESIGN OF STRUCTURES	L	T	P	C
20CE3020		3	0	0	3
Course Objective:					
1. To impart the knowledge on fire resistance of concrete 2. To understand the behaviour of structural members subjected to fire 3. To design the structural elements for fire load					
Course Outcome:					
At the end of the course students will be able to 1. Classify different types of fire 2. Identify the modes of failures 3. Explain the material characteristics exposed to fire 4. Analyse the distribution of temperature in concrete					

5. Evaluate the strength of fire affected member		
6. Design the structural elements for fire loading		
Module: 1	INTRODUCTION	7 Hours
Classification of fire - fire action - fire scenario - fire test and assessment procedures - consequences of fire on a concrete structure – codal provisions– Time temperature relations - ISO and hydrocarbon curve - concrete and fire safety - failure modes in fire – Process of combustion – fuel controlled fire		
Module: 2	STRUCTURAL BEHAVIOUR AND MATERIAL CHARACTERISTICS	7 Hours
Factors affecting fire resistance of concrete and steel - material characteristics - effect of cover and size on fire resistance - density - moisture content - porosity - effect of rebar and mechanical properties of concrete under fire - stress strain behaviour - performance of structural steel		
Module: 3	THERMAL BEHAVIOUR	8 Hours
Thermal properties - thermal conductivity - specific heat - coefficient of thermal expansion - thermal diffusivity - significance and types of spalling - thermal stress - thermal strain - thermal cracks - temperature distribution - Thermo-gravimetric analysis - differential thermal analysis.		
Module: 4	DESIGN OF STRUCTURAL ELEMENTS	8 Hours
Fire resistance of RCC and Steel structures – fire resistant design problems as per EN standards - Isotherm method – RCC slab – Simply supported beam – column – steel beams and columns – composite structures		
Module: 5	FIRE PROTECTION	8 Hours
Basic concepts of fire protection – process of combustion – Ventilation and fuel controlled fire - fire resistance - fire safety- urban planning – escape and refuge - General requirements as per IS and NBC - characteristics of fire resisting materials – firefighting installations – devices - fire safety measures–hydrants – protective coatings		
Module: 6	POST-FIRE INVESTIGATION AND REPAIR OF FIRE-DAMAGED CONCRETE STRUCTURES	7 Hours
Introduction - Data collection - damage analysis - diagnosis - chemical analysis - damage classification - repair criteria - repair methods - role of fibers - NDT methods - case studies on fire damaged structures.		
Total Lectures		45 Hours
Reference Books		
1.	IS 3809-1979, Fire Resistance Test of Structures, Bureau of Indian Standards, New Delhi	
2.	IS 1641-1988, Code of practice for fire safety of buildings (general): General principles of fire grading and classification, Bureau of Indian Standards, New Delhi	
3.	Tom lennon, “Structural Fire Engineering”, ICE Publications 2011	
4.	“Fire Resistance Design of steel framed buildings”, SCI hand book	
5.	Paulo Vila Real & Jean-Marc Franssen, “Fire Design of Steel Structures”, Wiley Publications 2012	
6	EN 1992-1-2: Eurocode 2 Design of Concrete Structures. Part 1-2: Structural fire design, Bratislava, SÚTN 2007.	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	ANALYSIS AND DESIGN OF PRECAST CONCRETE STRUCTURES	L	T	P	C
20CE3021		3	0	0	3
Course Objective:					
1. To understand the prefabricated building system and to familiarize the precast frame analysis. 2. To demonstrate the concepts of design of precast column, beam, floor and shear wall. 3. To familiarize the concepts of connection and progressive collapse of precast system.					
Course Outcome:					
At the end of the course students will be able to 1. Identify the precast concrete materials and systems 2. Analyze the precast frames. 3. Identify suitable precast floor and beam for a precast structure. 4. Choose appropriate precast column and shear wall for a precast structure. 5. Apply proper connection techniques to a precast structure 6. Apply suitable techniques to mitigate vulnerable effects of progressive collapse.					
Module: 1	PRECAST CONCRETE BUILDING SYSTEMS	8 Hours			
Prefabrication technology – the advantages of factory production – Materials used in precast structures – Standardization- elements and components – Tolerance and calculations for fit - production – handling –Transportation and Erection – Sustainability.					
Module: 2	PRECAST FRAME ANALYSIS	7 Hours			
Types of precast concrete structures – Simplified frame analysis – Design loads on beams and frames – Serviceability limit state – Ultimate limit state – Instability limit state – Accidental limit state – Gravity and horizontal ultimate loads on frames – Comparison of standard designs to BS 8110 and Eurocodes.					
Module: 3	PRECAST CONCRETE FLOORS AND BEAMS	7 Hours			
Precast concrete flooring options – Flooring arrangements – Structural design of individual units – Design of composite floors. Types of precast beams – Non-composite reinforced concrete beams – Composite reinforced beams.					
Module: 4	PRECAST COLUMN AND SHEAR WALL	8 Hours			
Precast concrete columns – Geometry, strength and general requirements – Column design for factory handling – Column design for pitching and erection – Design rules in BS EN 192 1-1 for columns in precast structures. Shear walls – Horizontal and vertical stability –Types of precast concrete shear walls – Distribution of horizontal loading.					
Module: 5	JOINTS AND CONNECTIONS	8 Hours			
Definitions – Compression joints – Shear joints –Tension joints – Pin jointed connections – Moment resisting connections – design philosophy of moment resisting connection – Floor connections at load bearing walls – Beam to column connections – Column to foundation connections.					
Module: 6	PROGRESSIVE COLLAPSE AND CASE STUDIES	7 Hours			
Abnormal loads and Progressive Collapse – Importance of avoiding progressive collapse – Indirect design method – Alternative load path method - Case studies on precast concrete buildings construction – failure of precast joints and members.					
Total Lectures					45 Hours
Reference Books					
1.	Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013				

2.	Alfred Steinle, Hubert Bachmann, Mathias Tillmann, “Precast Concrete Structures”, John Wiley & Sons, 2019.
3.	Design of precast concrete structures against accidental actions, fib Fédération internationale du béton, 2012
4.	Hubert Bachman., “Precast Concrete Structures”, Wiley online library, Germany, 2012
5.	IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice
6.	Code of Practice for Precast concrete construction, PCI Design hand book, 2003
Recommended by Board of Studies	
Approved by Academic Council	
12 th September 2020	

Course code	CEMENT AND CONCRETE CHEMISTRY	L	T	P	C
20CE3022		3	0	0	3
Course Objective:					
1. To understand the hydration chemistry of cement paste 2. To study the microstructure of concrete 3. To learn the modern micro structure analysis techniques					
Course Outcome:					
At the end of the course students will be able to 1. Classify the phase system of cement 2. Explain the cement hydration process 3. Analyse the properties of cement paste and concrete 4. Illustrate the hydration of cement with mineral admixtures 5. Examine the properties of hardened paste 6. Adopt modern micro structure analysis technique					
Module: 1	COMPOSITION OF CEMENT PHASES:	8 Hours			
Cement manufacture - Principles of cement classification – clinkering process - phase diagram of cement chemistry system – Tricalcium Silicate and Alite Phase - Dicalcium Silicate and Belite phase - Aluminate phase in clinker - influence of minor constituents – cement types – quality control in production - Blended cement - effect of chemical composition – Role of flyash, silica fume, slag and metakaolin - formation of secondary gel – strength development – characteristics of blended cement					
Module: 2	CEMENT CHEMISTRY:	7 Hours			
Hydration of cement constituents – strength development - microstructure of cement paste – Hydraulic reactivity - properties of cement paste - rheological properties of - volume changes of the plastic paste - delayed ettringite - permeability of paste - interfacial transition zone (ITZ)					
Module: 3	PORE STRUCTURE:	8 Hours			
Pore structure - surface area of cement paste - water content of CSH gel - pore system - classification of pores - application of mercury intrusion porosimetry - effect of w/c ratio on age - curing conditions of concrete					
Module: 4	CHEMICAL STRUCTURE AND BOND:	8 Hours			
Cement paste – aggregate bond - paste–reinforcement bond - corrosion mechanism – corrosion in concrete in chlorides solutions - effect of high temperature on hydrated cement paste - solids in the hydrated cement paste - voids in the hydrated cement paste - water in the hydrated cement paste – chemical binders					

Module: 5	CHEMICALS FOR CONCRETE PRODUCTION:	8 Hours
Chemical admixtures – Admixture type and dosage - Admixtures for workability – flowability - Segregation resistance – Poly carboxylate ether based materials – naphthalene based materials – cement and admixture compatibility – Mechanism and action of water reducers – polymers for concrete		
Module: 6	Instrumental Analysis:	7 Hours
Thermo analytical techniques in cement chemistry – Infrared spectroscopy - Elemental Analysis - Mechanical and Physical Analysis (Mechanical Behavior of Paste) - Scanning Electron Microscopy (SEM) - X-Ray Diffraction (XRD) - Energy Dispersive X Ray Spectroscopy (EDAX) - Transmission electron microscopy (TEM) - Fourier transform infrared spectroscopy (FTIR) - Thermogravimetric Analysis of Concrete (TGA) – Differential Scanning Calorimetry (DSC)		
Total Lectures		45 Hours
Reference Books		
1.	Kurdowski & Wieslaw, “Cement and Concrete Chemistry”, Springer Publications 2014	
2.	Ghosh S.N, “Advances in Cement Technology: Chemistry, Manufacture and Testing”, CRC Press, 2002	
3.	Santhakumar A.R, “Concrete Technology” Oxford University press, Delhi, 2006	
4.	Peter Hewlet, “Lea's Chemistry of Cement and Concrete”, Elsevier., 2003	
5.	Bensted J.and. Barnes P “Structure and Performance of Cements”, 2nd Edition, Edited by, Spon Press, London, 2002.	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	DESIGN OF COMPOSITE STRUCTURES	L	T	P	C
20CE3023		3	0	0	3
Course Objective:					
1. To understand the behaviour of composite structures 2. To study the design of steel concrete composite elements 3. To understand the concept of shear connectors					
Course Outcome:					
At the end of the course students will be able to 1. Classify different types of shear connectors 2. Recommend suitable type of profile sheeting 3. Examine the elastic behaviour of composite structural members 4. Analyze the steel concrete composite elements 5. Design different types of composite elements 6. Evaluate the strength of shear connectors					
Module: 1	Introduction:	7 Hours			
Introduction to steel - concrete composite construction – materials - Composite action – Moment of resistance - Serviceability - Design criteria - provisions on IS, BS and Euro codes - Lateral stability					
Module: 2	Design of Composite Flexural Members:	7 Hours			
Design of composite beams - simply supported and continuous - Design of slabs - profiled sheeting - stiffeners - composite floor specification, Classification, Moment of resistance and fire rating - Modeling of composite materials					

Module: 3	Design of Composite Columns and Trusses:	8 Hours
Design of columns - Encased column - Infilled column - axially, uni-axially and bi-axially loaded columns - design of composite trusses		
Module: 4	Design of Connections:	8 Hours
Shear connectors – types – design of connections in composite structures – behaviour of shear connectors – partial and full interaction of shear connectors		
Module: 5	Building Envelope Design:	8 Hours
Building envelope design principles and strategy- strength and stability – control of heat flow – control of air flow – control of water vapour flow - design for fire – durability - Sustainability - passive protection techniques		
Module: 6	Case Studies:	7 Hours
Case studies on steel - concrete composite construction in buildings - fire resistance - seismic behaviour of composite structures		
Total Lectures		45 Hours
Reference Books		
1.	Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Blackwell Scientific Publications, 2014.	
2.	Panchal D R., “Composite steel concrete structures”, Scholars Press, Latvia European Union, 2015	
3.	Duggal S K., "Limit state design of steel structures", Tata McGraw hill, New Delhi, 2010	
4.	Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.	
5.	Owens.G.W and Knowles.P, “Steel Designers Manual”, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

Course code	SUSTAINABLE CONSTRUCTION	L	T	P	C
20CE3024		3	0	0	3
Course Objective:					
1. To provide students a strong awareness in sustainable construction need 2. To impart knowledge on sustainable construction practices 3. To learn the contribute on energy efficiency and green building					
Course Outcome:					
At the end of the course students will be able to 1. Identify sustainable design aspects 2. Evaluate the life cycle assessment 3. Design building based on environmental aspects 4. Incorporate energy efficiency in design of buildings 5. Design environmental friendly buildings 6. Apply green building ratings					
Module: 1	PRINCIPLES OF DESIGN FOR SUSTAINABILITY:	7 Hours			

Emphasis on the built environment - Basic design of buildings - infrastructure with low to no impact on the environment		
Module: 2	LIFE-CYCLE OF THE INFRASTRUCTURE;	7 Hours
integration of human and economic aspects in the design - need of sustainable buildings - factors like population growth, well-being, energy consumption - technological progress connected with buildings - growth in consumption - Buildings' contribution to environmental devastation		
Module: 3	SUSTAINABLE CONCRETE BUILDINGS:	8 Hours
Use of recycled concrete aggregate - disposal of waste by the construction industry - Sustainability and Rehabilitation in concrete buildings – Eco-friendly constructions – planning – materials - cost effective technique		
Module: 4	ENGINEERING SYSTEMS:	8 Hours
Environmental considerations - personal behavior - inspiration from nature - sustainable design - design of sustainable buildings		
Module: 5	ENERGY EFFICIENT AND ENVIRONMENT FRIENDLY BUILDINGS:	8 Hours
Climate - solar radiation - Perform an energy-load analysis/ audit of a building - Decrease water consumption inside buildings - Photovoltaic buildings		
Module: 6	GREEN BUILDING:	7 Hours
Elements- Design- LEED rating system - Indian Green Building Council (IGBC) - Green Rating for Integrated Habitat Assessment (GRIHA) - Energy Consumption Building Code (ECBC)		
Total Lectures		45 Hours
Reference Books		
1.	Gajanan M. Sabnis. “Green Building with Concrete: Sustainable Design and Construction”, CRC Press;2013	
2.	Sam Kubba, “LEED Practices, Certification, and Accreditation Handbook”, BnH Inc.,2013	
3.	Paul Appleby . “Integrated Sustainable Design of Buildings”, Earthscan Pvt Ltd.,2013	
4.	Nanjunda Dc “Re-discovering Rural Development: A Reflection on Potential and Prospects”; Sarup & Sons, New Delhi, 2013	
5.	Charles J kibert; “Sustainable construction: Green Building design and delivery”, John Wiley & Sons; 2005	
Recommended by Board of Studies		
Approved by Academic Council		12 th September 2020

**DEPT. OF CIVIL
ENGINEERING**

LIST OF NEW COURSES

Sl. No	Code No.	Course Name	Credits			
			L	T	P	C
1	18CE2063	Infrastructure for Renewable Energy	3	0	0	3
2	18CE2064	Surfacewater Storage Structures	3	0	0	3
3	18CE2065	Sustainable Infrastructure for Food Production	3	0	0	3
4	18CE2066	Building Architecture and Health	3	0	0	3
5	18CE3084	Experimental Techniques and Instrumentation	3	0	0	3
6	18CE3085	Fire Resistant Design of Structures	3	0	0	3
7	18CE3086	Analysis and Design of Precast Concrete Structures	3	0	0	3
8	18CE3087	Cement and Concrete Chemistry	3	0	0	3
9	18CE3088	Design of Steel Concrete Composite Structures	3	0	0	3
10	18CE3089	Waste to Energy	3	0	0	3
11	19CE1001	Engineering Drawing for Civil Engineers	0	0	6	3
12	19CE1002	Field Practices - I (Smart Architectural Planning)	0	0	2	1
13	19CE1003	Field Practices - II (Intelligent Measurement Techniques)	0	0	1	0.5
14	19CE2001	Civil Engineering – Societal and Global Impact	2	0	0	2
15	19CE2002	Energy Science and Engineering	2	0	0	2
16	19CE2003	Engineering Mechanics	3	1	0	4

18CE2063	INFRASTRUCTURE FOR RENEWABLE ENERGY	L	T	P	C
		3	0	0	3

Course learning Objective:

1. To introduce the basics of renewable energy sources and their components.
2. To impart knowledge on the various methods of power generation by renewable energy sources □
3. To appraise on the scope of renewable energy infrastructure development.

Course Outcome:

Student will be able to

1. Illustrate the fundamental aspects of renewable energy sources.
2. Plan and set out different types of power plants.
3. Develop various renewable energy infrastructure.
4. Derive the cost effective solutions for power generation and construction.
5. Select the appropriate the technology for power requirements.
6. Provide the technological solutions for present and future energy demands

Module 1: WIND ENERGY: Site selection - classification of wind turbines – components - foundations – installations–housing for electrical switchgear –integration to the grid - SCADA central equipment –losses and efficiency – cost estimation - maintenance – repair and rehabilitation

Module 2: SOLAR ENERGY: Site selection – solar intensity – meteorological parameters – solar panels - types – power production - installation of solar panels - mounting structures - integration to the grid – cost estimation

Module 3: TIDAL ENERGY: Site selection – tides and tidal current– basic laws of tidal power generation– transport and dissipation - tidal barrages - Basin systems: Single and Double Basin system turbines and generators – cost estimation – maintenance.

Module 4: HYDEL ENERGY: Site selection – classification – components - hydropower generation capacity power house tunnels and underground structures – cost estimation.

Module 5: GEOTHERMAL ENERGY: Conduction, convection and radiation– heat flow mechanisms – heat exchange systems – heat pumps - Geo thermal power generation – factors influencing– enhanced geothermal system – sequestration - cost.

Module 6: BIO-ENERGY: Bio-digesters- components – feed stocks - generation rate – factors influencing – high rate digesters – construction – sludge management – energy recovery from Municipal solid waste - co-digestion – fecal sludge management

Text Books:

1. Boyle. G, “Renewable energy: Power for a sustainable future”, Oxford University press. 2004
2. Khan B H, “Non-Conventional Energy Resources”, The McGraw –Hill Second edition, 2006

References:

1. Godfrey Boyle, Bob Everett and Janet Ramage, “Energy Systems and Sustainability. Power for a sustainable future”, Oxford University press, 2010
2. Rai G. D., “Non-conventional energy sources”, Khanna Publishers, New Delhi, 2006.
3. Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, 2nd Edition, Prentice Hall, 2003.
4. Godfrey Boyle, “Renewable Electricity and the Grid: The Challenge of Variability”, Earthscan , 2012
5. Gevorg Sargsyan, Mikul Bhatia, Sudeshna Ghosh Banerjee, Krishnan Raghunathan, Ruchi Soni “Unleashing the Potential of Renewable Energy in India” World bank report, 2011

18CE2064	SURFACEWATER STORAGE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about various types of water impoundment structures
2. To introduce the guidelines for design and maintenance of the structures.
3. To give exposure about rehabilitation measures for the structures

Course Outcomes:

Student will be able to

1. Acquire knowledge on the importance of storage and conveyance of surface water
2. Sketch the plan of the components of structures
3. Articulate the utilization level of structures
4. Outline the Operation and management of the structures
5. Measure the performance of structures
6. Interpret the measures to rehabilitate the structures

Module1: PONDS AND TANKS: Components – types – spillway requirements – feeder canals – embankment configuration - compaction – clay blankets – waterproof linings - capacity estimation - protection and safety – operation and maintenance - desilting

Module 2: LAKES: Lake ecosystem – flora and fauna - water balance – Inflow, outflow, evaporation, storage - Water quality – atmospheric load – point and non-point load – sedimentation - eutrophication – Causes and control measures – lake restoration

Module 3: RESERVOIRS: Investigation for reservoir sites - storage zones - storage capacity and yield of a reservoir using mass curve - sedimentation – life of reservoir – dredging – water budget - reservoir operation policies

Module 4: DAMS: Types – components – forces acting - elementary and practical profile - evaluation of profile by method of zoning - failure - estimation of seepage through and below the dam - seepage control

Module 5: WATER HARVESTING STRUCTURES: Roof top harvesting – scheme layout – roof water collection structures – components – percolation ponds – guidelines and design aspects – contour bunds – check dams – gabions - site characteristics – design guidelines – artificial recharging structures

Module 6: MAINTENANCE AND REHABILITATION: Periodical maintenance - risk assessment and management - maintenance and rehabilitation of storage structures - financial implications – restoration of old storage structures – Temple ponds

Text Books:

1. Garg S.K, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers N.D. 13th edition, 2009.
2. Modi, “Irrigation, Water Resources and water power engineering”, P.N. -Standard Book House, New Delhi, 2nd edition, 2008.

References:

1. Punmia and Pandey, “Irrigation & Water Power Engineering”, Laxmi Publications (P) Ltd., New Delhi, 2016.
2. Dandekar M.M and Sharma K.N., “Water Power Engineering”, 2nd edition Vikas publishers, 2013.
3. Asawa G.L. “Irrigation and Water Resources engineering”, New Age International (P) Ltd. Publishers, 1st edition, 2005.
4. Arora K. R, “Irrigation, Water Power and Water Resources Engineering”, Standard Publisher Distributors, 2002
5. Hossain Ali, “Practices of Irrigation & On-farm Water Management”, Volume 2, Springer Science & Business Media, 2011

18CE2065	SUSTAINABLE INFRASTRUCTURE FOR FOOD PRODUCTION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To inculcate knowledge on sustainable infrastructure
2. To impart understanding on process and systems of infrastructure.
3. To inculcate the application of structures for agricultural use

Course Outcomes

Student will be able to

1. Acquire knowledge about the sustainable development of fields
2. Select the various structures for agricultural use
3. Plan conveyance and water distribution system
4. Identify and use highly efficient irrigation methods
5. Monitor and maintain the storage structures
6. Execute farming using green-house technology

Module1: SUSTAINABLE FIELD DEVELOPMENT: Introduction –sustainability - principles and criteria - soil quality and topography - sustainable land management – rainfall data - factors influencing the crop selection – farming and irrigation practices - land reclamation –

Module 2: WATER MANAGEMENT: Regulator – canals - canal profile - lining cross drainage works - distributaries - flow measurements

Module 3: EFFICIENT IRRIGATION METHODS: Soil moisture - surface irrigation – subsurface irrigation - sprinkler and drip irrigation-fertigation- deep root irrigation- soil-less culture – mulching-coir pith - drought management – smart irrigation methods

Module 4: SUSTAINABLE AGRICULTURE: Poly house - features and specifications -applications - green house - benefits of sustainable Agriculture - Pod house – organic farming – pest control

Module 5: STORAGE APPURTENANCES: Storage - storage methods - influence of environmental factors: Temperature, Moisture, Oxygen - deterioration of storage grains - drying and storing in ventilated buildings - natural ventilation- forced air ventilation -ware housing - types of ware houses - cold storage – climate atmospheric storage - silos – bunkers – transportation system

Module 6: MODERN FARMING: Roof tops and vertical farming - roof garden – specifications - water proofing - drainage – green roofing - Hydroponics – Aeroponics - Aerofarms- Plantscrapers - Skyfarm – Bowery

Text Books:

1. Bry Sarte S., “Sustainable Infrastructure: The Guide to Green Engineering and Design”, 1st edition, Wiley, 2010
2. Fenner, Richard.A, Charles Major Ainger, “Sustainable Infrastructure: Principles into Practice (Delivering Sustainable Infrastructure Series)”, ICE Publishing, 2013

References:

1. Asawa G.L. “Irrigation and Water Resources engineering”, New Age International (P) Ltd. Publishers, 1st edition, 2005.
2. Christou. P, Savin.R, Costa Pierce.B, Miszta.I, Whitelaw.B, “Sustainable Food Production”, Springer; 2013
3. Sargis S Safarian, “Design and construction of silos and bunkers”, Van Nostrand Reinhold, 1985
4. Arden B. Andersen, “Science in Agriculture: Advanced Methods for Sustainable Farming”, Acres USA, Second edition, 2000
5. Ken Yeang, Lucy Bullivant, “Eco Skyscrapers- Vol II”, Images Publishing, 2011

18CE2066	BUILDING ARCHITECTURE AND HEALTH	L	T	P	C
		3	0	0	3

Course Objective:

1. To understand the principles in the design of healthy buildings
2. To design healthy residential, commercial, educational building
3. To design health care centers

Course Outcome:

Student will be able to

1. Choose suitable locations for various building types for healthy environment
2. Illustrate the features of health architecture in buildings
3. Organize the elements required to building healthy buildings
4. Examine the health of existing buildings
5. Determine suitable technologies to improve the health of buildings
6. Develop the design concepts for health of the buildings

Module 1: BUILDING ATTRIBUTES: Human-Nature relationship - environmental design- biophilic design- elements - attributes; environmental features - nature, shapes and forms: natural patterns and processes- space and light – orientation - design based on function, natural light and health- psychology - day lighting strategies- waste management – building management system – emergency response systems.

Module 2: RESIDENTIAL BUILDINGS: Planning strategies - Site selection and orientation - natural light and ventilation: colors and furnishings - open spaces- recreation– water harvesting and recycling – maintenance - drainage systems

Module 3: INSTITUTIONAL BUILDINGS: Planning strategies - Site selection and orientation - Integrated design- site selection, social factors, climatic considerations, acoustics - building structure envelope - roof design - natural ventilation- storm water, ground water management - maintenance – waste management - case studies

Module 4: COMMERCIAL BUILDINGS: Planning strategies - site selection and orientation - spaces- internal work environment - heating and ventilation systems - environmental science aspects, lighting- types of work place illness- maintenance of working environment- occupational health services- sick building syndrome – risk management systems

Module 5: INDUSTRIAL BUILDINGS: Site location- natural lighting- environmental issues- safety measures- transport facilities - occupational safety and hazards – industrial waste management- case studies

Module 6: HOSPITAL BUILDINGS: Planning strategies - site selection and orientation – essential components - occupational safety and hazards biomedical waste management - case studies

Text Books:

1. Andrew L. Dannenberg, Howard Frumkin, Richard J. Jackson, “Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability”, Island Press, 2012
2. Mohamed Boubekri, “Daylighting, Architecture and Health: Building Design Strategies”, Routledge, 2008

References:

1. Workplace Environmental Design in Architecture for Public Health, Stamatina Th. Rassia, Springer 2017
2. Lisa Gelfand, “Sustainable School Architecture: Design for Elementary and Secondary Schools”, John Wiley & Sons, 29-Mar-2010
3. Stephen Verderber, “Innovations in Hospital Architecture”, Taylor and Francis 2010
4. Andrew L. Dannenberg, Howard Frumkin, Richard J. Jackson, “Making Healthy Places: Designing and Building for Health, Well-being, and sustainability”, Island Press, 2013
5. Robin Guenther, Gail Vittori, “Sustainable Healthcare Architecture”, John Wiley & Sons, 2013

18CE3084	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. Inculcate knowledge on the principles of measurements of static and dynamic response
2. Illustrate the construction and working principles of various devices
3. Formulate complex structures for static and dynamic load

Course Outcomes

Student will be able to

1. Implement the principles of measurements for static and dynamic response of structures and carryout the data analysis
2. Plan various experiments and the required instruments
3. Adopt various measuring devices for various parameters
4. Choose the appropriate data recorders
5. Evaluate the distress in structures
6. Analyze the structure by non-destructive testing methods and model analysis

Module1:FORCE AND STRAIN MEASUREMENT: Experimental stress analysis – Data analysis - Characteristics of measuring devices - Calibration - Errors in measurements - Hydraulic jacks – Electronic load cells – Proving Rings – Pressductor - Principles of operations of UTM - Photo elasticity - principle and applications - vibrating wire sensors– Fibre optic sensors - Linear Variable Differential Transformer (LVDT) - Strain gauge – principle – classification - performance and uses – strain Rosette analysis

Module2: VIBRATION MEASUREMENTS AND STORAGE AND DISPLAY DEVICES: Characteristics of Structural Vibrations –Vibration exciter - Transducers for velocity and acceleration measurements - Vibration meter – Seismographs – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Data Acquisition system.

Module 3: FLOW MEASURANDS: Wind tunnel test – necessity – wind tunnel test types – Bernoulli’s Principle – pressure measurements - Dead weight tester - flow meter types – venturimeter – flow obstruction methods – drag effects - Interferometer

Module 4: MODEL ANALYSIS: Dimensional homogeneity - Model analysis – laws of similitude – Model materials – necessity for model analysis – advantages – applications – scale effect in models – Indirect model study – direct model study - limitations of models – usage of influence lines in model studies

Module5: DAMAGE ASSESSMENT: Diagnosis of distress in structures – crack observation - crack measuring devices – damage assessment – brittle coating controlled blasting for demolition – techniques for residual stress measurements

Module6: NON DESTRUCTIVE TESTING METHODS: Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – corrosion of reinforcement in concrete – Half cell potentiometer –corrosion analyzer – rebar locator - impulse radar techniques - Holography - Impact echo - impulse radar techniques - Ground penetrating radar (GPR).

References:

1. Hollman J. P, “Experimental Methods for Engineers”, 7th edition, McGraw Hill Education Pvt. Ltd. 2007
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
4. Sirohi.R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.
5. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., andRamachandra, K., “Experimental Stress Analysis”, Tata McGraw-Hill, New Delhi, 1984.

18CE3085	FIRE RESISTANT DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. Impart the knowledge on fire resistance of concrete
2. Understand the behaviour of structural members subjected to fire
3. Design the structural elements for fire load

Course Outcomes

Student will be able to

1. Classify different types of fire
2. Identify the modes of failures
3. Explain the material characteristics exposed to fire
4. Analyse the distribution of temperature in concrete
5. Evaluate the strength of fire affected member
6. Design the structural elements for fire loading

Module 1: INTRODUCTION: Classification of fire - fire action - fire scenario - fire test and assessment procedures - consequences of fire on a concrete structure – codal provisions– Time temperature relations - ISO and hydrocarbon curve - concrete and fire safety - failure modes in fire – Process of combustion – fuel controlled fire

Module 2: STRUCTURAL BEHAVIOUR AND MATERIAL CHARACTERISTICS: Factors affecting fire resistance of concrete and steel - material characteristics - effect of cover and size on fire resistance - density - moisture content - porosity - effect of rebar and mechanical properties of concrete under fire - stress strain behaviour - performance of structural steel.

Module 3: THERMAL BEHAVIOUR: Thermal properties - thermal conductivity - specific heat - coefficient of thermal expansion - thermal diffusivity - significance and types of spalling - thermal stress - thermal strain - thermal cracks - temperature distribution - Thermo-gravimetric analysis - differential thermal analysis.

Module 4: DESIGN OF STRUCTURAL ELEMENTS: Fire resistance of RCC and Steel structures – fire resistant design problems as per EN standards - Isotherm method – RCC slab – Simply supported beam – column – steel beams and columns – composite structures.

Module 5: FIRE PROTECTION: Basic concepts of fire protection – process of combustion – Ventilation and fuel controlled fire - fire resistance - fire safety- urban planning – escape and refuge - General

requirements as per IS and NBC - characteristics of fire resisting materials – firefighting installations – devices - fire safety measures– hydrants – protective coatings

Module 6: POST-FIRE INVESTIGATION AND REPAIR OF FIRE-DAMAGED CONCRETE STRUCTURES: Introduction - Data collection - damage analysis - diagnosis - chemical analysis - damage classification - repair criteria - repair methods - role of fibers - NDT methods - case studies on fire damaged structures.

References:

1. IS 3809-1979, Fire Resistance Test of Structures, Bureau of Indian Standards, New Delhi
2. IS 1641-1988, Code of practice for fire safety of buildings (general): General principles of fire grading and classification, Bureau of Indian Standards, New Delhi
3. Tom lennon, “Structural Fire Engineering”, ICE Publications 2011
4. “Fire Resistance Design of steel framed buildings”, SCI hand book
5. Paulo Vila Real & Jean-Marc Franssen, “Fire Design of Steel Structures”, Wiley Publications 2012
6. EN 1992-1-2: Eurocode 2 Design of Concrete Structures. Part 1-2: Structural fire design, Bratislava, SÚTN 2007.

18CE3086	ANALYSIS AND DESIGN OF PRECAST CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. Study different types of prefabricated building system
2. Analyse and design precast buildings
3. Learn the connections in precast buildings

Course Outcomes

Student will be able to

1. Select the suitable prefabricated building system
2. Identify the suitable erection technique
3. Explain the behaviour of pre-stressed precast element
4. Analyze the precast structural frame
5. Design the precast structural element
6. Examine the behaviour of joints in precast frame

Module 1: PRECAST CONCRETE BUILDING SYSTEMS: Prefabrication technology - planning - Materials - elements and components— production – element fabrication – handling - Transportation - erection - overall structural systems - systems for lateral load resistance

Module 2: STRUCTURAL ANALYSIS AND DESIGN: Introduction - Materials - Loads - Load factors - Analysis of frame with stability elements - modelling and analysis - Design consideration - Safety against progressive collapse - Design problems - Beams and Slabs

Module 3: PRE-STRESSED PRECAST CONCRETE: Background and scope - Advantages - typical applications of pre-stressing for precast elements - Limitations - Special analysis and design aspects for pre-stressed precast elements - pre-tensioned elements - post tensioned elements - Case studies on construction

Module 4: SEISMIC DESIGN OF PRECAST STRUCTURES: Design philosophy - design approaches - limitations of precast concrete applications in seismic regions - moment resisting frames - structural walls - diaphragms - support details - detailing

Module 5: JOINTS AND CONNECTIONS IN PRECAST BUILDINGS: Introduction - requirements - details of connections - column to foundation connections - wall panel to foundation connections - column to column to connection - floor to beam connection - wall panel to wall panel connection - connection materials

Module 6: CASE STUDIES ON PRECAST CONSTRUCTION:

Case studies on precast concrete buildings construction – failure of precast joints and members – Modeling of precast of structures – Mini project on design of precast building design.

References:

1. Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013
2. Hubert Bachman., “Precast Concrete Structures”, Wiley online library, Germany, 2012
3. Eph Bljuger F., “Design of Precast Concrete Structures”, E. Horwood, 1988
4. IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice
5. Code of Practice for Precast concrete construction, PCI Design hand book, 2003

18CE3087	CEMENT AND CONCRETE CHEMISTRY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To know about modern micro structure analysis techniques
2. To study the microstructure of concrete
3. To understand the hydration chemistry

Course Outcomes

Student will be able to

1. Classify the phase system of cement
2. Explain the cement hydration process
3. List the types of pores in concrete
4. Analyse the properties of cement paste and concrete
5. Discuss the hydration of cement with mineral admixtures
6. Examine the properties of hardened paste

Module 1: PHASE SYSTEMS: Principles of cement classification - different phase systems of cement chemistry ($\text{CaO-SiO}_2\text{-Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$) system - Thermo chemistry of clinkering Process - Phase Composition of Portland Cement - Tricalcium Silicate and Alite Phase - Dicalcium Silicate and Belite phase - Aluminate phase in clinker

Module 2: CEMENT HYDRATION: Effect of constituents of cement on hydration – properties of cement paste - rheological properties of concrete - microstructure and strength of cement paste - volume changes of the plastic paste - permeability of paste - interfacial transition zone (ITZ) - chromium reducers - phases in the $\text{CaO-SiO}_2\text{-H}_2\text{O}$ System

Module 3: CHEMICAL STRUCTURE AND BOND: The Microstructure of C-S-H Gel - chemical structure of C-S-H Phases - delayed ettringite - cement paste – aggregate bond - paste–reinforcement bond - corrosion of concrete in the chlorides solutions - effect of high temperature on hydrated cement paste - microstructure of the hydrated cement paste - solids in the hydrated cement paste - voids in the hydrated cement paste - water in the hydrated cement paste

Module 4: PORE STRUCTURE: Introduction - pore structure and surface area of cement paste - water content of CSH gel - pore system and classification of pores - application of mercury intrusion porosimetry - effect of w/c ratio on age and curing conditions of concrete

Module 5: CHEMICALS FOR CONCRETE PRODUCTION: Chemical admixtures – Admixture type and dosage - Admixtures for workability – flowability - Segregation resistance – Poly carboxylate ether based materials – naphthalene based materials – cement and admixture compatibility – Mechanism and action of water reducers – polymers for concrete

Module 6: MICROSTRUCTURE INVESTIGATION: Mineral Admixture - flyash, silica fume, slag and metakaolin - formation of secondary gel - Scanning Electron Microscopy (SEM) - X-Ray Diffraction (XRD) - Energy Dispersive X Ray Spectroscopy (EDAX) - Transmission electron microscopy (TEM) - Fourier transform infrared spectroscopy (FTIR) - TGA - DSC

References:

1. Kurdowski & Wieslaw, "Cement and Concrete Chemistry", Springer Publications 2014
2. Ghosh S.N, "Advances in Cement Technology: Chemistry, Manufacture and Testing", CRC Press, 2002
3. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, 2005
4. Santhakumar A.R, "Concrete Technology" Oxford University press, Delhi, 2006
5. Peter Hewlet, 'Lea's Chemistry of Cement and Concrete', Elsevier., 2003

18CE3088	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. Develop an understanding on the behaviour of composite structures
2. Study the design of steel concrete composite elements
3. Impart knowledge on shear connectors

Course Outcomes

Student will be able to

1. Classify different types of shear connectors
2. Recommend suitable type of profile sheeting
3. Examine the elastic behaviour of composite structural members
4. Analyze the steel concrete composite elements
5. Design different types of composite elements
6. Evaluate the strength of shear connectors

Module 1: INTRODUCTION: Introduction to steel - concrete composite construction – materials - Composite action – Moment of resistance - Serviceability - Design criteria - provisions on IS, BS and Euro codes

Module 2: DESIGN OF COMPOSITE FLEXURAL MEMBERS: Design of composite beams - simply supported and continuous - Design of slabs - profiled sheeting - stiffeners

Module 3: DESIGN OF COMPOSITE COLUMNS AND TRUSSUS: Design of columns - Encased column - Infilled column - axially, uni-axially and bi-axially loaded columns - design of composite trusses.

Module 4: DESIGN OF CONNECTIONS: Shear connectors – types – design of connections in composite structures – behaviour of shear connectors – partial and full interaction of shear connectors

Module 5: BUILDING ENVELOPE DESIGN: Building envelope design principles and strategy - strength and stability – control of heat flow – control of air flow – control of water vapour flow – control of sound transmission - control of fire – durability - Sustainability

Module 6: CASE STUDIES: Case studies on steel - concrete composite construction in buildings - fire resistance - seismic behaviour of composite structures.

References:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2. Panchal D R., "Composite steel concrete structures", Scholars Press, Latvia European Union, 2015
3. Duggal S K., "Limit state design of steel structures", Tata McGraw hill, New delhi, 2010
4. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.
5. Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.

18CE3089	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about energy untaken on waste
2. To introduce various energy sources and drawing technologies existing
3. To enable the student to apply the technology

Course Outcomes:

Student will be

1. Identify the energy attributes presented in waste
2. Understand and choose the different principles of energy from waste techniques
3. Implement energy from waste concepts
4. Conduct characterization of different energy sources in waste
5. Analysis different types energy driving techniques from waste
6. Design efficient and effective energy conservation techniques from waste

Module 1: INTRODUCTION TO ENERGY FROM WASTE: Classification of waste as fuel – Agro based, Forest residue, Industrial waste – Municipal solid waste – Conversion devices – Incinerators, gasifiers, digestors

Module 2: BIOMASS PYROLYSIS: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3: BIOMASS GASIFICATION: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4: BIOMASS COMBUSTION: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Module 5: BIOGAS: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production

Module 6: URBAN WASTE TO ENERGY: Municipal solid waste to energy generation - Biomass energy programme in India – world energy council waste to energy initiatives - case studies.

References:

1. Desai, Ashok V, “Non-Conventional Energy”, Wiley Eastern Ltd.,1990.
2. Khandelwal, K. C. and Mahdi, S. S., “Biogas Technology - A Practical Hand Book” - Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Challal D. S, “Food, Feed and Fuel from Biomass”, IBH Publishing Co. Pvt. Ltd.,1991.
4. WereKo-Brobby C. Y and Hagan E. B., “Biomass Conversion and Technology”, John Wiley & Sons, 1996.

19CE1001	ENGINEERING DRAWING FOR CIVIL ENGINEERS	L	T	P	C
		0	0	6	3

Course Objectives:

1. To draw and interpret various projections of 1D, 2D and 3D objects
2. To enable to prepare and interpret the drawings of buildings
3. To provide knowledge to make basic engineering drawings using both geometric instruments as well as softwares

Course Outcomes:

Student will be able to

1. Sketch two-dimensional orthographic drawings and three-dimensional isometric views.
2. Create and modify two-dimensional orthographic drawings using AutoCAD software, complete with construction lines, dimensions, and layers, conforming to industry standards.
3. Create three-dimensional solid models using AutoCAD software, and generate paper space layouts from model space geometry.
4. Visualize three-dimensional solids from two-dimensional pictures.
5. Create a portfolio of drawings to demonstrate their abilities to potential employers.
6. Communicate effectively using manual and computerized graphical techniques.

List of Exercises:**Auto CAD:**

1. Introduction to AutoCad : File creation, Fix the page limits and Title block.
2. Drawing and plotting: Snap, Grid, Limits, Osnap, line types and weights, text, plotting.
3. Drawing Commands: Methods of drawing lines, arcs, circles and Polygons.
4. Modifying Commands: Erase, trim, array, lengthen, break, mirror, offset, move, copy etc. Layers, Dimensioning, Hatching methods to show different materials.
5. Isometric view of solids Elements
6. Plan of one room building.

Drawings:

7. Introduction to use of drawing instruments and Lettering practice. Construction of polygons dimensioning practice of lines, circles, arcs using aligned and chain dimensioning systems.
8. Projection of points in different quadrants.
9. Projection of lines
10. First angle projections, conversion of pictorial views into orthographic views
11. Projections of prism, pyramid, cylinder and cone - axis parallel to one plane and perpendicular to the other plane, Parallel to both planes.
12. Introduction to Isometric projection - Isometric views of basic solids - prism, pyramid, cylinder and cone – perspective projections – one point method

Text Books:

1. Gurcharan Singh, “Civil Engineering Drawing”, Standard Publishers Distributors, 2005
2. Shah, M.B. and Rana B.C, “Engineering Drawing and Computer Graphics”, Pearson Education, 2008

Reference Books:

1. Bhatt N.D., Panchal V.M. and Ingle P.R., “Engineering Drawing”, Charotar Publishing House, 2014.
2. Agrawal B. and Agrawal C. M, “Engineering Graphics”, TMH Publication, 2012
3. Narayana, K.L. and P Kannaiah, Text book on “Engineering Drawing”, Scitech Publishers, 2008
4. David A. Madsen, David P. Madsen “Engineering Drawing and Design”, Cengage Learning, 2016
5. IS 962 : 1989, IS 965 : 1963

19CE1002	FIELD PRACTICES – I (SMART ARCHITECTURAL PLANNING)	L 0	T 0	P 2	C 1

Course Objectives:

1. To be familiar with the Sketchup software in developing Plan for any building and 3D View of building and other components involved in it.
2. Familiar to visualize the realistic view of interior and exterior part of the building and output from different rendering tools.
3. To be familiar with the wholistic view of any proposed residential building of their own use.

Course Outcomes:

Student will be able to

1. Understand the concept of Planning
2. Interpret the components of the building by creative visualization.
3. Develop the complete model of a building.

Descriptions:

1. Planning of the one roomed Building.
2. Extrusion of the Plan.
3. Fixing the interior and exterior components of the building.
4. Creating wholistic view of the building using Lumion / V-Ray Desk.

19CE1003	FIELD PRACTICES – II (INTELLIGENT MEASUREMENT TECHNIQUES)	L	T	P	C
		0	0	1	0.5

Course Objectives:

1. To familiarize with the drawing and execution of a plan
2. To familiarize with the setting out of foundation
3. To construct the foundation as per plan

Course Outcomes:

Student will be able to

1. Develop a building plan with measurements.
2. Execute setting-out of foundation and excavation the building plan
3. Construct foundation of the building

Descriptions:

1. Building Plan for a Single Room Building with measurements. - Column Centre line Drawing for marking of columns - Footing Centre line Drawing for excavation of soil.
2. Setting out of Foundation in the field.
3. Foundation Excavation of Soil.
4. Construction of Foundation and backfilling

19CE2001	CIVIL ENGINEERING – SOCIETAL AND GLOBAL IMPACT	L	T	P	C
		2	0	0	2

Course Objectives:

1. To provide awareness of the importance of civil engineering and the impact it has on the society and at global levels
2. To impart awareness of the impact of civil engineering for the various specific fields of human endeavor
3. To inculcate the need to think innovatively to ensure sustainability

Course Outcomes:

Student will be able to

1. Identify the impact of civil engineering projects on the society at large and on the global arena.
2. Justify the need for infrastructure for energy generation
3. Recommend sustainable environment keeping aesthetics intact
4. Bring out the scope of civil engineers for environment protection
5. Build good environment by reducing the factors impacting the quality of life
6. Apply professional and responsible decisions on the environmental effects

Module 1: INTRODUCTION: Recent major civil engineering breakthroughs and innovations- global warming - impact and causes- evaluating future requirements for various resources - GIS and applications for monitoring systems - human development index - ecological footprint of India vs other countries and analysis

Module 2: UNDERSTANDING THE IMPORTANCE OF CIVIL ENGINEERING: Shaping and impacting the world - The ancient and modern marvels and wonders in the field of Civil Engineering- future vision for Civil Engineering

Module 3:INFRASTRUCTURE: Metrocities, smart cities, futuristic visions- transportation – energy generation - water provisioning- telecommunication needs- awareness of various codes and standards governing infrastructure development- innovations and methodologies for ensuring sustainability

Module 4: EFFECTS ON ENVIRONMENT: Solid waste management, water purification, wastewater treatment and recycling, hazardous waste treatment- flood control - river interlinking- multi-purpose water projects, atmospheric pollution- global warming phenomena and pollution mitigation measures, stationarity and nonstationarity- environmental metrics and monitoring

Module 5: BUILT ENVIRONMENT: Facilities management -climate control- recycling -temperature and sound control in built environment - intelligent and smart buildings - aesthetics of built environment- innovations and methodologies for ensuring sustainability

Module 6: CIVIL ENGINEERING PROJECTS: Environmental impact analysis procedures- advanced construction techniques for better sustainability- techniques for reduction of greenhouse gas emissions in various aspects of civil engineering projects.

Text Books:

1. Michael Murray, “Corporate Social Responsibility in the Construction Industry”, Taylor and Francis, 2009
2. Robert L. France “Handbook of Water Sensitive Planning and Design”, CRC Press. 2002

Reference Books:

1. Brito, Ciampi, Vasconcelos, Amarol, Barros,“Engineering impacting Social, Economical and working environment”, 120 ASEE Annual Conference and Exposition, 2013
2. Environmental Impact Assessment: Theory and Practice, [Anji Reddy](#), [Mareddy, Anil Shah](#) and [Naresh Davergave](#), Butterworth-Heinemann, 2017
3. Centre for Water Sensitive Cities, “Blueprint for a water sensitive city”, Monash University, 2012
4. Žiga Turk,“Global Challenges and the Role of Civil Engineering”, Chapter 3 in: Fischinger M.(eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht, 2014
5. NAE Grand Challenges for Engineering, “Engineering for the Developing World - The Bridge”, Vol 34, No.2, Summer 2004.
6. Allen M. “Cleansing the city”, Ohio University Press. Athens Ohio,2008

19CE2002	ENERGY SCIENCE AND ENGINEERING	L	T	P	C
		2	0	0	2

Course Objectives:

1. To provide an introduction to energy systems and renewable energy resources
2. To provide knowledge to explore society’s present needs and future energy demands
3. To impart knowledge on design of various civil engineering systems/ projects dealing with energy generation paradigms in an efficient manner.

Course Outcomes:

Student will be able to

1. List and explain the main sources of energy and their primary applications nationally and internationally
2. Understand the energy sources and scientific concepts/principles behind them
3. List and describe the primary renewable energy resources and technologies.
4. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
5. Collect and organize information on renewable energy technologies

- Understand the Engineering involved in projects utilizing these sources

Module 1: INTRODUCTION TO ENERGY SCIENCE: Scientific principles - historical interpretation to place energy use in the context of pressing societal, environmental and climate issues- Introduction to energy systems and resources - Introduction to Energy, conventional and non-conventional sources, sustainability and the environment.

Module 2: ENERGY SOURCES: Overview of energy systems, sources, transformations, efficiency, and storage - fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present and future

Module 3: REMEDIES AND ALTERNATIVES FOR FOSSIL FUELS: Hydropower, biomass, wind, solar, nuclear, wave, tidal and hydrogen- sustainability and environmental trade-offs of different energy systems- possibilities for energy storage or regeneration.

Module 4: ENERGY AND ENVIRONMENT: Energy efficiency and conservation- introduction to clean energy technologies - importance in sustainable development - carbon footprint - energy consumption and sustainability- introduction to the economics of energy- linkages between economic and environmental outcomes.

Module 5: CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES: Coal mining technologies - oil exploration offshore platforms - underground and under-sea oil pipelines - solar chimney project - wave energy caissons - nuclear reactor containment buildings and associated buildings - hydroelectric power project

Module 6: ENGINEERING FOR ENERGY CONSERVATION: Concept of green building and green architecture- LEED ratings - embodied energy analysis - tool for measuring sustainability - energy audit of facilities - optimization of energy consumption.

Text Books:

- Giri N.K, “Alternate Energy (Sources, Applications and Technologies)”, Khanna Publishers, 2012
- Amlan Chakrabarti, “Energy Engineering and Management”, PHI Learning Pvt. Ltd., 2011
- John Andrews and Nick Jelly, “Energy Sciences: Principles, Technologies and Impacts”, OUP Oxford, 2017

Reference Books:

- Boyle, Godfrey, “Renewable Energy”, 2nd edition, Oxford University Press, 2004
- Jean-Philippe- Zaccour, Georges (Eds.), “Energy and Environment Set: Mathematics of Decision Making”, Loulou, Richard- Waaub, XVIII, 2005
- Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A, “Energy and the Environment”, 2 Edition, John Wiley, 2006
- UNDP, “Energy and the Challenge of Sustainability”, World Energy assessment, 2000
- Adrian Bejan, Peter Vadász, Detlev G. Kröger, “Energy and the Environment”, Springer Sciencand Business Media. 1999

19CE2003	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide knowledge about statics with emphasis on force equilibrium and free body diagrams.
- To expose to the stresses and response of elements.
- To impart the mechanical behavior of materials under various load conditions.

Course Outcomes:

Student will be able to

- Illustrate the concepts of mechanics
- Identify the philosophies to suite suitable sections
- Examine the forces in the members
- Analyse the response of the elements

5. Evaluate the behavior based on the response
6. Apply the basic principles to solve problems in mechanics

Module 1: INTRODUCTION: Centroid - centre of gravity - moment of inertia of plane sections - theorems of moment of inertia - composite sections - mass moment of inertia of circular plate, cylinder, cone, sphere, hook.

Module 2: DYNAMICS: Particle dynamics- rectilinear motion - plane curvilinear motion - relative and constrained motion - newton's second law: rectangular, path, and polar coordinates - work-kinetic energy, power and potential energy - impulse-momentum- impact - direct and oblique.

Module 3: KINETICS OF RIGID BODIES: Principles in dynamics - types of motion - D'Alembert's principle: plane motion and connected bodies - work energy principle: plane motion and connected bodies - kinetics of rigid body rotation

Module 4: BASIC STRUCTURAL ANALYSIS: Stability of equilibrium - equilibrium in three dimensions - method of sections - method of joints - simple trusses - beams - types of beams

Module 5: VIRTUAL WORK AND ENERGY METHOD: Virtual displacements - degrees of freedom - energy equation for equilibrium - analysis of statically determinate beams - cantilever, simply supported beam, overhanging beam: point load, UDL and UVL

Module 6: SIMPLE STRESSES AND STRAINS: St. Venant's principle - types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – working stress – factor of safety – lateral strain, Poisson's ratio and volumetric strain – relation between moduli – bars of varying section – composite bars– temperature stresses

Text Books:

1. Irving H. Shames, "Engineering Mechanics", 4th Edition, Prentice Hall, 2006
2. Beer F. P and Johnston E. R, "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2011
3. Egor, P.Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2003.

Reference Books:

1. Hibbler R. C., "Engineering Mechanics: Principles of Statics and Dynamics", Pearson Press. 2006
2. Andy Ruina and Rudra Pratap, "Introduction to Statics and Dynamics", Oxford University Press, 2011
3. Shanes and Rao, "Engineering Mechanics", Pearson Education, 2006
4. Bansal R.K, "A Text Book of Engineering Mechanics", Laxmi Publications, 2010
5. Khurmi R.S., "Engineering Mechanics", S. Chand and Co. 2010

LIST OF COURSES

S. No.	Course Code	Course Name	Credits
1	17CE2067	Strength of Materials for Agricultural Engineering	3:1:0
2	18CE1001	Basics of Surveying and Levelling	1:0:1
3	18CE2001	Smart Cities and Future Urbanism	3:0:0
4	18CE2002	Basics of Soil Mechanics	2:0:1
5	18CE2003	Building Construction and Cost Estimation	2:1:0
6	18CE2004	Watershed Hydrology	2:0:1
7	18CE3001	Biotechnological Applications for Geotechnical Engineering	3:0:0
8	18CE3002	Environmental Chemistry and Microbiology	3:0:0
9	18CE3003	Water and Wastewater Treatment Technology	3:0:0
10	18CE3004	Surfacewater Hydrology	3:0:0
11	18CE3005	Groundwater Hydrology	3:0:0
12	18CE3006	Design of Hydraulic and Conveyance Structures	3:0:0
13	18CE3007	Advanced Hydrology and Environmental Engineering Laboratory	0:0:2
14	18CE3008	Aquatic Ecosystems	3:0:0
15	18CE3009	Impact of Climate Change on Water Resources	3:0:0
16	18CE3010	Urban Water Management	3:0:0

Sl. No	Code No.	Course Name	Credits			
			L	T	P	C
1	18CE1002	Civil Engineering - Societal and Global Impact	2	0	0	2
2	18CE1003	Energy Science and Engineering	2	0	0	2
3	18CE1004	Engineering Drawing for Civil Engineers	0	0	6	3
4	18CE2005	Disaster Preparedness and Planning	2	0	0	2
5	18CE2006	Construction Engineering and Management	3	0	0	3
6	18CE2007	Geology and Materials	3	0	0	3
7	18CE2008	Engineering Mechanics	3	1	0	4
8	18CE2009	Instrumentation and Sensor Technologies for Civil Engineering Applications	3	0	0	3
9	18CE2010	Materials Testing and Evaluation Laboratory	0	0	2	1
10	18CE2011	Engineering Practices Laboratory	0	0	4	2
11	18CE2012	Computer - Aided Civil Engineering Drawing	0	0	3	1.5
12	18CE2013	Computer Applications Laboratory	0	0	3	1.5
13	18CE2014	Design and Drawing	0	0	3	1.5
14	18CE2015	Fluid Mechanics	3	0	0	3
15	18CE2016	Solid Mechanics	3	0	0	3
16	18CE2017	Surveying and Geomatics	3	0	0	3
17	18CE2018	Structural Analysis	3	0	0	3
18	18CE2019	Hydraulic Engineering	3	0	0	3
19	18CE2020	Reinforced Concrete Elements	3	0	0	3
20	18CE2021	Design of Steel Structures	3	0	0	3
21	18CE2022	Soil Mechanics	3	0	0	3

22	18CE2023	Foundation Engineering	3	0	0	3
23	18CE2024	Concrete Technology	2	0	0	2
24	18CE2025	Hydrology and Water Resources Engineering	3	0	0	3
25	18CE2026	Environmental Engineering	3	0	0	3
26	18CE2027	Transportation Engineering	3	0	0	3
27	18CE2028	Quantity Surveying and Estimation	3	0	0	3
28	18CE2029	Survey Laboratory	0	0	2	1
29	18CE2030	Fluid Mechanics and Machinery Laboratory	0	0	2	1
30	18CE2031	Environmental Engineering Laboratory	0	0	2	1
31	18CE2032	Geotechnical Engineering Laboratory	0	0	2	1
32	18CE2033	Concrete and Highway Laboratory	0	0	2	1
33	18CE2034	Design Project	0	0	4	2
34	18CE2035	Interior Design	2	0	0	2
35	18CE2036	Construction Equipment and Automation	2	0	0	2
36	18CE2037	Structural Geology	2	0	0	2
37	18CE2038	Expansive soil	2	0	0	2
38	18CE2039	Ground Improvement Methods	2	0	0	2
39	18CE2040	Design of Reinforced Concrete Structures	3	0	0	3
40	18CE2041	Prestressed Concrete	3	0	0	3
41	18CE2042	Design of Precast Concrete Structures	3	0	0	3
42	18CE2043	Basics of Dynamics and Aseismic Design	3	0	0	3
43	18CE2044	Repairs and Rehabilitation of Structures	3	0	0	3
44	18CE2045	Masonry Structures	3	0	0	3
45	18CE2046	Irrigation Engineering and Hydraulic Structures	3	0	0	3
46	18CE2047	Open Channel Flow	3	0	0	3
47	18CE2048	Groundwater Engineering	3	0	0	3
48	18CE2049	Surface Hydrology	3	0	0	3
49	18CE2050	Environmental Laws and Policy	3	0	0	3
50	18CE2051	Basics of Remote Sensing and Geographical Information System	3	0	0	3
51	18CE2052	Municipal Solid Waste Management	3	0	0	3
52	18CE2053	Air and Noise Pollution Control	3	0	0	3
53	18CE2054	Pavement Materials and Design	3	0	0	3
54	18CE2055	Airport Planning and Design	3	0	0	3
55	18CE2056	Town Planning and Architecture	3	0	0	3
56	18CE2057	Structural Design of Foundation	3	0	0	3
57	18CE2058	Traffic Engineering and Management	3	0	0	3
58	18CE2059	Green Buildings	3	0	0	3
59	18CE2060	Global Climate Change and its Impact	3	0	0	3
60	18CE2061	Smart Buildings	3	0	0	3

61	18CE2062	Energy Efficient Buildings	2	0	0	2
62	18CE3011	Advanced Solid Mechanics	3	0	0	3
63	18CE3012	Structural Dynamics	3	0	0	3
64	18CE3013	Finite Element Methods in Structural Engineering	3	0	0	3
65	18CE3014	Seismic Analysis and Design of Structures	3	0	0	3
66	18CE3015	Theory of Structural Stability	3	0	0	3
67	18CE3016	Numerical Analysis Laboratory	0	0	4	2
68	18CE3017	Advanced Concrete Laboratory	0	0	4	2
69	18CE3018	Model Testing Laboratory	0	0	4	2
70	18CE3019	Structural Design Laboratory	0	0	4	2
71	18CE3020	Theory of Thin Plates and Shells	3	0	0	3
72	18CE3021	Theory and Applications of Cement Composites	3	0	0	3
73	18CE3022	Advanced Steel Design	3	0	0	3
74	18CE3023	Design of Advanced Concrete Structures	3	0	0	3
75	18CE3024	Structural Optimization	3	0	0	3
76	18CE3025	Design of High Rise Structures	3	0	0	3
77	18CE3026	Design of Formwork	3	0	0	3
78	18CE3027	Design of Masonry Structures	3	0	0	3
79	18CE3028	Advanced Design of Foundation Structures	3	0	0	3
80	18CE3029	Design of Bridges	3	0	0	3
81	18CE3030	Soil Structure Interaction	3	0	0	3
82	18CE3031	Design of Industrial Structures	3	0	0	3
83	18CE3032	Analysis of Laminated Composite Plates	3	0	0	3
84	18CE3033	Fracture Mechanics of Concrete Structures	3	0	0	3
85	18CE3034	Design of Prestressed Concrete Structures	3	0	0	3
86	18CE3035	Atmospheric Environmental Pollution and Control	3	0	0	3
87	18CE3036	Surface Flow Hydrology	3	0	0	3
88	18CE3037	Environmental Chemistry and Microbiology	3	0	0	3
89	18CE3038	Water Resources Planning and Systems Engineering	3	0	0	3
90	18CE3039	Water and Wastewater Treatment Technology	3	0	0	3
91	18CE3040	Hydrology laboratory	0	0	4	2
92	18CE3041	Advanced Environmental Engineering Laboratory	0	0	4	2
93	18CE3042	GIS Laboratory	0	0	4	2
94	18CE3043	Computational Techniques Laboratory	0	0	4	2
95	18CE3044	Solid and hazardous waste management	3	0	0	3
96	18CE3045	Environmental Impact Assessment	3	0	0	3
97	18CE3046	Cleaner Production and Sustainable Development	3	0	0	3
98	18CE3047	Environmental Policies and Legislation	3	0	0	3
99	18CE3048	Nanotechnology in Environmental Engineering	3	0	0	3

100	18CE3049	Electrochemical water processing and water treatment	3	0	0	3
101	18CE3050	Noise Pollution and Control Techniques	3	0	0	3
102	18CE3051	Occupational Health and Safety	3	0	0	3
103	18CE3052	Groundwater Hydrology	3	0	0	3
104	18CE3053	Design of Hydraulic and Conveyance Structures	3	0	0	3
105	18CE3054	Principles of Integrated Water Resources Management	3	0	0	3
106	18CE3055	Hydro Power Engineering	3	0	0	3
107	18CE3056	River Mechanics and Sediment Transport	3	0	0	3
108	18CE3057	Forest, urban and agricultural Watershed Management	3	0	0	3
109	18CE3058	Wetland Hydrology	3	0	0	3
110	18CE3059	Impact of Climate Change on Water Resources	3	0	0	3
111	18CE3060	Urban Water Hydrology and Management	3	0	0	3
112	18CE3061	Remote Sensing and Geographical information system	3	0	0	3
113	18CE3062	Subsurface Investigations and Field Testing	3	0	0	3
114	18CE3063	Advanced Foundation Engineering	3	0	0	3
115	18CE3064	Strength and deformation characteristics of soils	3	0	0	3
116	18CE3065	Theoretical Soil Mechanics with Finite Element Applications	3	0	0	3
117	18CE3066	Dynamics of Soils and Foundations	3	0	0	3
118	18CE3067	Soil Mechanics Laboratory - I	0	0	4	2
119	18CE3068	Soil Mechanics Laboratory - II	0	0	4	2
120	18CE3069	Subsoil Exploration Laboratory	0	0	4	2
121	18CE3070	Geotechnical Design Studio	0	0	4	2
122	18CE3071	Ground Improvement Techniques	3	0	0	3
123	18CE3072	Pavement Analysis and Design	3	0	0	3
124	18CE3073	Environmental Geotechnology	3	0	0	3
125	18CE3074	Mechanics of unsaturated soils	3	0	0	3
126	18CE3075	Rock mechanics in Engineering Practice	3	0	0	3
127	18CE3076	Earth Retaining Structures	3	0	0	3
128	18CE3077	Reinforced Soil Structures	3	0	0	3
129	18CE3078	Geology in Geotechnical Engineering	3	0	0	3
130	18CE3079	Slope Stability and Landslides	3	0	0	3
131	18CE3080	Geotechnical Earthquake Engineering	3	0	0	3
132	18CE3081	Professional Practices in Design of Geotechnical Structures	3	0	0	3
133	18CE3082	Offshore Engineering	3	0	0	3
134	18CE3083	Disaster Management	2	0	0	0

17CE2067 STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING
Credit: 3:1:0

Course Objectives:

- To understand the basics of solid mechanics
- To draw the bending moment and shear force diagram for determinate and indeterminate beams
- To learn the different types of stresses on structural elements

Course Outcomes:

Students at the end of the course will be able to

- understand the basic concepts of solid mechanics
- sketch shear force and bending moment diagram for determinate beams
- interpret the stresses acting on beams
- determine shear force and bending moment for indeterminate beams
- determine the buckling load on columns for different end conditions.
- calculate deflection for determinate beams under standard loading condition

Description:

Rigid and deformable bodies – Stability, strength and stiffness- Stress strain behaviour of ductile and brittle material in uniaxial state of stress - Hooke's law - Poisson's ratio – Relationship between elastic constants - Relationship between loading - Shear force and bending moment - Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated loads and uniformly distributed loads - Maximum bending moment and point of contra flexure - Theory of simple bending assumptions – Simple bending equation –Section modulus - Application of bending equation - Shear stresses-variation of shear stress in beam cross section - Application of shear stress relations for rectangle, circle and triangle cross sections - Fixed Beams - Fixed end moments, reactions, slope and deflection for standard cases of loading - Continuous beams - support reactions and moments – Theorem of three moments – Shear force and bending moment diagrams - Behaviour of short and long columns - Euler's theory of long columns – Critical loads for prismatic columns with different end conditions - Rankine-Gordon Formula - Deflection in statically determinate beams – Double integration method.

Text Books:

1. Rajput.R.K. "Strength of Materials", S.Chand and Company Ltd., New Delhi 2015.
2. Bansal R.K "Strength of Materials", Laxmi Publications, 2004.

Reference Books:

1. Egor.P.Popo v, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi 2001
2. Vazirani.V.N, Ratwani.M.M, Duggal .S.K, "Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1", Khanna Publishers, New Delhi 2014.
3. Timoshenko.S.P. and Young .D.H., "Elements of Strength of Materials", V Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 2002.
4. Beer. F.P. and Johnston.E.R., "Mechanics of Materials", Tata McGraw Hill, New Delhi 2010.
5. Subramaniam.R., "Strength of Materials", Oxford university Press, 2005

18CE1001 BASICS OF SURVEYING AND LEVELLING

Credit: 1:0:1

Course Objectives:

- To give hands-on training on the use of chains and levelling instruments
- To introduce the levelling concepts
- To familiarize the students with basic surveying procedures and modern surveys.

Course Outcomes:

At the end of the course student will be able to

- recall the principles of surveying equipment
- select methods to measure distances
- schedule field surveying operations.
- examine the implementation of surveying procedures for contour surveying
- appraise the usage of equipment and methods in levelling procedures
- formulate the surveying methods and executions

Description:

Introduction and Chain Surveying - Definition, principle and classification of surveying – conventional signs – equipment used in chain survey – ranging and chaining – setting perpendiculars –Errors in chaining – corrections due to sag, slope, curvature, temperature, pressure – Compass: Basic principles - Types - Bearing - Sources of errors - Traversing - Plotting - Adjustment of closing error - Levelling - Type of levels and staves – bench marks – temporary and permanent adjustments – fly, check, profile levelling – booking - reduction – arithmetic checks –Errors in levelling - Theodolite - Types - Description - Horizontal and vertical angles - repetition and reiteration methods – Traversing - Closing error and distribution-Bowditch's and Transit rule – Omitted measurements -Heights and distances - Contouring, Areas and Volumes Contouring – characteristics and uses of contours – calculation of areas from field notes and plan – graphical and instrumental methods – volume of earth work – Total stations

Practices:

Marking the boundary of a plot on the ground using chain - Running a closed compass traverse – plotting and adjustments - Fly levelling - Contour survey of an area preparation of contour map - Finding height of object by using Theodolite - Introduction to Total Station (Area calculation)

Text Books:

1. Kanetkar, T.P and Kulkarni, S.V., “Surveying and levelling parts 1 and 2”, Vidyarthi Griha Prakashan, Pune, 2010.
2. Bhavikatti SS, “Surveying and leveling”, I.K.International Publishing House Pvt. Ltd. 2008

Reference Books:

1. Rangwala S. C., “Surveying and Levelling”, Charotar Publishing House Pvt. Limited, 2011
2. Basak, N, “Surveying and Levelling”, McGrawHill and Co, 2014

18CE2001 SMART CITIES AND FUTURE URBANISM

Credits: 3:0:0

Course Objectives:

- To interpret and select the needs for consumers and stakeholders in smart cities;
- To introduce the Smart Cities Mission in India and the issues related with it;
- To familiarize the concept of Smart City.

Course Outcomes:

At the end of the course, student will be able to

- familiarize the concept of Smart Cities
- familiar with Smart City Mission in India
- understand the Environment Domain of Smart City and provide solutions
- understand the Transportation Domain of Smart City and provide solutions
- understand the Public Service Domain of Smart City and provide solutions
- Assess the performance of Smart Cities.

Unit I - INTRODUCTION TO SMART CITIES: Smart Cities in India– concept, origin and ideology - characteristics of smart cities – smart economy, smart people, smart governance, smart mobility, smart environment, smart living – smart building

SMART CITIES MISSION IN INDIA: Smart City Mission – Objectives, features, coverage and duration - strategy, challenges, profile of smart cities - Mission implementation – selection process

Unit II - ENVIRONMENTAL DOMAIN: Pollution reduction – Noise, carbon emissions, groundwater contaminations - climate change – flooding, drought, water supply– ageing Infrastructure, smart metering, security, sewer - waste collection and management – route Inefficiencies, landfill monitoring.

Unit III - TRANSPORTATION DOMAIN: Transportation Planning – Transport Philosophy - Travel demand estimation - Public transport - External connectivity - Internal transport - Pedestrian facilities, streetscape, signage systems, smart transportation systems.

Roadways / Highways – congestion, accident / Breakdown notifications, maintenance, bad motorists, parking, pollution, fuel scarcity and pricing.

Railways – On-time Services - Ageing Infrastructure - Service Over / Under Utilization, Integration with Other Public Transport Services.

Aerospace – Over / Under Utilization, Pollution, Security, Integration with other Public Transport Services.

Unit IV - PUBLIC SERVICE DOMAIN: PUBLIC SERVICES: Safety – Natural disasters – Maintenance - Notification and Awareness - Child / Elderly / Disabled Person Welfare - Police – Crime, Prevention - Civil Unrest, Parking Traffic - Fire – Response Times, False Alarms, Delayed Notifications - Unaware of Dangers within a Situation - Health – Long Waiting Times - Disease Control and Prevention - Community Outreach - Bin Filling - Employee and Asset Oversight.

Unit V - CRITICAL EVALUATION OF PERFORMANCE OF SMART CITY CONCEPT AND CASE STUDY: Smart about the Smart City – Critical evaluation of performance of Smart City concept - contradiction of being smart – Smart vs Dull - Fast vs Slow - Urban and Digital divide - social divide - Financial and Economic viability of smart cities - case study – Tel Aviv – the Smartest City

Text Books:

1. Amitabh Satyam and Igor Calzada, “The Smart City Transformations: The Revolution of 21st Century”, Bloomsbury India, New Delhi, 2017
2. ArunFirodia, “Smart City”, Vishwkarma Publications, Pune, 2015
3. Mani, N, “Smart Cities and Urban Development in India”, New Century Publications, New Delhi, 2016
4. Tripathi Gupta, “Smart Cities Transforming India”, Pentagon Press, New Delhi, 2016

Reference Books:

1. Sylviane Toporkoff, Sebastien Levy, Alan Shark, “Smart Cities for a Bright Sustainable Future – A Global Perspective”, Kindle Edition, Washington, 2014
2. Alex Grosu, “Public Transport in Smart Cities: An Utopian View by Alex Grosu”, Kindle Edition, Amazon Digital Services LLC, 2017
3. Dutton, W. H., Blumler, J. G., and Kraemer, K. L. “Wired cities: Shaping future communication”, New York: Macmillan, 1987
4. Stamatina Th. Rassia, Panos M. Pardalos, “Cities for Smart Environmental Energy Futures: Impacts on Architecture and Technology (Energy Systems)’, Springer, Softcover reprint of the original, 1st Ed 2014 Edition, 2015
5. Houbling Song, Ravi Srinivasan, Tamim Sookoor, Sabina Jeschke, “Smart Cities: Foundations, Principles and Applications”, Wiley Publishers, 1st Edition, 2017

18CE2002 BASICS OF SOIL MECHANICS

Credits: 2:0:1

Course Objectives:

- To gain knowledge about index and engineering properties of soil
- To study about stress distribution and settlement behaviour of soil
- To gain knowledge on stability of soils.

Course Outcomes:

At the end of the course, student will be able to

- explain the multiphase nature of soils and to derive quantities relating to the volumes and masses of the different phases of a soil
- describe and classify soils according to Indian Standard
- predict the flow through soil.
- estimate the magnitude of settlement due to consolidation process.
- determine shear strength parameters and stress changes in soil
- evaluate the index and engineering properties of soil.

Description:

Introduction to soil mechanics, phase diagram, physical and index properties of soil - engineering classification of soils – Atterberg's limits - Effective and neutral stress - Seepage Analysis - Flow net construction- Capillary phenomena - Two dimension flow - Darcy's law - Permeability - Constant head method - falling head method - Stratified Strata - Factors influencing soil permeability - Seepage - Laplace's equation - Quick sand - Liquefaction - Flow nets - Shear strength of cohesive and cohesion less soils - Mohr-Coulomb failure theory - Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests - Pore pressure parameters

Practices:

Determination of water content - Specific gravity of soil - Field density of soil by core cutter method - Grain size analysis by sieving - Atterberg's Limit - Standard proctor test - Unconfined compressive strength of soil

Text Books:

1. Punmia B C, Jain A K and Jain A K. "Soil Mechanics and Foundations". Laxmi Publications (P) Ltd. New Delhi, 2005.
2. Ranjan Gopal and Rao A S R., "Basic and Applied Soil Mechanics", Welley Easters Ltd., New Delhi, 1993.

Reference Books:

1. Singh Alam, "Soil Engineering", Vol. I, CBS Publishers and Distributions, Delhi, 1994.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, 2011.
3. Venkatramiah, "Geotechnical Engineering", New Age International (P) Limited, 1993.
4. Purushothama Raj. P., "Soil Mechanics and Foundation Engineering" Pearson Education, 2008

18CE2003 BUILDING CONSTRUCTION AND COST ESTIMATION

Credits: 2:1:0

Course Objectives:

- To understand the properties of building materials
- To identify the building components and their functions
- To estimate the cost of the structure

Course Outcomes:

At the end of the course, the student will be able to

- define the physical and mechanical properties of earth materials
- identify the physical and mechanical properties of the building materials
- adopt the construction methodology for different types of construction
- evolve the detailed specification for different types of structures
- determine the rates of various items of civil works
- justify estimated cost of civil construction projects

Description:

Rocks - Stones - characteristics of stones – material property – Bricks and blocks - Properties of clay bricks - material test – Timber - Cement - Concrete – Steel – Aluminium - Rubber - plastics – Glass - Foundations – plinth – sill – Lintels – Arches - stair cases - Flooring - Roofs and roof covering - Damp proofing – Termite proofing - Plastering and Pointing - Joinery - Painting - introduction to Quantity surveying – purpose of estimates - Types of estimates - Principles in selecting units of measurement for items, various units and modes of measurement for different trades –detailed specifications for various items of work - Types of agricultural buildings - related needs - Methods of estimation - estimate of walls - estimate of warehouse - polyhouse - Rate analysis and preparation of bills – Rates for various items of works – Economic methods for evaluating investments in buildings and building systems

Text Books:

1. Varghese P.C., “Building materials”, Prentice Hall, 2005.
2. Dutta.B.N, “Estimating and Costing in Civil Engineering Theory and Practice”, UBS Publishers Distributors Pvt Ltd, 2016.

Reference Books:

1. Bhavikatti S, “Building Constructions”, Prentice Hall, New Delhi 2007.
2. Rangwala, S.C., “Engineering Materials”, Charotar Publishing House, Anand, 2008.
3. Surendra Singh, “Building Materials”, Vikas Publishing Company, New Delhi, 1996.
4. Birdie.G.S, “A Text Book on Estimating and Costing”, DhanpatRai and Sons, New Delhi, 2000.
5. Rangwala .S.C, “Valuation of Real Properties”, Charotar Publishing House, Anand, 1984.

18CE2004 WATERSHED HYDROLOGY

Credits: 2:0:1

Course Objectives:

- To understand the concepts of watershed
- To characterize the watershed parameters
- To learn the measurement of hydrological parameters

Course Outcomes:

At the end of the course, student will be able to

- recall the watershed characteristics
- determine the streamflow parameters
- apply the knowledge of hydrograph analysis for rainfall-runoff modeling
- conduct water-budget analysis
- Interpret the effect of landuse changes on watershed characteristics
- conduct watershed analysis to improve the watershed management

Description:

Watershed characteristics - Hydrologic cycle - Watersheds – Water Balance – Surface and groundwater hydrology - Characteristics of hydrologic data - Rainfall-runoff - rainfall measurement – Representation of rainfall - Stream characteristics - Stream flow measurement - Water balance analysis - Abstractions – Evaporation, infiltration and interception – Infiltration indices – measurement of evaporation -

Morphometric analysis of watersheds - Hydrologic processes in different land covers: agricultural, forest, urban, floodplain and wetlands - Types of watershed models - Effects of land use change; Climate change.

Practices:

Estimation of average annual rainfall - Estimation of missing data of rainfall - Computation of runoff by SCS method and rational method - Streamflow velocity measurement - Derivation of unit hydrograph - Derivation of S-Curve - Conduction of flood routing

Text books:

1. P V Seethapathi, "Hydrology of Small Watersheds", TERI Press, 2014.
2. Subramanya K., "Hydrology", Tata McGraw Hill Co., New Delhi, 2009.
3. Ragunath H.M., "Hydrology", Wiley Eastern Ltd., New Delhi, 2011.

Reference books:

1. Chatterjee, S. N., "Water Resources Conservation and Management", Atlantic Publishers, 2008
2. Murthy, V.V.N., "Land and Water Management", Khalyani Publishers, 2004
3. Muthy, J. V. S., "Watershed Management", New Age International Publishers, 1998
4. Mutreja, K.N., "Applied Hydrology" - Tata McGraw Hill, 1986.

18CE3001 BIOTECHNOLOGICAL APPLICATIONS FOR GEOTECHNICAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To impart knowledge on microbiological applications
- To learn on the biotechnological processes
- To apply the bio-cementation process

Course Outcomes:

At the end of the course, student will be able to

- recall the various microorganisms, their classifications and characterization
- explain the various biotechnological processes
- quantify the biomass contents in a biotechnological product.
- compare the different mechanisms of ground improvement
- justify the importance of microbially induced calcite precipitation
- develop biotechnological processes for potential geotechnical applications

Unit I - INTRODUCTION TO MICROBIOLOGY: Microorganisms – groups of microorganisms – cells of microorganisms -classification and identification of fungi, algae and protozoa - enzymes as the catalysts of biochemical reactions - types of biogeochemical reactions - biogeochemical reactions - geotechnical modifications in-situ; bio-safety in geotechnical applications - major groups of *bacteria* suitable for geotechnical biotechnological processes

Unit II - INTRODUCTION TO BIOTECHNOLOGY: Biotechnology: Bioprocesses used in geotechnical biotechnology -stages of biotechnological process - upstream processes - acquiring of microbial strain from collection - selection of an enrichment culture, ecosystem and construction of genetically engineered microorganisms - core biotechnological process: batch cultivation – continuous cultivation - downstream processes - separation and concentration of biomass contents - aggregates of cells - separation and concentration of products - drying, mixing and packing of biotechnological products

Unit III - BIO-CEMENTATION: Calcium based microbial cementation in nature – calcium based cementation in macro-organisms- urease-dependent calcium-based microbial cementation - (MICP) in Engineering: Biochemistry of MICP - Use of Urease for MICP - Bacteria used in MICP - use of enrichment culture of indigenous microorganisms with urease activity in-situ - biocementation by injection, percolation, and spraying - activated sludge of municipal wastewater treatment plants as raw material dry

calcium-based biocement - Geotechnical Engineering applications of MICP

Unit IV- BIOTECHNOLOGICAL TREATMENT OF SOIL: Bio-aggregation to control wind soil erosion and dust emission- dust control technologies - Bio crusting using microbial Polysaccharides - Bioclogging; Biocementation of soil - Bio desaturation of water-saturated cohesionless soil - Bio encapsulation of soft soil; Bio immobilization of the Pollutants in Soil - sanitation of soil - comparison of the different mechanisms of ground improvement

Unit V- BIOREMEDIATION OF SOIL: Bioremediation of soil: options - advantages and disadvantages of biogeotechnologies for remediation -problems of bioremediation –in-situ and off-site - microbiological preparations for bioremediation - biotechnological control of dispersion of pollutants - leaching of the pollutants from sand - biomediated immobilization of sand- biomitigation of soil liquefaction through biogas production in situ - denitrification as a source of biogas production in situ - stability of biogas bubbles in soil -biogas production in-situ decreased primary consolidation settlement in clayey soils.

References:

1. Fernando PacecoTorgal and J.A.Labrincha, “Biotechnologies and Bio-inspired Materials for the Construction Industry: An Overview”, International Journal of Sustainable Engineering, Taylor and Francis Group, 2013, pp 1-12
2. Fernando Paceco Torgal, J.A.Labrincha, M.V.Diamanti, C.P.Yu and H.K.Lee (Editors), “Biotechnologies and Biomimetics for Civil Engineering”, Springer International Publishing, Switzerland, 2015
3. Volodymyr Ivanov and Viktor Stabnikov, “Construction Biotechnology”, Springer, 2017, ISBN: 978-981-10-1444-4.

18CE3002 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Credits: 3:0:0

Course Objectives:

- To impart knowledge on the transformation of chemicals in the environment
- To educate the basics of microbiology involved in air, water and soil.
- To study the basics of environmental chemistry, chemical reactions and electro kinetic properties.

Course Outcomes:

At the end of the course, student will be able to

- learn basic chemistry concepts
- gain competency in solving environmental issues
- able to determine chemical calculations required for treatment purpose
- identify contaminating chemicals and learn the conceptual skills
- apply micro- organisms for the treatment of wastes
- evaluate type, growth metabolism and culturing techniques of micro organisms

Unit I - INTRODUCTION: Importance of chemistry, Nano technology and biotechnology in environmental engineering- basic definitions-equilibrium-activity- various laws – gas laws-oxidation – reduction- stoichiometry-kinetic principles- sorption- adsorption theories.

Unit II - ENVIRONMENTAL CHEMISTRY PRINCIPLES: Enzymes and cofactors- Colloidal chemistry- properties- destabilisation of colloids- Acids and bases-buffer index- Water and wastewater analysis- quantitative chemistry and instrumental methods- optical –electrical- chromatographic methods- soil and atmospheric chemistry.

Unit III- APPLICATIONS OF NANOTECHNOLOGY: applications of Nano material in water and wastewater treatment-synthesis of materials-separation techniques-membrane filtration-types - Nano materials as adsorbents and oxidants- fate and toxicity

Unit IV- MICROBIOLOGY: classification of microorganisms- bacteria- viruses- protozoa-algae- classification- morphology- reproduction –culturing - growth curve- factors affecting growth- control of growth-pathogens.

Unit V- MICROBIOLOGY APPLICATIONS: applications in water and wastewater treatment environmental biotechnology – aerobic process: activated sludge process, oxidation ditches, rotating drums- oxidation ponds, anaerobic process: anaerobic digestion- anaerobic filters-biodegradation- bio-augmentation- bio-magnification, bioassay.

References:

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. “Chemistry for Environmental Engineers”, 3rd Edition. Tata McGraw Hill, New Delhi, 2013
2. Ronbald A. Hites , “Elements of Environmental Chemistry”, Wiley, 2007.
3. Bhatia, S.C., “Handbook of Environmental Microbiology”, Vol. I, II and III, Atlantic Publ. and Dist. Ltd., 2008.

18CE3003 ADVANCED WATER AND WASTEWATER TREATMENT TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To impart knowledge on characteristics of water and wastewater, primary and secondary treatment.
- To educate the methods of disposal of sludge and treated wastewater.
- To educate the students on the working principles and design of various physical, chemical treatment systems for water and wastewater.

Course Outcomes:

At the end of the course, student will be able to

- Imparts knowledge on characteristics and standards of water and wastewater
- Understand principle of water and wastewater treatment systems
- Design water and wastewater treatment systems.
- Evaluate efficiency of treatment units
- Illustrate the design principles of industrial wastewater
- Apply knowledge on the disposal and treatment of sludge.

Unit I - INTRODUCTION: Importance of water- quality and characteristics of water- physical- chemical- biological- standards; need of treatment- treatment methods for surface and ground water – natural treatment principles- sedimentation- aeration.

Unit II - WATER TREATMENT: Principle and design - aeration- types of aerators- coagulation – filtration- rapid sand filtration- disinfection methods- softening- lime soda process- carbonation- ion exchange- reverse osmosis- dialysis- removal of colour- de-fluoridation.

Unit III - WASTEWATER TREATMENT: Principle and design - screens, grit chamber- skimming tank- primary sedimentation tank- secondary treatment- activated sludge process- trickling filter- oxidation ponds- RBC- towers- tertiary treatment: chemical oxidation -advanced oxidation process- adsorption, removal of toxics

Unit IV- INDUSTRIAL WASTEWATER TREATMENT: Differences between domestic and industrial wastewater- characteristics-population equitant-reduction of strength- equalization- proportionating- neutralization-removal of oils and fats- removal of organic solids- precipitation- removal of nitrogen and phosphorous compounds.

Unit V- SLUDGE TREATMENTDISPOSAL: Characteristics of sludge- sludge treatment methods- reduction of moisture content- anaerobic and anaerobic treatment methods – energy from sludge-sludge beds- disposal methods- sludge as fertilizer.

References:

1. “Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.
2. Bajwa, G.S., “Practical Handbook on Public Health Engineering”, Deep Publishers, Simla, 2003
3. Metcalf and Eddy, “Wastewater engineering, Treatment and Reuse”, Tata McGraw-Hill, New Delhi, 2003.
4. Kuruvilla Mathew, Stewart Dallas, Goen Ho, Decentralized Water and Wastewater Systems, IWA Publications, 2008

18CE3004 SURFACEWATER HYDROLOGY**Credits: 3:0:0****Course Objectives**

- To provide a basic knowledge on different components of hydrologic cycle
- To impart practical experience in hydrological data acquisition, analysis
- To interpret hydrologic components on temporal and spatial scales

Course Outcome

At the end of the course, student will be able to

- possess a thorough knowledge of the hydrological processes associated with surface water
- analyze basic hydrologic data
- estimate the surface runoff
- measure flow in the streams
- conduct Probability analysis for extreme events
- conduct water budget analysis

Unit I - BASIC HYDRAULICS AND HYDROLOGY: Definition and introduction to hydraulics and hydrological science - Structure and properties of water - Conservation of mass and energy – Atmosphere – atmospheric air circulation – Cyclones, Fronts, Clouds - Hydrologic cycle: global to local scales- Radiation balance –Evaporation and condensation.

Unit II - FREQUENCY ANALYSIS AND STOCHASTIC HYDROLOGY: Return period - Random variable – Frequency distributions – Frequency analysis – Correlation coefficient – Method of least squares – Variance analysis - Simple and multiple regression analysis – Deterministic approach in hydrology - Stochastic hydrology - Introduction to: time series, deterministic and stochastic models.

Unit III - PRECIPITATION: Precipitation - Types of precipitation - Temporal and spatial distribution of precipitation - Precipitation measurement: precipitation gauges, satellite estimates of precipitation, radar measurement of precipitation - Interpretation of precipitation data: estimating missing precipitation data, double-mass analysis - Average precipitation over area: isohyets and Thiessen polygon - Depth-area-duration analysis.

Unit IV - RUNOFF AND STREAM FLOW: Phenomenon of runoff - Surface retention – Infiltration Runoff cycle - Estimating the volume of storm runoff: storm analysis - Basin characteristics - Streamflow measurements and rating curves - Flood estimation: unit hydrograph, flood frequency analysis, flood routing - Sediment yield and reservoir sedimentation.

Unit V - HYDROLOGIC ABSTRACTIONS: Factors affecting evaporation process - Water budget - Determination of reservoir evaporation - Energy budget - Determination of reservoir operation-Estimation of evaporation using Pan evaporimeter data Thornthwaite and Penman -Monteith methods - Lysimeter determination of evapotranspiration - Interception – Soil moisture - Infiltration loss estimation.

References:

1. Subramanya K., “Hydrology”, Tata McGraw Hill Co., New Delhi, 2017.
2. Ragunath H.M., “Hydrology”, Wiley Eastern Ltd., New Delhi, 2011.

3. VenTe Chow, "Hand book of Hydrology", McGraw Hill Publications, New York, 1995.
4. JeyaRamiReddy.P., "Hydrology", Laxmi Publications, New Delhi, 2005.
5. Vijay P.Singh, Elementary Hydrology, Prentice Hall of India, New Delhi, 2004.
6. Mutreja, K.N., "Applied Hydrology" Tata McGraw Hill, 1986.

18CE3005 GROUNDWATER HYDROLOGY

Credits: 3:0:0

Course Objectives:

- To understand the behavior of groundwater movement
- To estimate the groundwater modeling parameters
- To equip with analytical techniques to solve groundwater problems

Course Outcomes:

At the end of the course, student will be able to

- Understand the occurrence, distribution and movement of ground water
- enumerate the properties of groundwater
- calculate the aquifer parameters
- to resolve groundwater related problems including response of aquifers to pumping wells
- to develop a basic model for contaminant transport in subsurface media
- model and estimate groundwater recharge

Unit I - INTRODUCTION TO GROUNDWATER: Groundwater in Hydrologic Cycle – Occurrence of groundwater – Vadose Zone water; soil-water relationship - Hydrogeology – Hydrometeorology – soil sample analysis - Water bearing materials - Types of aquifers

Unit II - GROUNDWATER HYDRAULICS: Groundwater Movement - Darcy's law and its limitations - Stream lines and flow net analysis – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of wells – Interference of wells – Collector wells and Infiltration galleries.

Unit III - PUMPING TEST ANALYSIS: Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells.

Unit IV - GROUNDWATER TRANSPORT PROCESSES: Mass balance for transport of an ideal tracer – Contaminant transport mechanisms: advection, dispersion and diffusion – 1D, 2D and 3D solute transport – Pulse and step inputs – Solutions to advection, dispersion equation.

Unit V - GROUNDWATER RECHARGE AND MODELLING: Methods of artificial groundwater recharge – Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence - Wells in hard rock areas - Geophysical survey – Infiltration test – Permeability test – Drum culture experiment – Groundwater data analysis – Groundwater Models – MODFLOW, MODPATH and MT3D - Regional Groundwater Modeling.

References:

1. Todd D.K., "Groundwater Hydrology", John Wiley and Sons, Inc, New York, 2011.
2. Raghunath H.M. "Groundwater", 3rd Edition, Wiley Eastern Limited, NewDelhi , 2007.
3. Bouwer H., "Groundwater Hydrology", McGraw-Hill, New York, 1978.
4. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
5. Driscoll, "Groundwater and Wells", Johnson Filtration Systems, Inc., 1986.
6. Hantush M.S., "Hydraulics of wells in Advances in Hydro Science", Academic Press, 1964.

7. Ojha, C.S.P, Berndtsson, R and Bhunya, P., “Engineering Hydrology”, Oxford University Press, New Delhi, 2008.
8. K. R. Karanth, "Hydrogeology", TataMcGraw Hill Publishing Company, 1987

18CE3006 DESIGN OF HYDRAULIC AND CONVEYANCE STRUCTURES

Credits 3:0:0

Course Objectives:

- To impart knowledge about various types of hydraulic structures
- To introduce the planning and design concepts of hydraulic structures.
- To inculcate the importance of basic water supply and drainage systems in society

Course Outcomes:

At the end of the course the student will be able to

- understand the design criteria for various the types of dams
- analyze and design various hydraulic structures
- design a water supply distribution network
- design irrigation channels and cross drainage works
- estimate the hydropower potential
- design penstocks and surge tanks

Unit I- INTRODUCTION TO HYDRAULIC STRUCTURES: Introduction, types of hydraulic structures, storage, diversion, conveyance and distribution structures, capacity of a reservoir, reservoir silting, types of dams, factors governing selection of type of dam, selection of site for dam, preliminary and final investigations of dam sites, dam safety, design and construction of gravity and earth dams, flow-nets.

Unit II - DAM OUTLET WORKS: Principles and classification, design of ogee and open channel spillways- cavitations in spillway -energy dissipation devices, basins, buckets and gates- canals: types, components, selection.

Unit III - DESIGN OF IRRIGATION CHANNELS: Theory and design principles, design of canal sections in alluvial soil and hard rock zones canal inlets and sluices, gates maintenance problems, design examples of regulators and canal falls - Design of irrigation channels- principles of design- theories- canal head works- canal masonry works- canal outlets- maintenance of canals- cross drainage works- flow measuring devices.

Unit IV - WATER DISTRIBUTION NETWORKS:flow through pipes, solving pipe network, flow problems- use of computer software for network analysis- cross country pipelines, hydraulic transient analysis.

Unit V- HYDROPOWER STRUCTURES: Types of hydropower structures, components of a hydropower structure, intakes and trash racks, water conductor systems, penstocks, power canals, tunnels, surge tanks, anchor blanks.

References:

1. Punmia and Pandey, “Irrigation and Water Power Engg.” Laxmi Publications (P) Ltd., New Delhi, 2016.
2. Dandekar M.M and Sharma K.N, “Water Power Engineering”, 2nd edition Vikas publishers, 2013.
3. Asawa G.L. “Irrigation and Water Resources engineering” -New Age International (P) Ltd. Publishers, 1st edition, 2005.
4. Garg S.K, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers N.D. 13th edition, 1998.
5. Modi, “Irrigation, Water Resources and water power engineering”, P.N. -Standard Book House, New Delhi, 2nd edition, 1990.
6. Design of small dams, United States Bureau of Reclamation, Third Edition, 1987.

18CE3007 ADVANCED HYDROLOGY AND ENVIRONMENTAL ENGINEERING LABORATORY

Credits: 0:0:2

Course Objectives:

- To impart practical knowledge in hydrologic processes and aquifer parameters
- To demonstrate the sampling techniques and analytical methods in assessing air and water quality
- To introduce the principle of instrumentation in air and water quality analysis

Course Outcomes:

At the end of course, the student will be able to

- make use of groundwater flow and transport models
- estimate the aquifer parameters and carryout groundwater budget
- analyse the subsurface characteristics and conduct water balance studies
- collect, monitor and assess air and water quality of samples
- make use of instrumentation techniques and analyse the impact of pollution
- design suitable treatment method and control measures for water and air pollution problems

List of Experiments:

1. Rainfall data using mass curve, hyetograph from obtained data and Thiessen polygon method
2. Determination of Φ – index by double ring type infiltrometer
3. Determination of rate of evaporation and calculation of crop water requirement
4. Pumping test on well
5. Determination of hydraulic conductivity
6. Electrical resistivity method
7. Determination of heavy metals in the sample using UV Spectrophotometer
8. Estimation of Total Organic Carbon
9. Determination of Chemical
10. Determination of Biological Oxygen Demand
11. Microbial analysis using MPN method
12. Synthesis of nanoparticles
13. Solid waste analysis (Density, Components and Energy value)
14. Noise measurement
15. Determination of air quality

References:

1. Fetter C.W., “Applied Hydrogeology”, Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock., “Hydrogeology, Principles and Practice”, Blackwell Publishing, Oxford, UK, 2005.
3. Subramanya K., “Engineering Hydrology”, TataMcGraw Hill, New Delhi, 2008.
4. “Standard Methods for the Examination of Water and Wastewater”, 14th edition, American Public Health Association, Washington, DC, 1999.
5. Environmental Engineering Organisation, Government of India, New Delhi, 2010.
6. C.N Sawyer, P.L. MacCarty and G.F. Parkin, “Chemistry for Environmental Engineering and Science”, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.

18CE3008 AQUATIC ECOSYSTEMS

Credits: 3:0:0

Course Objectives:

- To understand the principles of natural ecosystems,
- To analyse the social dimensions and approaches
- To plan and implement the management of ecosystems

Course Outcomes:

At the end of the course, student will be able to

- understand the human intervention in ecosystem functions
- implement the reuse concepts
- examine the issues in aquatic ecology
- estimate environmental flows
- formulate sustainable ecosystems

Unit I - PRINCIPLES OF ECOSYSTEMS: Introduction to Ecosystems – Ecosystem structure and function – Ecosystem development – Atmosphere - Freshwater ecosystems – Agro ecosystems.

Unit II - AQUATIC ECOSYSTEMS: Ecosystem processes – Lakes, Rivers and Estuaries - Agricultural vs Ecosystem productivities – Riparian processes and interactions – Eco-hydrology – Impacts of human intervention – Water-food-ecosystem linkages – Living organisms in water- -Chemical classification of river water- -Influence of Chemical Factors on the Biota.

Unit III - ECOSYSTEM SERVICES: Water for irrigation – Livelihoods – Industrial / developmental needs – domestic and drinking water sector – Green, Blue and Grey water concepts – Economic instruments – Virtual water and trade.

Unit IV - FRESHWATER ECOSYSTEMS: Streams and Rivers – floodplains and wetlands – modification of floodplain ecosystems – interbasin transfer and water needs – human induced changes in lakes – Effect of climate change - modelling

Unit V - ECOSYSTEM MANAGEMENT: Ecosystem assessments – Environmental flows – Future freshwater challenges – Waterquality – Biological indicators – waterquality monitoring and assessment – Social and political issues of water use - Sustainable Ecosystems - Environmental governance.

References:

1. MalinFalkenmark and Johan Rockstrom, “Balancing water for Humans and Nature, Earthscan”, VA, USA, 2005.
2. Caroline M Figueres, Cecilia Tortajada and Johan Rockstrom (ed), Rethinking, “Water Management”, EarthScan, VA, USA, 2005.
3. Jeffries, M and Mills, D. “Freshwater Ecology, Principles and Applications”, Belhaven Press,1990
4. Gooch, G. D., A. Rieu-Clarke and P. Stalnacke (eds), “Integrating Water Resources Management: Interdisciplinary methodologies and strategies in Practice”, IWA Publishing, London, UK, 2012.
5. Jorgensen, S., J. G. Tundisi, J. M. Tundisi, “Handbook of inland aquatic ecosystem management”, CRC Prerss, FL, USA, 2013
6. Sithamparanathan, J., Rangasamy, A. and Arunachalam, N., “Ecosystem principles and sustainable agriculture”, Scitech Publishers, Chennai, 1999.

18CE3009 IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

Credits: 3:0:0

Course Objectives:

- To understand the hydrologic cycle with reference to climate
- To assess the impact on ecosystem services
- To diagnose the cause of climate related water issues

Course Outcomes:

At the end of the course, student will be able to

- enumerate the characteristics of climate change
- assess the impact of climate change
- utilize the tools for vulnerability assessment
- incorporate the adaptation techniques

- plan the mitigation activities
- implement the mitigation activities as per the policies

Unit I - INTRODUCTION TO CLIMATE : Definitions- Climate, Climate system, climate change – Drivers of Climate change – Characteristics of climate system components – Large scale climate - Greenhouse effect – Carbon cycle – Wind systems - Trade winds and the Hadley cell – Ozone hole in the stratosphere - El Nino, La Nina – ENSO- Regional differences

Unit II - IMPACTS OF CLIMATE CHANGE : Global Climatology – Indian Scenario – Observed changes and projected changes of IPCC – Monsoon onsets, withdrawals and breaks – Cyclones in India – Indian rainfall in different seasons – interannual variability of monsoon - Impacts on sectoral vulnerabilities – SRES – different scenarios

Unit III - TOOLS FOR VULNERABILITY ASSESSMENT : Need for vulnerability assessment – Steps for assessment –Approaches for assessment – Models – Quantitative models, Economic model, Impact matrix approach - Box models - Zero-dimensional models - Radioactive-convective models - Higher-dimension models - EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – sectoral models

Unit IV - CLIMATE CHANGE ADAPTATION AND MITIGATION: Water-related adaptation to climate change in the fields of Ecosystems and biodiversity, - Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) - Adaptation, vulnerability and sustainable development Sector-specific mitigation - Carbon dioxide capture and storage (CCS) - Land-use change and management, Cropland management, Afforestation and Reforestation - Potential water resource conflicts between adaptation and mitigation - Implications for policy and sustainable development.

Unit V - CASE STUDIES: Water resources assessment case studies – Ganga Damodar Project , Himalayan glacier studies, Ganga valley project - Adaptation strategies in Assessment of water resources- Hydrological design practices and dam safety- Operation policies for water resources projects - Flood management strategies - Drought management strategies - Temporal and spatial assessment of water for Irrigation -Land use and cropping pattern - Coastal zone management strategies.

References:

1. SangamShreshta, Mukund S. Babel and Vishnu Prasad Pandey., “Climate Change and Water Resources”, CRC Press, 2014.
2. IPCC Report Technical Paper VI – “Climate change and water” , 2008.
3. Anil Markandya, “Climate Change and Sustainable Development: Prospects for Developing Countries”, Routledge, 2002
4. UNFCCC Technologies for Adaptation to climate change, 2006.
5. P R Shukla, Subobh K Sarma, NH Ravindranath, Amit Garg and Sumana Bhattacharya, “Climate Change and India: Vulnerability assessment and adaptation”, University Press (India) Pvt Ltd, Hyderabad, 2003.
6. Preliminary consolidated Report on “Effect of climate change on Water Resources”, GOI, CWC, MOWR, 2008.
7. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

18CE3010 URBAN WATER MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To understand the concepts of urbanization and its impact on the natural water cycle
- To know the utilization of urban stormwater models for better storm water management

- To prepare urban stormwater master plan

Course Outcomes:

At the end of the course, student will be able to

- identify factors affecting urban hydrological cycle
- estimate urban water demand and stormwater quantity
- maintain the elements of drainage systems
- determine the runoff and peak flow
- plan and design stormwater control and disposal systems
- develop integrated urban water management system

Unit I - URBAN HYDROLOGIC CYCLE: General introduction to urbanisation and its effect on water cycle – urban hydrological cycle – trends in urbanisation – Effect of urbanisation on hydrology. Urban Hydrological cycle – time of concentration – importance of short duration of rainfall and runoff data – methods of estimation of time of concentration for design of urban drainage systems.

Unit II - URBAN WATER MANAGEMENT MODELS: Types of models – Physically based – conceptual or unit hydrograph based – Urban surface runoff models – Various model available for stormwater management - Management models for flow rate and volume control rate – Quality models - Stormwater Analysis - calculation of runoff and peak – Design of stormwater network systems – water distribution networks.

Unit III - URBAN STORM WATER MANAGEMENT: Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts – Modelling concept – Types of storage – Magnitude of storage – Hydraulic analysis and design guidelines – Flow and storage capacity of urban components – system tanks.

Unit IV - MASTER DRAINAGE PLANS: Master drainage plans – issues to be concentrated upon – typical content of an urban drainage master plan – interrelation between water resources investigation and urban planning processes – planning objectives – comprehensive planning – use of models in planning..

Unit V - OPERATION AND MAINTENANCE: Elements of drainage systems – open channel – underground drains – appurtenances – pumping – source control - Operation and maintenance of urban drainage system – interaction between stormwater management and solid waste management

References:

1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), “Manual on Drainage in urbanized areas”, Vol.1 and Vol.II, UNESCO, 1987.
2. Hengeveld, H. and C. De Vocht (Ed)., “Role of Water in Urban Ecology”, Elsevier, Amsterdam, 1982.
3. Martin, P. Wanielista and Yousef, A. Yousef., “Stormwater Management”, John Wiley and sons, 1993.
4. Stahre, P., and Urbonas, B., “Storm water Detention for Drainage, water quality and CSO Management”, Prentice Hall, New Jersey, 1990
5. Wanielista, M.P., and Yousef, Y.A., “Stormwater Management”, John Wiley and Sons, Inc., New York, 1993

18CE1002	CIVIL ENGINEERING – SOCIETAL AND GLOBAL IMPACT	L 2	T 0	P 0	C 2

Course Objectives:

1. To provide awareness of the importance of civil engineering and the impact it has on the society and at global levels
2. To impart awareness of the impact of civil engineering for the various specific fields of human endeavor

3. To inculcate the need to think innovatively to ensure sustainability

Course Outcomes:

Student will be able to

1. Identify the impact of civil engineering projects on the society at large and on the global arena.
2. Justify the need for infrastructure for energy generation
3. Recommend sustainable environment keeping aesthetics intact
4. Bring out the scope of civil engineers for environment protection
5. Build good environment by reducing the factors impacting the quality of life
6. Apply professional and responsible decisions on the environmental effects

Module 1: INTRODUCTION: Recent major civil engineering breakthroughs and innovations- global warming - impact and causes- evaluating future requirements for various resources - GIS and applications for monitoring systems - human development index - ecological footprint of India vs other countries and analysis

Module 2: UNDERSTANDING THE IMPORTANCE OF CIVIL ENGINEERING: Shaping and impacting the world - The ancient and modern marvels and wonders in the field of Civil Engineering- future vision for Civil Engineering

Module 3:INFRASTRUCTURE: Metrocities, smart cities, futuristic visions- transportation - energy generation - water provisioning- telecommunication needs- awareness of various codes and standards governing infrastructure development- innovations and methodologies for ensuring sustainability

Module 4: EFFECTS ON ENVIRONMENT: Solid waste management, water purification, wastewater treatment and recycling, hazardous waste treatment- flood control - river interlinking- multi-purpose water projects, atmospheric pollution- global warming phenomena and pollution mitigation measures, stationarity and nonstationarity- environmental metrics and monitoring

Module 5: BUILT ENVIRONMENT: Facilities management -climate control- recycling -temperature and sound control in built environment - intelligent and smart buildings - aesthetics of built environment- innovations and methodologies for ensuring sustainability

Module 6: CIVIL ENGINEERING PROJECTS: Environmental impact analysis procedures- advanced construction techniques for better sustainability- techniques for reduction of greenhouse gas emissions in various aspects of civil engineering projects.

Text Books:

1. Michael Murray, “Corporate Social Responsibility in the Construction Industry”, Taylor and Francis, 2009
2. Robert L. France “Handbook of Water Sensitive Planning and Design”, CRC Press. 2002

Reference Books:

1. Brito, Ciampi, Vasconcelos, Amarol, Barros, “Engineering impacting Social, Economical and working Environment”, 120th ASEE Annual Conference and Exposition, 2013
2. Centre for Water Sensitive Cities, “Blueprint for a water sensitive city”, Monash University.2012
3. Žiga Turk, “Global Challenges and the Role of Civil Engineering”, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht, 2014
4. NAE Grand Challenges for Engineering, “Engineering for the Developing World - The Bridge”, Vol 34, No.2, Summer 2004.
5. Allen M. “Cleansing the city”, Ohio University Press. Athens Ohio, 2008

18CE1003	ENERGY SCIENCE AND ENGINEERING	L	T	P	C
		2	0	0	2

Course Objectives:

1. To provide an introduction to energy systems and renewable energy resources
2. To provide knowledge to explore society's present needs and future energy demands
3. To impart knowledge on design of various civil engineering systems/ projects dealing with energy generation paradigms in an efficient manner.

Course Outcomes:

Student will be able to

1. List and explain the main sources of energy and their primary applications nationally and internationally
2. Understand the energy sources and scientific concepts/principles behind them
3. List and describe the primary renewable energy resources and technologies.
4. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.
5. Collect and organize information on renewable energy technologies
6. Understand the Engineering involved in projects utilizing these sources

Module 1:INTRODUCTION TO ENERGY SCIENCE: Scientific principles - historical interpretation to place energy use in the context of pressing societal, environmental and climate issues- Introduction to energy systems and resources - Introduction to Energy, conventional and non-conventional sources, sustainability and the environment

Module 2: ENERGY SOURCES: Overview of energy systems, sources, transformations, efficiency, and storage - fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present and future

Module 3: REMEDIES AND ALTERNATIVES FOR FOSSIL FUELS: Hydropower, biomass, wind, solar, nuclear, wave, tidal and hydrogen- sustainability and environmental trade-offs of different energy systems- possibilities for energy storage or regeneration

Module 4: ENERGY AND ENVIRONMENT: Energy efficiency and conservation- introduction to clean energy technologies - importance in sustainable development - carbon footprint - energy consumption and sustainability- introduction to the economics of energy- linkages between economic and environmental outcomes

Module 5: CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES: Coal mining technologies - oil exploration offshore platforms - underground and under-sea oil pipelines - solar chimney project - wave energy caissons - nuclear reactor containment buildings and associated buildings - hydroelectric power project

Module 6: ENGINEERING FOR ENERGY CONSERVATION: Concept of green building and green architecture- leed ratings- identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates- embodied energy analysis and use as a tool for measuring sustainability - energy audit of facilities and optimization of energy consumption

Text Books:

1. Giri N.K, "Alternate Energy (Sources, Applications and Technologies)", Khanna Publishers, 2012
2. Amlan Chakrabarti, "Energy Engineering and Management", PHI Learning Pvt. Ltd., 2011

Reference Books:

1. Boyle, Godfrey, "Renewable Energy", 2nd edition, Oxford University Press, 2004
2. Jean-Philippe- Zaccour, Georges (Eds.), "Energy and Environment Set: Mathematics of Decision Making", Loulou, Richard- Waaub, XVIII, 2005

- Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A, “Energy and the Environment”, 2nd Edition, John Wiley, 2006
- UNDP, “Energy and the Challenge of Sustainability”, World Energy assessment, 2000
- Adrian Bejan, Peter Vadász, Detlev G. Kröger, “Energy and the Environment”, Springer Science and Business Media. 1999

18CE1004	ENGINEERING DRAWING FOR CIVIL ENGINEERS	L	T	P	C
		0	0	6	3

Course Objectives:

- To draw and interpret various projections of 1D, 2D and 3D objects
- To enable to prepare and interpret the drawings of buildings
- To provide knowledge to make basic engineering drawings using both geometric instruments as well as softwares

Course Outcomes:

Student will be able to

- Sketch two-dimensional orthographic drawings and three-dimensional isometric views.
- Create and modify two-dimensional orthographic drawings using AutoCAD software, complete with construction lines, dimensions, and layers, conforming to industry standards.
- Create three-dimensional solid models using AutoCAD software, and generate paper space layouts from model space geometry.
- Visualize three-dimensional solids from two-dimensional pictures.
- Create a portfolio of drawings to demonstrate their abilities to potential employers.
- Communicate effectively using manual and computerized graphical techniques.

List of Exercises:

- Introduction to use of drawing instruments and Lettering practice.
Construction of polygons
Dimensioning practice of lines, circles, arcs using aligned and chain dimensioning systems.
- Projection of points in different quadrants.
- Projection of lines
- First angle projections, conversion of pictorial views into orthographic views
- Projections of prism, pyramid, cylinder and cone - axis parallel to one plane and perpendicular to the other plane, Parallel to both planes.
- Introduction to Isometric projection - Isometric views of basic solids - prism, pyramid, cylinder and cone – perspective projections – one point method

Auto CADD:

- Drawing and plotting: Snap, Grid, Limits, Osnap, line types and weights, text, file creation and plotting.
- Modifying Commands: Erase, trim, array, lengthen, break, mirror, offset, move, copy etc.
- Methods of drawing lines, arcs and circles.
- Application of lines, arcs and circles to draw simple geometries.
- Dimensioning, hatching methods to show different materials, title block and layers.
- Isometric view of solids.

Text Books:

- Gurcharan Singh, “Civil Engineering Drawing”, Standard Publishers Distributors, 2005
- Shah, M.B. and Rana B.C, “Engineering Drawing and Computer Graphics”, Pearson Education, 2008

Reference Books:

- Bhatt N.D., Panchal V.M. and Ingle P.R., “Engineering Drawing”, Charotar Publishing House, 2014

2. Agrawal B. and Agrawal C. M, "Engineering Graphics", TMH Publication, 2012
3. Narayana, K.L. and P Kanniah, Text book on "Engineering Drawing", Scitech Publishers, 2008
4. David A. Madsen, David P. Madsen "Engineering Drawing and Design", Cengage Learning, 2016
5. IS 962 : 1989, IS 965 : 1963

18CE2005	DISASTER PREPAREDNESS AND REMEDIAL MEASURES	L	T	P	C
		2	0	0	2

Course Objectives

1. To introduce about types of natural and environmental disasters
2. To enable to develop skills in various stages of disaster preparedness, mitigation and management
3. To provide knowledge on the methodologies for disaster risk assessment

Course Outcomes

Student will be able to

1. Recall the types of disasters and its causes
2. Understand disaster cycle and assess the risks
3. Apply disaster concepts to disaster management
4. Analyze relationship between development and disasters
5. Decide the roles and responsibilities of organizations and institutions to society and its organizational structure
6. Design the disaster management and mitigation plan

Module 1: INTRODUCTION: Concepts and definitions: disaster – hazard – vulnerability - risks – severity - frequency and details - capacity - impact – prevention - mitigation - Disaster management cycle – its phases - prevention, mitigation, preparedness, relief and recovery - structural and non-structural measures - risk analysis - vulnerability and capacity assessment - early warning systems.

Module 2: DISASTERS: Disasters classification - Natural disasters: floods, draught, cyclones, earthquakes, tsunami, landslides, coastal erosion, soil erosion and forest fires - Manmade Disasters: industrial pollution, nuclear radiation, chemical spills, fire accidents and terrorist strikes.

Causal Phenomena - typical effects - general characteristics - measure and predictability - specific preparedness measures.

Module 3: DISASTER IMPACTS: Environmental – physical – social – ecological – economic - political – health - psycho-social issues -Hazard locations: global and national disaster trends - climate change and urban disasters.

Module 4: DISASTER MANAGEMENT: Post disaster environmental response - water, sanitation, food safety, waste management, disease control, security and communications.

Policies and legislation for disaster risk reduction - Hazard and vulnerability profile of India - mountain and coastal areas - ecological fragility.

Module 5: INSTITUTIONAL FRAMEWORK: Roles and responsibilities - Institutions arrangements (Community based Organisations) - financial arrangements - Role of Central, State, District and Armed Forces in disaster response - Police and other Departments - NGOs and other stakeholders - Institutional Framework - Nodal Ministries related with disaster – social responsibility

Module 6: APPLICATION AND CASE STUDIES: Case study – Natural disaster - (or) - Manmade disaster

Text Books

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2004
2. Singh B.K., "Handbook of Disaster Management: Techniques and Guidelines", Rajat Publication; 2008

Reference Books

1. Jon Ingleton, "Natural Disaster management", Tulor Rose, 1999

2. Iyengar, C.B.R.I. "Natural Hazards in the Urban Habitat", Tata McGraw Hill Co., 2001.
3. Ghosh G.K., "Disaster Management", APH Publishing Corporation, 2006
4. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
5. Inter-Agency Standing Committee (IASC) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC. Feb. 2007

18CE2006	CONSTRUCTION ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the latest construction technologies adopted by Industry
2. To impart knowledge about advanced project management and monitoring techniques
3. To inculcate the concepts of construction management

Course Outcomes:

Student will be able to

1. Recall the basics of building components
2. Understand the items / facets of construction engineering
3. Apply the construction engineering techniques for various components
4. Classify the various techniques for different project
5. Explain the importance of project management
6. Propose an Engineering and Management Plan

Module 1: ASPECTS OF CONSTRUCTION ENGINEERING: Components of building, steps in construction of a residential building - site preparation – site layout, site clearing, setting out buildings – requirement of excavation and foundation, types of foundation, shoring and strutting, anti-termite treatment, dewatering and backfilling

Module 2: VARIOUS CONSTRUCTIONS: Masonry constructions – types and materials of masonry constructions, bonds in masonry construction, concrete constructions – types of concrete constructions, foundations, columns, beams, lintels, slabs, methods of construction, IS provisions (introduction), Joints in RC construction

Module 3: ENABLING WORKS: Formwork and scaffolding – types of formworks, scaffolding works for concreting, shoring and under-pinning, striking of formwork - reinforcement works – organising the works, bending of reinforcement, fixing works

Module 4: FINISHING WORKS: Plastering, pointing and painting – types of plasters, special plasters, types of pointing, painting – description of painting, whitewashing, cement paint, dry distemper - flooring – components of floors, toppings in floor construction, choice of floor finish, floor surface hardeners, types of flooring – concrete, stone, ceramic, wooden flooring – roof: flat roof, sloped roof - openings – doors, windows and ventilators – standard sizes and fixing methods

Module 5: CONSTRUCTION MANAGEMENT BASICS: Construction as industry: introduction to construction industries - concepts and need of management in construction -principles of management: concept, scope, functions of management - construction project planning: life cycle, identification, preparation, appraisal - detailed planning – implementation - monitoring and control -network: need, importance - bar chart - CPM and PERT techniques - analysis of network - time-cost trade off - scheduling technique - updating project - resource allocation and levelling.

Module 6: MATERIAL AND EQUIPMENT MANAGEMENT: Material Management: Scope, importance, objectives, functions of material management classification and codification of material - inventory control: need, function, economic order quantity - construction equipment management: types of equipment and factors affecting selection - functions of equipment management - owning and operating costs - time-value of money concept - economic life, safety, maintenance and repair of equipment.

Text Books:

1. Seetharaman, S., “Construction Engineering and Management”, Umesh Publications, 2007
2. Sengupta, B., and Guha, H., “Construction Management and Planning”, Tata McGraw-Hill Book cc, 2000.

Reference Books:

1. Rana, V. K., “Construction Management Practice”, Tata McGraw-Hill publishing CO, 2000
2. Chitkara, K. K., “Construction Project Management”, Tata McGraw-Hill publishing COM, 2000
3. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000
4. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.
5. IS 1003 : Part 1 : 2003, IS 4082 : 1996, National Building Code, Bureau of Indian Standards, New Delhi, 2017

18CE2007	GEOLOGY AND MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives

1. To introduce the characteristics of building materials
2. To understand the various natural dynamic processes their influence on the surface features, natural material and their consequences.
3. To familiarize the physical properties of rocks and minerals.

Course Outcomes

Student will be able to

1. Understand the application of knowledge on geology to civil engineering structures
2. Investigate the geological formations and their contributions
3. Comprehend the significance of earth and its minerals
4. Identify geological structures and processes for rock mass quality
5. Explore modern equipments and the recent techniques to be used
6. Apply geological principles for mitigation of natural hazards and select sites for constructions

Module 1: GEOLOGY: Geology in civil engineering – branches of geology – earth structure and composition – continental drift and plate tectonics - earth processes – weathering – work of rivers – causes of earthquake – earthquake belts in India – Mineralogy: crystallographic systems – physical properties of minerals – study of the following rock forming minerals – quartz family, behavior family, augite, hornblende, biotite, muscovite, calcite, garnet – properties, behavior and engineering significance of clay minerals

Module 2: PETROLOGY: Classification of rocks – distinction between igneous, sedimentary and metamorphic rocks - description, occurrence, engineering properties and distribution of rocks - igneous rocks: granite, syenite, diorite, gabbro, pegmatite and basalt - sedimentary rocks: sandstone, limestone, shale, conglomerate and breccia - metamorphic rocks: quartzite, marble, slate, thyllite, gneiss and schist.

Module 3: STRUCTURAL GEOLOGY: Attitude of beds – outcrops – geological maps – study of structures – folds, faults and joints – Engineering investigations – Landslides – causes and prevention - Sea erosion and coastal protection - Tsunami

Module 4: BUILDING MATERIALS: Bricks - types - properties, mortar and concrete: cement, aggregates, water, characteristics of concrete - properties and use of pozzolana materials - types of mortars: lime - properties, lime concrete, timber products - properties and application

Module 5: ADVANCED MATERIALS: Polymeric materials: rubber and plastics, properties, properties and application - polymers in civil engineering, fibers and composites, admixtures and m-sand - ceramic

materials: classification, refractories, glass, wool, mechanical and thermal properties, fire resistance materials, uses and application.

Module 6: PROTECTIVE COATINGS: Types of structural steels, alloy steel, stainless steel, light gauge steel, corrosion resistant materials, measures of protection and protective coatings – waterproofing materials: properties, types and its applications - flooring materials – tiles - acoustic treatment materials

Text Books

1. Varghese P.C., “Building materials”, Prentice Hall, 2005
2. Parbin Singh, “Engineering and general Geology”, Katson publication House, 2010.

Reference Books

1. Rajput. R.K., “Engineering Materials”, S. Chand and Company Ltd., 2008
2. Shetty.M.S., “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd., 2008
3. Gambhir.M.L., “Concrete Technology”, 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., “Building Materials”, 4th Edition, New Age International , 2008
5. SP 21 , IS 1077 : 1992, IS 1141 : 1993

18CE2008	ENGINEERING MECHANICS – STATICS AND DYNAMICS	L	T	P	C
		3	1	0	4

Course Objectives:

1. To provide knowledge about statics with emphasis on force equilibrium and free body diagrams.
2. To expose to the stresses and response of elements.
3. To impart the mechanical behavior of materials under various load conditions.

Course Outcomes:

Student will be able to

1. Illustrate the concepts of mechanics
2. Identify the philosophies to suite suitable sections
3. Examine the forces in the members
4. Analyse the response of the elements
5. Evaluate the behavior based on the response
6. Apply the basic principles to solve problems in mechanics

Module 1: INTRODUCTION: Centroid - centre of gravity - moment of inertia of plane sections - theorems of moment of inertia - composite sections - mass moment of inertia of circular plate, cylinder, cone, sphere, hook.

Module 2: DYNAMICS: Particle dynamics- rectilinear motion - plane curvilinear motion - relative and constrained motion - newton’s second law: rectangular, path, and polar coordinates - work-kinetic energy, power and potential energy - impulse-momentum- impact - direct and oblique.

Module 3: KINETICS OF RIGID BODIES: Principles in dynamics - types of motion - D’Alembert’s principle: plane motion and connected bodies - work energy principle: plane motion and connected bodies - kinetics of rigid body rotation

Module 4: BASIC STRUCTURAL ANALYSIS: Stability of equilibrium - equilibrium in three dimensions - method of sections - method of joints - simple trusses - beams - types of beams

Module 5: VIRTUAL WORK AND ENERGY METHOD: Virtual displacements - degrees of freedom - energy equation for equilibrium - analysis of statically determinate beams - cantilever, simply supported beam, overhanging beam: point load, UDL and UVL

Module 6: SIMPLE STRESSES AND STRAINS: St. Venant’s principle - types of stresses and strains, Hooke’s law – stress – strain diagram for mild steel – working stress – factor of safety – lateral strain, Poisson’s ratio and volumetric strain – relation between moduli – bars of varying section – composite bars– temperature stresses

Text Books:

1. Irving H. Shames, “Engineering Mechanics”, 4th Edition, Prentice Hall, 2006
2. Beer F. P and Johnston E. R, “Vector Mechanics for Engineers”, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill, 2011

Reference Books:

1. Hibbeler R. C., “Engineering Mechanics: Principles of Statics and Dynamics”, Pearson Press. 2006
2. Andy Ruina and Rudra Pratap, “Introduction to Statics and Dynamics”, Oxford University Press, 2011
3. Shames and Rao, “Engineering Mechanics”, Pearson Education, 2006
4. Bansal R.K, “A Text Book of Engineering Mechanics”, Laxmi Publications, 2010
5. Khurmi R.S., “Engineering Mechanics”, S. Chand and Co. 2010

18CE2009	INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS	L 3	T 0	P 0	C 3

Course Objectives:

1. To understand sensor theory and technology, data acquisition, and decision making.
2. To interpret the principles used in physical infrastructure/bridges/buildings/pavements.
3. To learn the IoT and its implementation

Course Outcomes:

Student will be able to

1. Understand the principles of operation and characteristics of instrumentation and integrated sensor systems
2. Predict sensor technologies for specific applications along with limitations
3. Specify the requirements in the calibration of sensors and instruments
4. Analyze the errors during measurements
5. Design sensor systems and set up measurement systems
6. Implement smart systems using IoT

Module1: FUNDAMENTALS OF MEASUREMENT, SENSING AND INSTRUMENTATION:

Definition-measurement and instrumentation-physical variables-common types of sensors-function of these sensors-sensor applications- interpret signals from sensor type- types of instrumentation- sensor specifics-permanent installations-temporary installations

Module 2: SENSOR INSTALLATION AND OPERATION: Response of sensors to various inputs-conceptual instrumentation and monitoring program-methodology for sensor installation-differentiate types of sensors and their modes of operation and measurement - approach to planning monitoring programs - define target -sensor selection-measurement uncertainty – sensor pavers and sensors in batching plants, landslides, concrete

Module 3: DATA ANALYSIS AND INTERPRETATION: Statistical concepts-data reduction and interpretation- piezometer, inclinometer, strain gauge -time domain signal processing- discrete signals-signals and noise –calculation: mean, standard deviation-median-mode-range

Module 4: SENSOR APPLICATION: Principles - Transducer characteristics - acoustic, current, temperature, pressure, electric, magnetic, gravity, salinity - concentration of contaminants – velocity - heat flow and optical devices – infrastructure: bridges, buildings, pavements, batching plant, concrete, slopes, pavers

Module 5: INTERNET OF THINGS: IoT architecture outline- standards considerations- M2M and IoT technology fundamentals - devices and gateways - local and wide area networking- cloud computing for IoT

Module 6: IMPLEMENTATION OF SMART SYSTEMS: Big data analytics-privacy and security – sensing and actuator devices - smart convergent technologies - RFID and microcontrollers

Text Books:

1. Alan S Morri, “Measurement and Instrumentation Principles”, 3rd edition, Butterworth Hienemann, 2001.
2. Manabendra Bhuyan, “Intelligent Instrumentation: Principles and Applications”, CRC Press. 2010

Reference Books:

1. David A. Bell, “Electronic Instrumentation and Measurements”, 2nd edition, Oxford Press, 2007
2. Tumanski S., “Principle of Electrical Measurement”, Taylor and Francis, 2006.
3. Arun K. Ghosh, “Introduction to Measurements And Instrumentation”, Phi Learning Pvt. Ltd., 2012
4. Ali Al-Sabbagh, “Internet of Things and Big Data Analysis”, United Scholars Publication, 2016
5. Ilya Gertsbakh, “Measurement Theory for Engineers”, Springer, 2010.

18CE2010	MATERIALS TESTING AND EVALUATION LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives

1. To demonstrate the basic principles in the areas of mechanics of materials and structural analysis
2. To apply the theory of mechanics of solids on real specimens
3. To give hands on training on testing of real specimens

Course Outcome

Student will be able to

1. Be familiar with the operations and laboratory testing equipment
2. Conduct various tests on steel and other materials following BIS code
3. Interpret the laboratory test results

List of Experiments:

1. Tension Test on Mild Steel
2. Double Shear Test on Mild Steel
3. Brinell Hardness Test
4. Rockwell Hardness Test
5. Charpy and Izod Impact Test
6. Test on Open Coil Helical Springs
7. Test on Closed Coil Helical Springs
8. Test on Carriage Springs
9. Verification of Maxwell reciprocal theorem
10. Deflection Test on Steel Beam
11. Compressive Test on Bricks
12. Torsion Test on mild steel

Text Books:

1. Bansal, R. K, “Strength of Materials”, Laxmi Publications (P). Ltd., 2007.
2. Rajput, R. K, “Strength of Materials”, S Chand and Co., 2007.

Reference Books:

1. Timoshenko S.P., “History of Strength of Materials”, Dover Publications, 1953.
2. IS 1500:2005 (ISO 6506-1:1999), Indian Standard “Method for Brinell Hardness Test For Metallic Materials”, Bureau of Indian Standards, New Delhi

- IS 280:2006 Indian Standard “Mild Steel Wire for General Engineering Purposes”, Bureau of Indian Standards, New Delhi

18CE2011	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

Course Objective:

- To introduce the application of civil engineering theory in to practices.
- To provide knowledge about analysis and design bar bending schedule and welding joints.
- To impart knowledge using modern equipments in civil engineering

Course Outcome:

Student will be able to

- list electrical and plumbing work for buildings and factories
- explain the bar bending schedule to supervisors
- construct a brick masonry wall

List of Experiments

- Plumbing Connection of PVC/CPVC pipes for water lines with elbow, coupling, Tee, bend
- Sealants in CPVC windows and doors (demo)
- Steel bar bending for RCC works (demo only)
- Practices in Brick Masonry Construction
- Practices in Brickwork Plastering
- Wiring for residential building
- Construction of formwork (demo only)
- Nuts, Bolts and hinges (demo only)
- Measurement of electrical quantities voltage, current and power
- Welding Practices (single v-butt joint, lap joint)
- Sheet metal works (Rectangular, Cone making)
- Carpentry work (Middle lap joint, T joint)

Text Books:

- Saravanapandian M, Pranitha S, Jeyapoovan T., “Engineering Practices Laboratory Manual”, VRB Publishers Private Ltd 2009
- Jeyachandran.K, Natarajan.S and Balasubramanian.S. “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.

Reference Books:

- Bawa.H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
- Rajendra Prasad.A and Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
- IS 817 : 1966 Code of practice for training and testing of metal arc welders

18CE2012	COMPUTER AIDED CIVIL ENGINEERING DRAWING	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To develop graphical skills for communicating concepts, ideas and designs of engineering products
- To get exposure to national standards relating to technical drawings
- To examine a design critically with understanding of CAD

Course Outcomes:

Student will be able to

- Develop Parametric design and the conventions of formal engineering drawing

2. Produce and interpret 2D and 3D drawings
3. Draw conventional structures using practical norms.

List of Experiments

1. Planning and orientation of Residential buildings
2. planning and orientation of Industrial building
3. Glazed and paneled wooden door and windows
4. Residential Buildings with load bearing walls including details of Wall footing. (Plan, Section and Elevation)
5. Typical two storeyed commercial RCC building including all joinery, finishing and other details (Plan, Section and Elevation)
6. Typical two storeyed School building including all joinery, finishing and other details (Plan, Section and Elevation)
7. MEP drawing for Residential building
8. Building with sloped roof
9. Industrial building - Trusses with Joints
10. Architectural drawing of Multi-storeyed residential buildings (3DDrawing)
11. Architectural drawing of Pre Engineering buildings (3D Drawing)
12. Auto DCR

Text Books:

1. Subhash C Sharma and Gurucharan Singh, “ Civil Engineering Drawing” , Standard Publishers, 2005
2. Ajeet Singh, “ Working with AUTOCAD 2000 with updates on AUTOCAD 2001”, Tata- Mc Graw-Hill Company Limited, New Delhi, 2002

Reference Books:

1. Venugopal, “Engineering Drawing and Graphics + AUTOCAD”, New Age International Pvt. Ltd.,2007
2. Sham Tickoo Swapna D, “ AUTOCAD for Engineers and Designers”, Pearson Education,2009
3. AutoCAD 2017 - Reference manual

18CE2013	COMPUTER APPLICATIONS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To introduce computer skills related to the field of civil engineering
2. To make the Student to analyse and design structural elements using software
3. To provide hands on experience in design and preparation of drawings relating civil engineering practice.

Course Outcomes:

Student will be able to

1. Develop and program engineering analyses using Excel
2. Design various structures for the requirements of the society as per IS codes
3. Learn to solve civil engineering problems with differential equations using software

List of Exercises:

1. Analysis and Design of Residential building for static loads
2. Analysis and Design RCC multistoried framed building for static loads
3. Analysis and Design RCC multistoried framed building for lateral loads
4. Analysis and Design of Steel framed building
5. Analysis and Design of Truss
6. Evaluation of seepage using MODFLOW

7. Creation of shape files in ArcGIS
8. Evaluation of settlement of foundation
9. Slope stability analysis of soil
10. Analysis and Design of RCC Retaining wall
11. Spread sheets for the design of Water tank
12. Spread sheets for the design of Beam

Text Books:

1. Krishnaraju, N. "Structural Design and Drawing", Universities Press, 2009.
2. Punmia B.C, "Soil Mechanics and Foundation", Laxmi Publications, 2017

Reference Books:

1. Krishnamurthy, D., "Structural Design and Drawing – Vol. II and III", CBS Publishers, 2010.
2. STAAD Pro V8i - Reference manual
3. Tim Orms, Eileen Napoleon, Robert Burke, Carolyn Groessler, Laura Feaster, "Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo", ESRI, Inc., 2004

18CE2014	DESIGN AND DRAWING	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To provide knowledge about design and detail of RCC structures.
2. To impart knowledge about design and detail of steel structures.
3. To maintain and operate environmental structures

Course Outcomes:

Student will be able to

1. Recall the design procedures of various structures
2. Estimate the various loads on the structures
3. Appraise and design of impounding structures and cross drainage works

List of Experiments:

Design of Reinforced Concrete structures

1. Building floor system
2. Cantilever Retaining wall
3. Dog legged Staircase
4. Rectangular and Overhead Water tank

Design of Steel Structures

5. Slab base with steel column
6. Roof Truss and its connection
7. Gantry Girder
8. Framed Connections

Environmental Engineering

9. Sedimentation tank
10. Septic tank
11. Rapid sand filter
12. Layout of treatment plant components

Text Books:

1. Krishna Raju N, "Structural Design and Drawing", University Press, 2005.
2. Duggal .S.K, "Design of steel structures", Tata Mcgraw –Hill Publishing company Ltd, 2009.
3. Santhosh Kumar Garg "Sewage Disposal and Air Pollution Engineering" Khanna publications, 2015

Reference Books:

1. Ramchandra, "Design of Steel Structures", Standard Book House, Delhi-6, 2004
2. Krishna Raju, N and Pranesh, R.N., "Reinforced Concrete Design – IS 456 – 2000 Principles and Practice", New Age International Publishers, New Delhi, 2003
3. SP 34 – "Handbook on Reinforcement and Detailing", Bureau of Indian Standards, New Delhi

18CE2015	FLUID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce fundamental concepts of fluid statics, kinematics and dynamics
2. To apply the concepts of flow measurements and analysis of flow through pipes
3. To provide knowledge about boundary layer theory and flow around submerged objects

Course Outcomes:

Student will be able to

1. Recall the behaviour of fluids under static condition, measure pressure changes and estimate total pressure on plane surfaces
2. Demonstrate flow measurement methods
3. Identify the flow pattern and estimate total energy
4. Select method to design pipe flows including losses
5. Formulate and solve boundary layer problems
6. Relate the physical parameters using dimensional analysis

Module 1:INTRODUCTION: Fluid Properties – Newton’s law of Viscosity – classification of fluids - fluid statics - pressure – Pascal’s law – atmospheric, absolute, gauge and vacuum pressures – pressure measurement - hydrostatics: forces on plane and curved surfaces-total pressure and centre of pressure

Module 2:FLUID KINEMATICS: Types of flow – stream line - continuity equation – one dimensional and three dimensional flow – velocity potential and stream function - equations of motion Euler’s equation in one dimensional form – Bernoulli’s equation

Module 3: FLOW MEASUREMENTS: Venturimeter – orifice meter – turbulent flow - Reynold’s experiment – Reynold’s number

Module 4: FLOW THROUGH PIPES: Loss of energy in pipes – hydraulic gradient - energy gradient – major and minor energy losses – pipes in series and parallel –equivalent pipe

Module 5: BOUNDARY LAYER FLOW: Boundary layer and its definition - displacement thickness - momentum thickness - energy thickness - forces on submerged bodies

Module 6: DIMENSIONAL ANALYSIS AND SIMILITUDE: Fundamental and secondary dimensions – dimensional homogeneity – Rayleigh and Buckingham Pi methods – significance of dimensionless numbers – classification of hydraulic models – scale effect

Text Books:

1. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines" ,S.Chand and Co., New Delhi, 2008.
2. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2005

Reference Books:

1. Modi, P.N. and Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 2007
2. Som S.R, and Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2012
3. Subramanya, K., "Fluid Mechanics and Hydraulic Machines", McGraw Hill India Pvt. Ltd., New Delhi, 2011

4. Gupta S. C, “Fluid Mechanics and Hydraulic Machines”, Pearson Education India., 2006
5. Yunus A Cengel, “Fluid Mechanics”, Tata McGraw Hill India Pvt. Ltd., 2010.

18CE2016	SOLID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge about the analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system.
2. To familiarize the fundamental concepts of stress, strain and deformation of solids with applications to bars, beams and trusses.
3. To impart the procedures to estimate the load carrying capacity of various structural components and elements

Course Outcomes:

Student will be able to

1. Illustrate the concepts and principles
2. Explain the behaviour of structural elements
3. Analyze the structural members for various forces
4. Estimate the response of the elements
5. Develop suitable response intricacies
6. Adapt suitable analysis procedure

Module 1: INDETERMINATE BEAMS: Strain energy method: Static indeterminacy - strain energy method - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures - temperature effect - bending moment and shear force diagram.

Module 2: BENDING AND SHEAR STRESS: Flexural stresses-theory of simple bending – assumptions – neutral axis – bending stresses – section modulus of various solid and hollow sections – flitched beams - shear stresses - shear stress distribution for solid sections

Module 3: SLOPE AND DEFLECTION- DETERMINATE BEAMS: Relationship between moment, slope and deflection - Moment area method - Conjugate beam method - Macaulay’s method.

Module 4: TORSION: Torsion equation - hollow and solid circular shafts - torsional rigidity - Combined torsion and bending of circular shafts – helical springs

Module 5: COLUMNS: Short and long columns - Euler’s theory – Critical load – Rankine’s formula – Eccentrically loaded column – middle third rule

Failure theories: Principal stress – principal strain – shear stress – strain energy – distortion energy theory

Module 6: THIN AND THICK CYLINDERS: Hoop stress - longitudinal stress - cylinder subjected to internal pressures - analysis of compound cylinders

Text Books:

1. Rajput.R.K. “Strength of Materials”, S.Chand and Company Ltd., New Delhi 2014.
2. Bhavikatti, S., “Structural Analysis”, Vol.1 and 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2011

Reference Books:

1. Egor.P.Popo V, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi 2001
2. Vazirani.V.N, Ratwani.M.M, Duggal .S.K, “Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1”, Khanna Publishers, New Delhi 2014.
3. Timoshenko.S.P. and Young .D.H., “Elements of Strength of Materials”, V Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 2002.
4. Vaidyanathan, R. and Perumal, P., “Structural Analysis”, Vol.1 and 2, Laxmi Publications, New Delhi, 2014
5. Ramamrutham S, “Theory of structures”, DhanpatRai publications, 2004

18CE2017	SURVEYING AND GEOMATICS	L 3	T 0	P 0	C 3

Course Objectives:

1. To introduce the principle of surveying methods
2. To teach different methods of surveying
3. To provide knowledge about the surveying applications in Civil Engineering

Course Outcomes:

Student will be able to

1. Perform basic land surveying instruments and perform related calculations.
2. select methods to measure angles and distances
3. schedule field surveying operations
4. examine the implementation of surveying procedures for setting out curves
5. appraise the usage of equipment's and methods in triangulation survey
6. formulate the surveying methods and executions

Module 1: INTRODUCTION TO SURVEYING: Surveying: Principles, linear and angular methods, survey stations, survey lines- ranging, bearing of survey lines, levelling: principles of levelling-instruments- bench mark, temporary and permanent adjustment-booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning, curvature and refraction correction – reciprocal levelling, errors in levelling; contouring: characteristics, methods, uses.

Module 2: THEODOLITE SURVEYING: Theodolite—principle and practices –types- temporary and permanent adjustments- horizontal and vertical angles – repetition and reiteration methods – traversing - closing error and distribution-bowditch's and transit rule – omitted measurements -heights and distances- single plane-double plane method

Module 3: TACHEOMETRIC SURVEYING: Tacheometric surveying - principle of stadia method – distance and elevation formulae for staff held vertical – instrumental constants - anallactic lens -tangential method- subtense bar

Module 4: CURVES: Curve surveying: curves types - elements of simple curves – setting out simple curves by linear and angular methods – transition curve - requirements and functions.

Module 5: TRIANGULATION AND SETTING OUT WORKS: classification of triangulation systems - intervisibility and height of stations - signals and towers – satellite stations: reduction to centre –setting out introduction- setting out of a building, culvert and bridge pier.

Module 6: TOTAL STATION: EDM: Total Station – parts of a total station - accessories –advantages and applications - errors in total station survey- downloading - processing and preparation of maps, area, contouring, downloading

Text Books:

1. Punmia B. C., Ashok k Jain, Arun K Jain., “Surveying”, Vol I,II,III, Laxmi Publications, 2005
2. Arora, K.R., “Surveying, Vol-I, II and III”, Standard Book House, 2015.

Reference Books:

1. Basak, N., “Surveying and Levelling”, McGrawHill and Co., New Delhi 2015.
2. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2016
3. Madhu, N, Sathikumar, R and Satheesh Gobi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson India, 2006.
4. Paul R. Wolf, Charles D. Ghilani, “Elementary Surveying: An Introduction to Geomatics”, Prentice Hall, 2006
5. Uren J, Price W.F, “Surveying for Engineers”, Macmillan International Higher Education., 2010

18CE2018	STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge about different methods of analysis
2. To impart the different techniques available for the analysis of structures
3. To enable to identify the best suitable method of analysis

Course Outcomes:

Student will be able to

1. Illustrate the concepts and principles
2. Explain the behaviour of structural elements
3. Analyze the structural members for various forces
4. Estimate the response of the elements
5. Develop suitable response intricacies
6. Adapt suitable analysis procedure

Module 1: MOMENT DISTRIBUTION METHOD: Moment distribution method - analysis of continuous beams and portals –sway and non-sway analysis- bending moment and shear force diagram

Module 2: ROLLING LOAD: Influence line –rolling loads - influence lines for bending moment and shear force- Maxwell’s reciprocal theorem-Muller Breaslau’s - principle, determinate and indeterminate beams

Module 3: ARCHES: Three hinged arch – Two hinged arch – parabolic and semi-circular arches – Concentrated loads – Uniform loads – Temperature effects – determination of reaction, normal thrust, radial shear and bending moment – influence line for stress resultants in two hinged and three hinged arches – load position for maximum

Module 4: SUSPENSION CABLES AND BRIDGES: Cables and suspension bridges with three hinged stiffening girders

Module 5 : STIFFNESS METHOD: Forces not acting at co-ordinates - formulation of structure stiffness matrix - determination of displacements - application to determinate and indeterminate trusses, beams, frames - effect of temperature, lack of fit - static condensation technique. - use of analysis software for application to the analysis of plane trusses and frames.

Module 6 : PLASTIC ANALYSIS: Statically indeterminate structures – beams in pure bending – plastic moment of resistance – plastic modulus – shape factor – load factor – plastic hinge and mechanism - static and kinematic methods – upper and lower bound theorems -plastic analysis of indeterminate beams and frames

Text Books:

1. Vazirani and Ratwani, “Analysis of Structures, Vol. 1 and II” , Khanna publishers, 2003.
2. Bhavikatti, S., “Structural Analysis”, Vol.1 and 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2011

Reference Books:

1. Vaidyanathan, R. and Perumal, P., “Structural Analysis”, Vol.1and 2, Laxmi Publications, New Delhi, 2014
2. Ramamrutham S., “Theory of structures”, Dhanpat Rai publications, 2004
3. Reddy C.S., “Structural Analysis”, Tata McGraw Hill, 2002
4. Negi L.S., “Structural Analysis”, Tata McGraw Hill Co., 2003
5. Rajasekharan and Sankarasubramaiam, “Computational Structural Mechanics”, Prentice-Hall of India. 2000

18CE2019	HYDRAULIC ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives:

1. To introduce the fundamentals of flow in open channels
2. To inculcate the concepts of flow variations
3. To impart the knowledge on pumps and turbines

Course Outcomes:

Student will be able to

1. Define the uniform flow conditions for channels
2. Recognize the non – uniform flow conditions for channels
3. Demonstrate the application of hydraulic jumps
4. Measure flow in open channels
5. Experiment on the impact of forces exerted by the jet on inclined, curved and stationary bodies
6. Investigate the selection and operation turbines and pumps

Module 1: UNIFORM FLOW: Pipe flow and open channel flow – types of open channel flow, geometrical elements of open channel –velocity distribution in open channel – steady uniform flow: Chezy's equation, Manning's equation – most economical sections for uniform flow – computations in uniform flow – specific energy and specific force – critical depth and velocity.

Module 2: GRADUALLY VARIED FLOW: Dynamic equations of gradually varied flow – water surface flow profile classifications: Hydraulic slope and hydraulic curve – Flow measurements: weirs and notches – rectangular, triangular and trapezoidal

Module 3: RAPIDLY VARIED FLOW: Application of the energy equation for RVF – critical depth and velocity – critical, subcritical and super-critical flow – hydraulic jump – energy dissipation.

Module 4: IMPACT OF JET: introduction – force exerted by the jet on a stationary vertical plate, hinged plate, inclined plate – force exerted by a jet on moving plate - impact of jet on vanes.

Module 5: TURBINES: Turbines – layout and components of hydro-electric project – impulse turbine - reaction turbines – Francis turbine – Kaplan turbines – draft tube – head losses and efficiencies - specific speed.

Module 6: PUMPS: Centrifugal pumps – working principle – single stage and multi-stage pumps - minimum starting speed – Euler's head, manometric head – specific speed - reciprocating pumps – working principle of reciprocating pumps – indicator diagram - airvessels.

Text Books:

1. Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines”, S.Chand and Co., New Delhi, 2008.
2. Bansal, R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi, 2005

Reference Books:

1. Modi, P.N. and Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi, 2007
2. Som S.R, and Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, 2012
3. Gupta S. C, “Fluid Mechanics and Hydraulic Machines”, Pearson Education India., 2006
4. Subramanya, K., “Fluid Mechanics and Hydraulic Machines”, McGraw Hill India Pvt. Ltd., New Delhi, 2011
5. Yunus A.Cengel., “Fluid Mechanics”, Tata McGraw Hill India Pvt. Ltd., 2010.

18CE2020	REINFORCED CONCRETE ELEMENTS	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart the understanding of design philosophies of RCC elements
2. To enable design and detail the structural elements as per IS 456:2000
3. To enable plan and design a building using codal provisions

Course Outcomes:

Student will be able to

1. Identify the design philosophies for RCC elements
2. Demonstrate the behaviour of elements for load calculations
3. Illustrate the LSM for estimating stress resultants
4. Design the section and reinforcement for the structural elements
5. Develop suitable detailing diagrams
6. Prepare the design for buildings

Module 1: DESIGN PHILOSOPHY: Design Concept: working stress method, ultimate load method and limit state method –limit state of collapse and serviceability- partial safety factors for material and loading -stress-strain characteristics: concrete and reinforcing steel – sections: under reinforced, over reinforced and balanced section

Module 2: SLABS: Analysis and design: one way slab - two way slabs - continuous slabs - cantilever slabs - boundary conditions

Module 3: BEAMS: Analysis and design: singly, doubly reinforced rectangular and flanged beams – Design for bond and anchorage, deflection and torsion

Module 4: COLUMNS: Columns classifications – braced and unbraced columns -design of short column: axially loaded, uniaxial bending, biaxial bending - long column.

Module 5: FOOTING: Design of wall footing – design of axially and eccentrically loaded rectangular and sloped footings – design of combined rectangular footing for two columns only.

Module 6: RC FRAMED BUILDING: - Substitute frame method - planning and design of a G+3 storied RCC building.

Text Books:

1. Unnikrishna Pillai and Devdass Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd., 2003
2. Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi, 2007

Reference Books:

1. Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, 2002
2. Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., 2006
3. Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi 2005
4. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
5. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.

18CE2021	DESIGN OF STEEL STRUCTURES	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge on design connections, tension and compression members.
2. To enable to design Flexural members.
3. To enable to design Industrial Building.

Course Outcomes:

Student will be able to

1. Identify the behaviour of members
2. Estimate the forces in members.
3. Design the member for forces
4. Choose suitable codal provisions
5. Explain the design intricacies
6. Formulate the design for steel structures

Module 1: CONNECTIONS: Properties of structural steel- classification of steel sections- limit state design concepts- loads and load combination, connection- welding, bolting- design of bolted and welded joints- simple connections - efficiency of joints.

Module 2: TENSION MEMBERS: Types of sections- net area- net effective sections of angle and tee in tension – block shear - lug angles- design of tension splice - concept of shear lag - built-up sections - splicing of tension members

Module 3: COMPRESSION MEMBERS: Compression members – effective length - slenderness ratio – buckling – mode of failure - design of compression members - design of single and compound section members- design of laced and battened columns – slab base and gusseted base

Module 4: BEAMS: Design of laterally supported and unsupported beams- built up beams- design of welded plate girders- intermediate and bearing stiffeners.

Module 5: TRUSS: Roof truss - loading types - Roof and side covering- Design of purlin and elements of truss - end bearing - Design of gantry girder

Module 6: INDUSTRIAL SHED: Planning and design of roof truss supporting system and column base

Text Books:

1. Duggal. S.K, “Limit State Design of Steel Structures”, Tata McGraw Hill Publishing Company, 2014
2. Bhavikatti.S.S, “Design of Steel Structures by Limit State Method as per IS:800–2007”, IK International Publishing House Pvt. Ltd., 2014

Reference Books:

1. Subramanian.N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2013.
2. Gambhir.M.L., “Fundamentals of Structural Steel Design”, McGraw Hill Education India Pvt. Ltd., 2013
3. Shiyekar. M.R., “Limit State Design in Structural Steel”, Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
4. Pasala Dayaratnam, “Design of Steel Structures”, S. Chand Publishers, 2008
5. IS 800 :2007, IS4000:1982, SP : 6 (3)

18CE2022	SOIL MECHANICS	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge to classify the soil based on index properties.
2. To familiarize the Student on compaction, flow through soils, consolidation and shear strength of soils.
3. To impart knowledge on slope stability analysis.

Course Outcomes:

Student will be able to

1. Identify the soil properties.
2. Evaluate the flow through soils.
3. Analyze the stress behaviours.
4. Demonstrate the settlement characteristics.
5. Compare various slope stability analyses.
6. Integrate the laboratory tests with strength properties

Module 1: SOIL CLASSIFICATION AND COMPACTION: Soil description – Soil structure – Phase relation – Index properties – Particle size distribution – Atterberg’s limits – indices - BIS classification - Compaction of soils –laboratory tests – Proctor’s compaction – standard – modified – zero voids line - field compaction methods – factors influencing compaction of soils -compaction control

Module 2: EFFECTIVE STRESS AND PERMEABILITY: Soil - water – Static pressure in water - Effective stress concepts in soils – capillary phenomena– Two dimensional flow – Darcy’s law – permeability - laboratory methods - constant head - falling head methods – stratified strata - factors influencing permeability of soils – seepage - laplace’s equation – quick sand – liquefaction - flow nets.

Module 3: STRESS DISTRIBUTION: Stress distribution in homogeneous and isotropic medium – Boussinesq theory – Point load, Line load and UDL – Westergaard’s solution - Use of New marks influence chart

Module 4: CONSOLIDATION: Components of settlement — immediate and consolidation settlement – terzaghi’s one dimensional consolidation theory – computation of rate of settlement. - $\sqrt{t}$ and $\log t$ methods – e - $\log p$ relationship.

Module 5: SHEAR STRENGTH: Shear strength of cohesive and cohesion less soils – Mohr-Coulomb’s failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters

Module 6: SLOPE STABILITY: Stability Analysis - Infinite slopes and finite slopes – Total stress analysis - Friction circle method – Use of stability number – Method of slices – Fellenious and Bishop’s method –Stability number - Slope protection measures.

Text Books

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 2011.
2. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi. 2015

Reference Books

1. McCarthy, D.F., “Essentials of Soil Mechanics and Foundations”, Prentice-Hall, 2006.
2. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3. Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Ltd., International Publisher New Delhi (India) 2006.
4. Karl Terzaghi , “Soil Mechanics in Engineering Practice”, Read Books, 2010.
5. IS 2809-1972 ,IS 1498-1970,IS 2720 (Part 1-37), SP 36 Bureau of Indian Standards, New Delhi

18CE2023	FOUNDATION ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge on site investigation methods.
2. To select geotechnical design parameters and type of foundations.
3. To familiarize the geotechnical design of different type of foundations and retaining walls.

Course Outcomes:

Student will be able to

1. Recall the various site investigation methods.
2. Calculate the bearing capacity of soils and foundation settlements.
3. Analyze the various foundation system.
4. Design the foundation system for larger depths.
5. Suggest retaining structures catering to earth pressure conditions.
6. Adopt suitable subsurface instrumentation.

Module 1: SITE INVESTIGATION AND SELECTION OF FOUNDATION: Scope and objectives – methods of exploration – auguring and boring – wash boring and rotary drilling – depth and spacing of bore holes – bore log report - soil samples – representative and undisturbed – sampling methods – split spoon sampler, thin wall sampler, stationary piston sampler – penetration tests (SPT and SCPT) – data interpretation - selection of foundation based on soil condition

Module 2: BEARING CAPACITY: Introduction – location and depth of foundation – codal provisions – bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – factors affecting bearing capacity – bearing capacity from in-situ tests (SPT, SCPT and Plate load) – allowable bearing pressure – seismic considerations in bearing capacity evaluation - determination of settlement of foundations on granular and clay deposits from plate load test – total and differential settlement – allowable settlements – codal provision – methods of minimizing total and differential settlements – ground improvement techniques

Module 3: SHALLOW FOUNDATION: Isolated footing - combined footing - mat foundation – contact pressure and settlement distribution – proportioning of foundations – structural design of isolated and combined footing - floating foundation.

Module 4: PILE FOUNDATION: Types of piles and their functions – factors influencing the selection of pile – carrying capacity of single pile in granular and cohesive soil – static formula – dynamic formulae - engineering news and Hileys– capacity from insitu tests - SPT and SCPT – negative skin friction – uplift capacity- group capacity by different methods - Feld's rule, converse – Labarra formula and block failure criterion – settlement of pile groups – interpretation of pile load test - under reamed piles

Module 5: RETAINING WALLS: Plastic equilibrium in soils – active and passive states – Rankine's theory – cohesionless and cohesive soil – Coulomb's wedge theory – condition for critical failure plane – earth pressure on retaining walls of simple configurations – Culmann graphical method – pressure on the wall due to line load – stability analysis of retaining walls – codal provision.

Module 6: CASE STUDIES AND INSTRUMENTATION: Case studies on failure of foundations - Settlement plate – Piezometer – Load cells – inclinometer – transducers

Text Books:

1. Arora, K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.
2. Varghese, P.C., "Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2005.

Reference Books:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors Ltd., New Delhi, 2015.

2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd., New Delhi, 2005.
4. Venkatramaiah, C., "Geotechnical Engineering", New Age International Publishers, New Delhi, 2007 (Reprint).
5. BIS 2809-1972 ,BIS 1498-1970,BIS 2720 (Part 1-37)

18CE024	CONCRETE TECHNOLOGY (Industry run course)	L	T	P	C
		2	0	0	2

Course Objectives:

1. To impart knowledge on constituents of concrete material
2. To familiarize the properties of fresh and hardened concrete
3. To enable to design the concrete mixes

Course Outcomes:

Student will be able to

1. Understand the constituent materials and composite theory
2. Comprehend the different mechanisms causing volume change from fresh to hardened concrete
3. Recall standards for production of concrete with specified strength and durability.
4. Identify the concrete type under various production conditions for different purposes
5. List the techniques of measuring the failure modes of structural concrete
6. Design a concrete mix based on various parameters

Module 1: INTRODUCTION: Concrete: Properties of ingredients- w/c ratio - Production of concrete - fresh concrete – workability -hydration - concrete additives

Module 2: MECHANICAL PROPERTIES OF CONCRETE: Behavior of concrete in compression, tension and flexure - shear and bond - Influence of various factors on test results - creep, shrinkage and fatigue

Module 3: MIX DESIGN: Concrete mix design; Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion - different method of mix design.

Module 4: DURABILITY OF CONCRETE: Curing – curing methods - Behavior of concrete in extreme environment: hot weather, cold weather and under water conditions - permeability - sulphate and chloride attack – efflorescence - fire resistance – corrosion resistance and its prevention – repair and rehabilitation

Module 5: STRUCTURAL HEALTH ASSESSMENT: Inspection and testing of concrete- concrete cracking - types of cracks - causes and remedies - non-destructive tests on concrete - chemical tests on cement and aggregates;

Module 6: SPECIAL CONCRETE: Special concrete: Ready mixed concrete – pervious concrete – self compacting concrete- self healing concrete – Geopolymer concrete - Fibre reinforced concrete- Polymer concrete –High performance concrete

Text Books:

1. Santhakumar A.R., "Concrete Technology", Oxford University press, Jai Singh road, Delhi, 2006
2. Shetty, M.S., "Concrete Technology", S.Chand and Co., New Delhi, 2005

Reference Books:

1. Gambhir M.L., "Concrete Technology", Tata Mc Graw Hill Publishing Company limited, New Delhi, 2004
2. Neville, A.M., "Properties of Concrete", Longman Scientific and Technical, England, 1995
3. Neville, A.M., "Concrete Technology", Longman Scientific and Technical, 1990.
4. IS: 303-1970(Second Revision), Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete", Bureau of Indian Standards, New Delhi
5. SP 23: Handbook on Concrete Mixes, Bureau of Indian Standards, New Delhi

18CE2025	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the concepts of surface and ground water hydrology
2. To enable the student to develop skills to appreciate water resources systems
3. To know the purpose of various hydraulic structures

Course Outcomes:

Student will be able to

1. Recognise the concepts to manage water resources and apply for hydrological modelling
2. Decide and plan basic water resources projects
3. Solve water related environment problems
4. Appreciate the importance of reservoirs and hydraulic structures
5. Plan structures for recharging groundwater
6. Maintain hydraulic structures

Module 1: SURFACE HYDROLOGY: Hydrologic cycle – precipitation – measurement of rainfall – evaporation – factors affecting evaporation – empirical methods – transpiration – estimation of transpiration – evapotranspiration – empirical methods – transpiration – measurement of infiltration capacity

Module 2: RUNOFF: Introduction – factors affecting runoff – Estimation of Runoff and yield – Empirical methods – Runoff coefficient method – maximum flood discharge - empirical methods – envelope curves method

Module 3: HYDROGRAPH ANALYSIS: Hydrograph – components of hydrograph – base flow separation - unit hydrograph – derivation of unit hydrograph an isolated storm

Module 4: RESERVOIR PLANNING: Introduction – types of reservoirs – types of flood control reservoirs – selection of site for a reservoir – mass inflow curve and demand curve –analytical method for determination of storage capacity – flood routing (definition only)

Module 5: GROUNDWATER HYDROLOGY: Types of Geologic formation and aquifers – water table and piezometer surface – aquifer properties – Darcy’s law – Dupuite and Thiem’s theory – steady flow to a well in an unconfined aquifer – steady flow to a well in a confined aquifer – determination of transmissibility from steady flow equations – specific capacity and well efficiency – pumping test method for determination of S and T

Module 6: INTRODUCTION TO HYDRAULIC STRUCTURES: Control structures – modelling - river training and control dams – types – canal regulation works – canal fall – head and cross regulator – canal escapes – cross drainage works – diversion head works – weirs and barrages – causeways and culverts.

Text Books:

1. Subramanya, K., “Engineering Hydrology”, Tata McGraw Hill, 4th edition, 2013.
2. Arora, K. R., “Irrigation, water power and water resources Engineering”, Standard Publishers Distributors, 2012

Reference Books:

1. Linsley, R. K. and Franzini, J.B., “Water Resources Engineering”, McGraw Hill Inc, 4th edition 2013.
2. Sahasrabudhe, S.R., “Irrigation Engineering and Hydraulic Structures”, Katson Publishers, 3rd edition, 2011.
3. Patra K. C., “Hydrology and Water Resources Engineering”, Alpha Science International, 2008
4. Garg S. K., “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, 2009.
5. Michael, A.M., “Irrigation – Theory and Practices”, Vikas Publishing House, New Delhi, 2004

18CE2026	ENVIRONMENTAL ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives:

1. To familiarize with the component of water supply system and water treatment plants
2. To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution
3. To make the student conversant with different aspects of municipal solid waste

Course Outcomes:

Student will be able to

1. Understand the impact of humans on environment and environment on humans
2. Plan the structure of drinking water supply systems.
3. Estimate sewage generation and design sewer system.
4. Perform basic design of unit operations and processes in sewage treatment.
5. Understand the nature and characteristics of municipal solid waste.
6. Converse with basic environmental legislation.

Module 1: PLANNING FOR WATER SUPPLY SYSTEM: Public water supply system –Planning - Objectives - Sources of water and their characteristics - Design period - population forecasting -water demand – standards - water borne diseases.

Module 2: WATER TREATMENT: Objectives - Unit operations and processes - principle and functions of flash mixers, flocculators, sedimentation tanks, filtration, aeration, disinfection - distribution network - water softening.

Module 3: COLLECTION AND ESTIMATION OF SEWAGE: Different types of sewers - sewerage systems - variation in sewage flow - sewer appurtenance - estimation of storm water discharge - laying and testing of sewers.

Module 4: UNIT OPERATIONS FOR WASTEWATER TREATMENT: Layout of municipal wastewater treatment plant, physical unit operation – screening - flow equalization - flocculation, sedimentation - chemical precipitation - aerobic and anaerobic treatment process –sewage treatment plant (stp) - septic tank.

Module 5: AIR AND NOISE: Composition and properties of air - quantification of air pollutants - monitoring of air pollutants - air pollution- occupational hazards - urban air pollution - automobile pollution - air quality standards - control measures for air pollution - construction and limitations - noise- basic concept - measurement and various control methods.

Module 6: SOLID WASTE MANAGEMENT: Municipal solid waste (MSW) - composition and various chemical and physical parameters of MSW - Effects of solid waste on environment.

Text Books:

1. Gilbert M Masters, “Introduction to Environmental Engineering and Science”, Pearson new international edition, third edition, 2014.
2. Basak, “Environmental Engineering”, Tata McGraw-Hill Education., 2005

Reference Books:

1. Aarne Vesilind P., Susan M. Morgan, “Introduction to Environmental Engineering”, Thompson /Brooks/Cole; Second Edition 2008.
2. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 2013.
3. Met Calf and Eddy, “Wastewater Engineering, Treatment Disposal and Reuse”, Tata McGraw-Hill, New Delhi, 2010
4. Manual on :Water Supply and Treatment”. Ministry of Urban Development, New Delhi.

5. IS: 10500 (2012), IS: 1172 (2002), IS: 3025(2009), The Environment (Protection) Rules, 1986: [schedule – VI], Manual on water supply and treatment – CPHEEO, National Ambient Air Quality Standards (18 November 2009)

18CE2027	TRANSPORTATION ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart the importance of transportation and characteristics of different modes of transportation
2. To provide knowledge about the geometric and structural design of different modes of transportation
3. To impart knowledge about planning, construction and operations of Highways, Railways, Airports and Harbours

Course Outcomes:

Student will be able to

1. Understand the concepts of development of different modes of transportation
2. Explain the components of various transportation system
3. Carry out the engineering surveys involved in planning of transportation system
4. Design the geometric elements of different transportation system
5. Recognize the functions of structural elements of different transportation system
6. Identify the materials used for the construction of transportation modes

Module 1: INTRODUCTION TO HIGHWAY ENGINEERING: Different modes of transportation – Characteristics - Historical development of road construction- Highway development in India – Classification of roads - Road patterns - Engineering Surveys – Highway planning in India - Highway projects – Built Operate Transfer (BOT), Built Own Operate and Transfer (BOOT), and Public Private Partnership (PPP)

Module 2: GEOMETRIC DESIGN OF HIGHWAYS: Cross section elements; sight distance, design of horizontal alignment – design speed, super elevation, extra widening - transition curve - design of vertical alignment – summit curve and valley curve - design of intersections - problems

Module 3: PAVEMENT MATERIALS: Materials used in Highway construction - soil, stone aggregates, bituminous binders, bituminous paving mixes - portland cement and cement concrete - desirable properties – tests - requirements for different types of pavements - problems

Module 4: PAVEMENT DESIGN: Introduction - Flexible pavements: factors affecting design and performance - design of flexible pavements - Rigid pavements: components and functions - factors affecting design and performance - design of concrete pavements

Module 5: RAILWAY ENGINEERING: Railway Transportation and its development – elements of permanent way – rails, sleepers, ballast, rail fixtures and fastenings, subgrade and embankment – track alignment – survey for track alignment – points and crossing – station and yards – signaling and control system

Module 6: AIRPORTS AND HARBOURS: Airport planning - airport components – apron, terminal building, passenger facilities and services, hangers, runway, taxiway, parking area - runway orientation – wind rose diagram harbours – components of harbour –requirements of harbour -classification of harbours – site selection and planning of harbours - Ports and Docks – navigational aids

Text Books:

1. Kadiyali L.R, “Transportation Engineering”, Khanna Publishing, 2016
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, “Highway Engineering”, Revised 10th Edition, Nem Chand and Bros, 2017

Reference Books:

1. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, "Principles of Highway Engineering and Traffic Analysis", 4th Edition, John Wiley
2. Rangwala, "Railway Engineering", Charotar Publishing House, 2013
3. Mundrey J.S. "A course in Railway Track Engineering". Tata McGraw Hill, 2007
4. Rangwala, "Airport Engineering", Charotar Publishing House, 2013
5. IRC – 58 – 2015, IRC:37-2012, Standards for "Road and Bridge Works", Ministry of Road Transport and Highway (MORTH), 5th Edition, April 2013.

18CE2028	QUANTITY SURVEYING AND ESTIMATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the knowledge about the types of estimates
2. To identify the methods used for different structural components
3. To provide knowledge about rate analysis and process of preparation of bills

Course Outcomes:

Student will be able to

1. List the detailed specification for different types of structures
2. Plan the rate analysis of civil engineering works
3. Determine the rates of various items of civil works
4. Justify estimated cost of civil construction projects
5. Evaluate the actual value of any property
6. Explain specifications and tendering process for contracts

Module 1: INTRODUCTION TO ESTIMATES AND SPECIFICATIONS: Quantity surveying– purpose of estimates - types of estimates - various items to be included in estimates - principles in selecting units of measurement for items, various units and modes of measurement for different trades - IS 1200, specifications – purpose and basic principles of general and detailed specifications: detailed specifications for various items of work.

Module 2: ANALYSIS OF RATES: Rate analysis and preparation of bills – data analysis of rates for various items of works – abstract estimates for Building projects

Module 3: BUILDING AND SANITARY WORKS: Quantity surveying of building – method of estimate, estimate of walls - estimate of masonry platform - estimate of single room building with verandah - estimate of two roomed building - sanitary - estimation of a septic tank and soak pit

Module 4: RCC WORKS and STRUCTURES AND ROADS: R.C.C and Steel works - RCC Slab – RCC beam – RCC column with foundation - RCC framed building - Road- RCC slab culvert - detailed estimate for WBM - Bituminous road – introduction to MEP in building

Module 5: VALUATION: Valuation: rent fixation, gross income, net income – depreciation - methods of depreciation: straight line method, declining balance method, sinking fund method, plinth area method

Module 6: TENDERS AND CONTRACTS: Tender notice - tender document - contract-contractor and terms and conditions of contract – agreement - contract types - relative merits - prequalification - responsibility of owner, architect, contractor and engineer

Text Books:

1. Dutta.B.N, "Estimating and Costing in Civil Engineering Theory and Practice," UBS publishers 2016.
2. Birdie.G.S, "A Text Book on Estimating and Costing", Dhanpat Rai and Sons, New Delhi, 2000.

Reference Books:

1. Jogleka.P.T, "Practical Information for Quantity Surveyors", Institution of Surveyors, 2017.
2. Vazirani V. N., "Civil Engineering Estimating and Costing", Khanna Publishers, 2004

3. .Kohli R.C, “A Textbook of Estimating, Costing and Accounts (Civil)”, S. Chand Publishing, 2012
4. Rangwala .S.C, “Valuation of Real Properties”, Charotar Publishing House, Anand, 2008.
5. IS 1200 : Part 1– 19 – Method of measurement of buildings and civil engineering works

18CE2029	SURVEY LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To train to acquire skill in operation of various survey instruments
2. To give hands on training on the use of conventional and modern tools of surveying
3. To enhance the knowledge to carryout and interpret the field surveying procedures

Course Outcomes:

Student will be able to

1. Memorize the procedures of usage of surveying instruments
2. Identify the method for a typical survey
3. Demonstrate the appropriate methods of surveying
4. Organize the field operations during surveying
5. Use modern survey equipment to measure areas and volumes
6. Construct layouts and diagrams as per the field data

List of Experiments:

1. Use of Dumpy level - fly levelling
2. Use of Dumpy level – reciprocal levelling
3. Measurement of horizontal angles by the method of repetition
4. Measurement of horizontal angle by the method of reiteration
5. Single plane method
6. Double plane method
7. Stadia tacheometry and determination of constants of a theodolite
8. Tangential tacheometry
9. Setting out a simple circular curve by ordinates from long chord
10. Setting out a circular curve by Rankine’s method of tangential angles
11. Measurement of area using Total station
12. Measurement of volume using Total station

Text Books:

1. PunmiaB. C., Ashok k Jain, Arun K Jain., “Surveying Vol I,II,III”, Laxmi Publications, 2005
2. Arora, K.R., “Surveying”, Vol-I, II and III, Standard Book House, 2015.

Reference Books:

1. Basak, N., “Surveying and Levelling”, McGraw Hill and Co., New Delhi 2015.
2. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2016
3. Survey Manual, Department of Transportation (DOT), 2010

18CE2030	FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

1. To give hands on training on principle and working of different flow measuring instruments
2. To impart knowledge on working of different types of turbines and pumps.
3. To demonstrate energy losses in pipe connections

Course Outcome:

Student will be able to

1. Recall the principles of instruments used in flow related measurements.
2. Demonstrate energy losses in pipe connections.
3. Experiment and select turbines and pumps

List of Experiments:**Fluid Mechanics**

1. Determination of Darcy's Friction Factor.
2. Calibration of Flow Meters.
3. Flow over weirs / Notches.
4. Flow through Mouth piece / orifice.
5. Determination of Minor Losses in pipes
6. Determination of Metacentric height

Fluid Machinery

1. Performance of Centrifugal Pump
2. Performance of Submersible Pump
3. Performance of Gear Oil pump
4. Performance of Jet pump
5. Load Test on Pelton Wheel.
6. Load Test on Francis Turbine

Text Books:

1. Modi, P.N. and Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 10th Edition, 1991.
2. Sarbjit Singh, "Experiments in Hydraulic Engineering", PHI Learning Pvt. Ltd., 2012

Reference Books:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 1998.
2. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 1998.

18CE2031	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objective:

1. To conversant with the experimental procedures for quantitative estimation of water quality parameters
2. To give hands on training on the testing water sample for drinking water
3. To give training on the determination of wastewater characteristics and microbiological characteristics

Course Outcome:

Student will be able to

1. Examine the characteristics of water and waste water
2. Suggest suitable treatment method to water for drinking purpose
3. Check the microbiological presence in the water and wastewater

List of Experiments:

1. pH in given sample
2. Electrical conductivity and Total Dissolved Solids (TDS).
3. Total solids and settleable solids present in given sample
4. Alkalinity in given sample
5. Acidity in given sample
6. Turbidity and optimum coagulant dose of a sample from jar test experiment

7. Hardness in given sample
8. Chlorides in given sample
9. Dissolved Oxygen (DO) and Bio-chemical Oxygen Demand (BOD) for given sample
10. Chemical Oxygen Demand (COD)
11. Sulphates present in sample
12. Most probable Number (MPN)

Text Books:

1. Rao Surampalli, Rama Pulicharla, Tian C. Zhang, “Handbook of Environmental Engineering”, McGraw-Hill Education, 2018
2. Varandani N. S, “Environmental Engineering”, Pearson Education India., 2017

Reference Books:

1. Sawyer, N.C., and McCarty, P.L., “Chemistry for Environmental Engineering”, McGraw-Hill Book Co., New York, 2003.
2. Lee C. C, “Environmental Engineering Dictionary”, Government Institutes, 2005
3. “Standard Methods for the Examination of Water and Waste Water”, APHA- AWWAWPCF, latest Edn., Washington (D.C). 1995.

18CE2032	GEOTECHNICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To provide hands on training in the determination of engineering and index properties of soils, applied in field problems.
2. To provide knowledge on use of experimental results pertaining to foundation problems
3. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test and unconfined compressive test

Course Outcomes:

Student will be able to

1. Identify and classify soils based on their index properties
2. Plot and evaluate the soil strength parameters
3. Interpret the experimental results with the theoretical solutions

List of Experiments:

Index Properties of Soil

1. (a) Determination of moisture content using i) Oven drying method and ii) Infrared moisture balance iii) Pycnometer
(b) Determination of specific gravity of soil
2. Grain size distribution using Sieve Analysis
3. Grain size distribution using Hydrometer Analysis
4. Determination of Atterberg’s limit
5. Determination of field density using i) Sand replacement method and ii) core cutter method
6. Determination of relative density of soil

Engineering Properties of Soil

7. Standard Proctor’s compaction test
8. California Bearing Ratio Test
9. Permeability test using i) Constant head method and ii) Variable head method
10. Direct shear test
11. Unconfined Compression test
12. Consolidation Test

Text Books:

1. “Soil Engineering Laboratory Instruction Manual” published by Engineering College Co-operative Society, Anna University, Chennai, 2010.
2. Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, New age International (P) limited publishers, New Delhi, 2008.

Reference Books:

1. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.
2. Venkatappa Rao G. and Goutham .K. Potable, “Geosynthetics Testing – A laboratory Manual”, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.
3. BIS :2720(Part II)-1173, BIS: 2720 (Part 3/Set 1) – 1980, BIS 2720-14 (1983), BIS 2720-Part 4 (1985), BIS 2720 (Part 17-1986), BIS 2720 (Part – 13) 1986

18CE2033	CONCRETE AND HIGHWAY LABORATORY	L	T	P	C
		0	0	2	1

Course Objective

1. To provide good understanding of concepts and their applications in the lab
2. To understand the characteristics and behavior of civil engineering materials used in buildings and infrastructure.
3. To impart knowledge about statistical analysis and interpret laboratory test results

Course Outcome

Student will be able to

1. Determine the workability of cement concrete
2. Characterize various highway materials through relevant tests
3. Design the mix which fulfills the required properties for fresh and hardened concrete

List of Experiments:**CONCRETE:****Tests on Cement and Aggregate**

1. Standard Consistency and Setting time Test
2. Fineness, soundness and compressive strength of cement
3. Specific Gravity, Density and moisture content of aggregate
4. Grading of fine and coarse aggregate

Test on Fresh Concrete

5. Slump Cone Test
6. Compaction Factor test
7. Mix Design by Indian Standard Method

Test on Hardened Concrete

8. Compressive strength and Modulus of Elasticity of concrete
9. Tensile Strength and Flexural strength of concrete

HIGHWAY:

1. Crushing value of Coarse aggregate
2. Impact value of Coarse aggregate
3. Flakiness index and elongation index

Test on Bitumen

4. Ductility test on bitumen
5. Softening point test on bitumen
6. Penetration test on bitumen
7. Bitumen Mix design (study)

Text Books:

1. Shetty, M.S., “Concrete Technology”, S.Chand and Company Ltd., New Delhi, 2008
2. Martin Rogers, “Highway Engineering”, Wiley-Blackwell, 2003.

Reference Books:

1. Khanna, S. K., and Justo, C.E.G., “Highway Engineering”, Nem Chand and Bros., 2005.
2. IS 269 : 1989, Indian Standard, “Ordinary Portland cement - 33 Grade Specification”, Bureau of Indian Standards, New Delhi
3. IS 383 : 1970, IS 1489 (Part 1) : 1991, IS : 12269 -1987, IS: 303-1970 (Second Revision), IS 2386 – 1963 Part I, III, IS : 2430 – 1986

18CE2034	DESIGN PROJECT	L	T	P	C
		0	0	4	2

Course Objectives:

To impart and improve the design capability of the student. This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g.,

- Design of a RC structure
- Design of a wastewater treatment plant
- Design of a foundation system
- Design of a Steel structure
- Design of Irrigation structure
- Design of traffic intersection etc.

Course Outcomes:

Student will be able to

1. Have experience in designing various design problems related to Civil Engineering as per codal provisions.

Course Description:

The design problem can be allotted to either an individual student or a group of Student comprising of not more than four. The group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

Reference Books:

1. IS456, IS 800, MORTH Specifications, Handbook of Irrigation structures by Ellil, IRC

18CE2035	INTERIOR DESIGN	L	T	P	C
		2	0	0	2

Course Objectives:

1. To provide knowledge on various developments in Interior design through ages.
2. To understand the various aspects such as spatial quality, design vocabulary, design principles, and design process related to the design of interiors.
3. To familiarize the Interior Design on materials used in furniture and its construction and detailing

Course Outcomes:

Student will be able to

1. Relate the various aspects such as form, scale, light, dimension, height, transitional elements etc.
2. Explain the process involved in design including analysis, synthesis and evaluation
3. Construct the effects that could be created by manipulating the enclosing elements such as walls, roof etc
4. Organize the various anthropometric aspects, human factors and other design criteria involved in the design of furniture
5. Infer the landscaping elements and their application in interior spaces
6. Appraise the need and applications of air conditioning, acoustics, electrification

Module 1: HISTORY OF INTERIOR DESIGN: Early classical period - prehistoric cave paintings – primitive designs- interiors during Egyptian, Greek, Roman, Gothic, early Christian and Renaissance periods - middle ages - interiors in Romanesque, Gothic, and Renaissance periods - colonial to the beginning of the 21st century

Module 2: THEORY OF INTERIOR DESIGN: Interior space - space - spatial qualities: form, scale, outlook; structuring space with interior design elements - spatial form - spatial dimension - design vocabulary form – point, line, volume, shape, texture and colour

Module 3: DESIGN PRINCIPLES: Ratio; proportions – golden section - relationships – scale - balance – symmetrical, radial, occult - harmony - unity - variety - rhythm - emphasis - design control - design process – analysis, synthesis, design evaluation - interior design codes

Module 4: ELEMENTS OF INTERIOR SPACE and FURNITURE DESIGN: Wall planes - use of wall planes to create architectural effects - roof planes - different types and their visual impact – floor planes - various types of flooring - doors, windows and ventilators, etc. - room plans and furniture arrangement - types of furniture - modular, knockdown and economy furniture - traffic pattern and furniture layout for residence, commercial and office areas

Module 5: INTERIOR LANDSCAPE DESIGN: Interior landscaping – definition - classification of plants, indoor plants and their functions - layout and components, floriculture –commercial, ornamental, selection of plants and pest control.

Module 6: ROOF AND DECK LANDSCAPE AND INTERIOR SERVICES: Protection of the integrity of the roof and structure, provisions for drainage - lighting and colour in interiors - artificial lighting - effect of color in lighting - interior services - air-conditioning system and applications - fire safety - acoustics and sound insulation - electrical systems

Text Books:

1. Gary Gordon and Jamco L. Nuckolls, “Interior lighting for Designers”, Third edition, John Wiley and Sons, New York, 1995.
2. Jack E. Ingels, “Landscaping Principles and Practices”, Delmar Publishers. 2002

Reference Books:

1. Fiona Leolie, “Designs for 20th century Interiors”, VH Publications, London. 2000
2. Torquil Barker, “Concepts of lighting, Lighting design in Architecture”, 2001
3. Peter templeton and Saunders, “Detailing for architectural acoustics”, Architectural press, 1994
4. Jain V.K, “Fire Safety in Buildings”, New age International (Pvt Ltd) publishers, Chennai, 2007
5. Linda O'Shea, Chris Grimley, Mimi Love “The Interior Design Reference and Specification Book: Everything Interior Designers Need to Know Every Day”, Rockport Publishers, 2013

18CE2036	CONSTRUCTION EQUIPMENT AND AUTOMATION	L	T	P	C
		2	0	0	2

Course Objectives:

1. To impart knowledge about various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors
2. To familiarize the utility of equipments in construction projects.
3. To provide knowledge about robots in construction

Course Outcomes:

Student will be able to

1. Differentiate the conventional method and mechanized methods
2. Identify various types of equipments for different construction projects
3. Demonstrate the prestressing using jacks and grouting
4. Recommend the equipments used for lifting of materials
5. Evaluate the material handling equipment and determine equipment productivity

6. Adapt robots in construction sites

Module 1: CONSTRUCTION EQUIPMENTS AND MANAGEMENT: Introduction - conventional construction methods vs mechanized methods and its advantages- identification – planning of equipment – selection of equipment - equipment management in projects - maintenance management – equipment cost – operating cost – cost control of equipment - depreciation analysis – replacement of equipment-replacement analysis - safety management

Module 2: EQUIPMENT FOR EARTHWORK : Fundamentals of earth work operations - earth moving operations - types of earth work equipment - tractors, motor graders, scrapers, front end loaders – dozer, excavators, rippers, loaders, trucks and hauling equipment, compacting equipment, finishing equipment.

Module 3: OTHER CONSTRUCTION EQUIPMENT: Equipment for dredging: trenching, drag line and clamshells - tunneling – equipment for drilling and blasting - pile driving equipment - erection equipment - crane, mobile crane - types of pumps used in construction - equipment for dewatering and grouting – equipment for demolition - under water concreting equipment

Module 4: ASPHALT AND CONCRETE PLANTS: Aggregate production- different crushers – feeders - screening equipment - handling equipment - batching and mixing equipment - pumping equipment – ready mix concrete equipment - concrete placing equipment and concrete pavers - asphalt plant - asphalt pavers - asphalt compacting equipment

Module 5: PRESTRESSING JACKS AND GROUTING EQUIPMENT: Introduction -proprietary systems-wires, strands and tendons-bars-anchorage-types - tendon couplers- ducting-equipment for placing tendons-stressing jacks grouting system - grout mixer and agitator - grout pump - handling and installation of H.T. - strands necessary precautions –installation of ducts and strands

Module 6: MATERIALS HANDLING AND ERECTION EQUIPMENT: Forklifts and related equipment - portable material bins –conveyors – cranes, hoists and other equipment for lifting- industrial trucks- position equipment-unit load equipment-storage equipment- equipment for transportation of materials - equipment productivities - use of drones for spread out sites - use of robots for repetitive activities

Text Book:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., “Construction Planning, Equipment and Methods”, 5th Edition, McGraw Hill, Singapore, 2006.

Reference Books:

1. Deodhar, S.V. “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi, 1988.
2. Dr.Mahesh Varma, “Construction Equipment and its planning and Application”, Metropolitan Book Company, New Delhi. 1983.
3. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., “Construction Planning, Equipment and Methods”, McGraw Hill, Singapore, 2006.
4. Arora S.P. and Bindra S.P., “Building Construction, Planning Techniques and Method of Construction”, Dhanpat Rai and Sons, 1997.
5. Varghese , P.C. “Building construction”, Prentice Hall of India Pvt. Ltd, New Delhi, 2007

18CE2037	STRUCTURAL GEOLOGY	L	T	P	C
		2	0	0	2

Course Objectives:

1. To gain knowledge in the origin of earth structures
2. To understand the various strain concepts
3. To enlighten the structural geology of reservoir units.

Course Outcomes:

Student will be able to

1. Recall the geometry and type of structures present in earth.

2. Discuss the features formed in rocks when subjected to stress.
3. Illustrate the impact of structural geology to active tectonic settings
4. Investigate micro and macro scale deformation mechanisms (viz., brittle, ductile).
5. Predict 2D and 3D strain analysis for various deformation behaviours.
6. Interpret graphs and models used in structural geology to understand and demonstrate poly phase deformations.

Module 1: CONCEPTS OF ROCK DEFORMATION: Fundamental concepts of rock deformation - stress: hydrostatic, lithostatic and deviatoric stress - stress ellipsoid - dilation and distortion – strain: homogenous, non-homogenous, rotational and irrotational strain - strain ellipsoid - simple and pure shear - types of homogenous strain - stress-strain diagrams - stages of deformation - factors affecting deformation - progressive deformation - finite strain - measurement of strain in two dimensions.

Module 2: FAILURE MECHANISM: Brittle and shear failure – faults and fractures - Mohr circle -fault geometry and nomenclature - features of fault planes - fragmental rocks - faulting - lineaments and deep fractures – joints - analysis of fractures - shear zone - ductile and brittle - ductile shear zones - stress and strain ellipsoids - their application in the study of fractures.

Module 3: CLASSIFICATION OF CYLINDRICAL FOLDS: Geometric and genetic - classification of cylindrical folds - Canoe fold and inverted canoe fold - minor folds and their use in determining the major fold structure -Pumpelly’s rule - mechanics of folding - superposed folding - simple fold interference patterns.

Module 4: TECTONICS: Tectonics: classification, tectonic fabric - foliation – axial plane foliation and its origin, fracture cleavages, crenulation cleavage - transposed foliation - use of axial plane foliation and fracture cleavages and the determination of major structures. – lineation – types, classification and origin - geologic bodies and scale and structural co-ordinates - introduction to structural analysis and fundamentals of geometric analysis - application of stereographic and equal area projections in the representation of structures - geometric analysis of folds and lineations - concept of petrofabrics - use of universal stage in fabric studies - fabric symmetry.

Module 5: GEOPHYSICAL INVESTIGATION: Geophysical methods of exploration – electrical, magnetic, gravitational, seismic, radioactive and geochemical methods – influence of structure and texture of rocks - engineering properties - foundation problems in igneous, sedimentary and metamorphic rocks including recent sediments - investigations for foundation of dams and reservoirs –case studies – Investigation of canals and deep cuts – case studies.

Module 6: APPLICATIONS: Dams: classification, foundation, abutment and reservoir problem. geological aspects of dam investigations – Tunnels: classification - geological factors in tunneling – Landslides: types, causes and prevention – stability of slopes – aseismic design of buildings - influence of geological conditions on foundations - design of buildings

Text Books

1. David Pollard, Le, David D. Pollard, Raymond C. Fletcher., “Fundamentals of Structural Geology”, Cambridge University Press, 2005.
2. Ghosh.S.K., “Structural Geology: Fundamentals and Modern Developments”, Elsevier, 2013.

Reference Books

1. Krynine and Judd. “Principles of Engineering Geology and Geotechniques”, Mc Graw Hill 1957
2. Bell F. G. Engineering Geology. Elsevier 2007.
3. Lisle R. J. and Leyshon P. R. “Stereographic Projection Techniques for Geologists and Civil Engineers”, Cambridge University Press. 1994.
4. Marshak S. and GautamMitra, “Basic methods of Structural Geology”, Prentice Hall Inc. 1988.
5. Hobbs B.E., Means W.B. and William P. F. “An Outline of Structural Geology”, John Wiley 1976.
6. Ragan M. D. “Structural Geology”, Wiley 1969.

18CE2038	EXPANSIVE SOILS	L	T	P	C
		2	0	0	2

Course Objectives:

1. To equip to understand the properties and behaviour of expansive soils
2. To impart knowledge for the design of foundations on expansive soils
3. To enlighten the methods for modification of expansive soil

Course Outcomes:

Student will be able to

1. Understand in detail the behaviour and physical properties of expansive soil.
2. Improve the engineering properties and make it suitable for construction.
3. Estimate dynamic properties of soils.
4. Design the foundations on expansive soil.
5. Develop the site specific design spectrum for design of sub structure and evaluation of liquefaction potential.
6. Suggest preventive measures and stabilization of expansive soil.

Module 1: INTRODUCTION AND IDENTIFICATION: Expansive soils in India - related civil engineering problems - formation of expansive soils in field - identification of expansive soils: X-ray diffraction method - differential thermal analysis.

Module 2: PHYSICAL AND CHEMICAL PROPERTIES: Soil structure and clay mineralogy of expansive soil - atomic bond and molecular bonds - honey comb structure -base exchanges capacity - clay water relation - electrolysis processes.

Module 3: FOUNDATION ON BLACK COTTON SOIL: Foundations on swelling soils - swelling potential - mechanism of volume change - chemical composition of black cotton soil - construction techniques in black cotton soil - modern method of construction in under reamed soil.

Module 4: GROUND IMPROVEMENT TECHNIQUES: Stabilization of expansive soils: lime, slag (silica fume and aluminium sludge), cement, fly ash, chemicals and reinforced earth technique - micro reinforced vegetation -vibro floatation - grouting and soil nailing.

Module 5: LIQUEFACTION HAZARD MITIGATION: Factors affecting the expansive soil - method of assessment for liquefaction - effect instrumentation for monitoring - consolidation of marine clay deposits - expansive soil model of Bingham fluid bounded by porous beds.

Module 6: STABILIZATION METHODS: Moisture control - horizontal moisture barriers - vertical moisture barriers - subsurface drainage - peripheral drains -surface drainage -Soil replacement - soil stabilization - lime stabilization - chemical stabilization - compaction control

Text Books:

1. John Nelson , Debora J.Miller, “Expansive soils: Problems and Practice in Foundation and Pavement Engineering”, John Wiley and Sons, 1997
2. Kasmalkar B.J, “Foundation Engineering”, Pune Vidyarthi Griha Prakashan, Pune

Reference Books:

1. Gopal Rajan and Rao A.S.R, “Basic and applied Soil Mechanics” (Revised Edition), (New Age, New Delhi. 1998
2. Peck,R.B., Hanson W.E. and Thornburn. W.H. Johan, “Foundation Engineering” 2nd Edition, Wiley, New York 1976
3. Bowles J.E. “Foundation Analysis and Designing”, McGraw Hill, 1997
4. Alam Singh, “Soil Engineering in Theory and Practice” (Vol. – II), Asia Publishing House, New Delhi, 1981
5. Amer Ali Al-Rawas, Mattheus F.A. Goosen “Expansive Soils: Recent Advances in Characterization and Treatment” , CRC Press, 2006

18CE2039	GROUND IMPROVEMENT METHODS	L	T	P	C
		2	0	0	2

Course Objectives:

1. To impart fundamental knowledge of Ground Improvement Techniques
2. To understand the importance of Ground Improvement method.
3. To adopt appropriate method of Ground Improvement according to site conditions and requirement

Course Outcomes:

Student will be able to

1. Understand the types of ground improvement techniques and soil distribution in India
2. Identify the different types of stabilization techniques
3. Classify various types of ground improvement techniques.
4. Investigate the performance of the technique adopted.
5. Choose the appropriate method of Ground improvement based on their construction methods.
6. Measure the benefits due to the adopted ground improvement method.

Module 1: INTRODUCTION: Introduction to engineering ground modification- classification of ground modification techniques- soil distribution in India-reclaimed soils- ground improvement potential

Module 2: GROUTING: Grouting – aspects – groutability - grouting materials - suspension grouts and solution grouts - compaction grouting - procedure and applications of grouting.

Module 3: CHEMICAL STABILIZATION: Chemical stabilization – granular admixtures - cement - calcium chloride - fly ash – bitumen - chemical admixtures - construction methods.

Module 4: GROUND ANCHORS: Ground anchors – applications - types and components - anchor tests - rock bolts –applications and types- rock bolt action around an excavation - soil nailing – construction sequence –analysis of nailed soil

Module 5: COMPACTION: Compaction- moisture density relationship - shallow surface compaction- rollers – operational aspects - deep compaction – explosion - heavy tamping- vibro-compaction and vibro-replacement - properties of compacted soil - compaction control tests

Module 6: HYDRAULIC MODIFICATION: Hydraulic modification- Methods of dewatering- open sumps and ditches –wellpoint systems, deep well drainage - vacuum dewatering– electro osmosis – design of dewatering for excavations.

Text Books:

1. Purushothamaraj P., “Ground Improvement Techniques” ,University Science Press, 2005
2. Moseley, M. P. “Ground Improvement”, Blackie Academic and Professional, London,1993

Reference Books:

1. Manfred. R. Hausmann, “Engineering Principles of Ground Modification”, McGraw Hill, 1989
2. Orlando B. A, “Introduction to Frozen Ground Engineering”, Chapman and Hall, New York, 1994
3. Som, N and Das, S. P “Theory and practice of Foundation Design”, Eastern Economy Edition, India, 2003
4. Rawlings,C G, Hellowell,E. E. and Kilkenny,W. M. “Grouting For Ground Engineering”, Ciria, London, 2000.
5. Davics, M. C. and Schlosser, F. “Ground Improvement Geosystems”, Thomas Telford, London, 1997.

18CE2040	DESIGN OF REINFORCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To enable to design staircase, retaining walls and water tanks
2. To Impart the concept of study the design of bridges
3. To familiarize with the design of miscellaneous structures

Course Outcomes:

Student will be able to

1. Identify the behaviour of various structures
2. Estimate the loads on the structures
3. Design and detail RCC structures
4. Apply suitable codal provisions
5. Formulate the design for buildings
6. Solve the field implication for design

Module 1: STAIRCASE: Technical terms - requirements of good stair - types of stairs, geometrical design of rcc stair stair, dog legged staircase, open newel staircase (plan and sectional elevation).

Module 2: RETAINING WALLS: Types - behaviour and application of retaining wall, stability criteria, design and detailing of cantilever and counterfort type retaining wall for various ground conditions - Concepts of shear key.

Module 3: WATER TANKS: Design of circular tanks- flexible and rigid base - rectangular water tanks- tanks resting on ground, underground and overhead tanks - classification of water tank and method of analysis, permissible stresses, codal provisions.

Module 4: BRIDGES: Introduction to Bridges- classification of bridges- bridge deck system- IRC Loading class - design consideration- slab spanning in one direction - slab spanning in two direction- Pigeaud's chart- T-beam deck slab – Courbon's Method.

Module 5: MISCELLANEOUS STRUCTURES: Introduction – corbel design - modes of failure of corbel - IS code recommendations, design of deep beams - design aspects in deep beam - IS code recommendations - domes types - grid floor and flat slab.

Module 6: CASE STUDIES: Bridge, Multistorey building, Floor systems, Retaining walls, Domes - Reading reinforcement diagrams of structures.

Text Books:

1. Bhavikatti S. S, “Advanced RCC Design (RCC Vol.II)”, New Age International Publishers, 2016
2. Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi, 2007

Reference Books:

1. Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, 2002
2. Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., 2006
3. Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi 2005
4. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
5. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.

18CE2041	PRESTRESSED CONCRETE	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge on various prestressing methods, types and advantages of prestressing techniques
2. To enable to design prestressed concrete structures subjected to flexure
3. To impart the procedures for evaluation and estimation of losses of prestressing

Course Outcomes:

Student will be able to

1. Identify appropriate prestressing techniques
2. Understand the concepts of prestressing
3. Analyse prestressed concrete structures
4. Design prestressed concrete structural elements
5. Appraise on the quality parameters of PSC structures
6. Investigate the rationale for failure of a PSC structure

Module 1: INTRODUCTION: Basic concepts – advantages – materials required- systems and methods of prestressing –analysis of sections – stress concept – strength concept – load balancing concept – effect of loading on the tensile stresses in tendons – tendon profile

Module 2: DESIGN FOR FLEXURE: Basic assumptions for calculating flexural stresses – limit state of collapse - permissible stresses in steel and concrete – moment of resistance - – design for flexure - layout of cables and location of wires in pre and post tensioned members

Module 3: DESIGN FOR SERVICEABILITY: Factors influencing deflections – calculation of deflections – short term and long term deflections – losses of prestress

Module 4: DESIGN OF ANCHORAGE ZONE: Determination of anchorage zone stresses in post-tensioned beams by Magnel’s method, Guyons’ method and IS1343 code – design of anchorage zone reinforcement – spalling tension

Module 5: CONTINUOUS BEAM: Methods of achieving continuity in continuous beams –analysis for secondary moments – concordant cable and linear transformation – calculation of stresses – principles of design

Module 6: PRECAST ELEMENTS: Introduction to post tensioned precast structural elements - Case studies - failure - analysis and design of precast concrete structure - Mini project

Text Books:

1. Krishna Raju N., “Prestressed concrete”, 5th Edition, Tata McGraw Hill Company, NewDelhi,2012
2. Rajagopalan.N, “Prestressed Concrete”, Narosa Publishing House, 2014.

References Books:

1. Dayaratnam.P., “Prestressed Concrete Structures”, Oxford and IBH,2013
2. Pandit.G.S. and Gupta.S.P., “Prestressed Concrete”, CBS Publishers and Distributers Pvt. Ltd,2012
3. Lin T.Y. and Ned.H. Burns, “Design of Prestressed Concrete Structures”, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4. IS1343:1980, “Code of Practice for Prestressed Concrete”, Bureau of Indian Standards, New Delhi, 2012
5. IS 1785 : Part I and II : 1983 Specification for Plain Hard-drawn Steel Wire for Prestressed Concrete

18CE2042	DESIGN OF PRECAST CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the knowledge of production, transportation and erection process of precast elements
2. To enable to design the precast structural members
3. To impart the concept of analysis and design of different types of joints and its behavior

Course Outcomes:

Student will be able to

1. Establish suitable prefabrication building system
2. Catalog different types of precast construction
3. Illuminate the behavior of prefabricated structures
4. Review the behavior of precast structural connections
5. Endorse suitable types of joints for prefabricated structures
6. Precast structure against progressive collapse

Module 1: INTRODUCTION: Introduction – Precast concrete structural elements -Prefabricated systems - Advantages – Modular coordination - Materials – Production – Transportation – Erection – Quality control

Module 2: PREFABRICATED COMPONENTS: Over all structural system - roof and floor system - components - facial elements - design considerations and requirements —bearing for precast units

Module 3: DESIGN PRINCIPLES: Loading - load factor - modeling - analysis of frames - design of members - slab - beam – wall - guidelines - codal provisions

Module 4: JOINTS and CONNECTIONS: Joints and connections – tolerance - connection materials - requirements of structural joints – types of joints –detailing of joints - diaphragm connection – beam to column and column to column and column to foundation connections – joint fillers

Module 5: PRESTRESSED PRECAST CONCRETE: Design requirements for safety against progressive collapse – design of ties - introduction to prestressed precast concrete - case studies on precast construction and failures

Module 6: CASE STUDY: Analysis and design of simple precast building – Mini project – elements of prestressed – metro bridge construction

Text Books:

1. Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013
2. Kim S Elliott, “Precast Concrete Structures”, A Butterworth-Heinemann Title; 1 edition , 2002

Reference Books:

1. IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice
2. Code of Practice for Precast concrete construction 2003, PCI Design hand book
3. IS 12592 : 2002 Precast Concrete Manhole Cover and Frame – Specification
4. Hubert Bachmann, Alfred Steinle, “Precast Concrete Structures” ISBN: 978-3-433-02960-2, Aug 2011.
5. Bljuger F, “Design of Precast Concrete Structures”, John Wiley and Sons Inc 1988

18CE2043	BASICS OF DYNAMICS AND ASEISMIC DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To familiarize the principles of dynamics of structures
2. To enable to understand the behaviour of structures subjected to seismic forces
3. To impart knowledge about analysis and detailing of structures as per codal provisions

Course Outcomes:

Student will be able to

1. Identify the dynamic properties of structures

2. Estimate the forces on the structures
3. Assess the response on the structures
4. Design the structures for shear resistance
5. Evaluate the behavior of structures
6. Integrate suitable code provisions for applications

Module 1: FREE VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEM: Definition of degree of freedom – Idealization of structure as SDOF system – formulation of equation of motion for various SDOF system – D'Alembert's principles – effect of damping

Module 2: FORCED VIBRATION OF SINGLE DEGREE OF FREEDOM SYSTEM: response to harmonic forces- seismic instrumentation- vibration isolation- introduction to numerical methods

Module 3: MULTI DEGREE OF FREEDOM SYSTEM: Formulation of equation of motion for multidegree of freedom (MDOF) system – evaluation of natural frequencies and modes – Eigen values and Eigen vectors – Response to free and forced vibration of undamped and damped MDOF systems.

Module 4: INTRODUCTION TO EARTHQUAKE ENGINEERING: Elements of engineering seismology – definitions, introduction to seismic hazard, earthquake phenomenon – seismotectonics – seismic zones in India- inertia forces on structures- architectural features - earthquake design philosophy

Module 5: MASONRY STRUCTURES: Behaviour during seismic events- Box action in masonry buildings- Horizontal and vertical bonds- Protection of openings- lessons from past earthquakes

Module 6: RCC STRUCTURES: Ductility- capacity design concept- Evaluation of Earthquake forces – IS Code 1893: 2016 – Response Spectra –Design consideration –Earthquake resistant design of R.C.C. buildings –Design and detailing (IS 13920:2016)

Text Books:

1. Damodarasamy S.R, Kavitha.S, “Structural Dynamics and Seismic design”, Phi Learning Private Ltd., 2013.
2. Duggal S.K., “Earthquake Resistant Design of Structures”, OUP India Private Ltd.2013.

Reference Books:

1. Mario Paz, “Structural Dynamics – Theory and Computations”, Third Edition, CBS publishers, 2004
2. Jai Krishna, Chandrasekaran. A.R., and Brijesh Chandra, “Elements of Earthquake Engineering”, South Asia Publishers, 2009
3. Minoru Wakabayashi, “Design of Earthquake Resistant Buildings”, McGraw – Hill Book Company, 2006
4. Humar.J.L, “Dynamics of Structures”, Prentice Hall Inc., 2012.
5. Anil K Chopra, “Dynamics of structures – Theory and applications to Earthquake Engineering”, Prentice Hall Inc., 2001.
6. Moorthy.C.V.R., “Earthquake Tips”, BMTPC, NICEE, IIT Kanpur, 2005
7. IS 1893 : Part 1 : 2002 Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings

18CE2044	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the knowledge of causes of distress and aspects of rehabilitation.
2. To understand the techniques and materials needed for rehabilitation.
3. To get exposed to retrofitting and demolition techniques.

Course Outcomes:

Student will be able to

1. Evaluate a damaged structure.
2. Identify the structural and non-structural deterioration.

3. Interpret the causes, adopt the repair techniques and preventive measures for RCC, Steel and Masonry structures.
4. Adopt the suitable materials and techniques
5. Analyse and formulate suitable rehabilitation, retrofitting and demolition procedures
6. Recommend suitable solutions for existing structures

Module1: MAINTENANCE AND REPAIR STRATEGIES: Definitions: maintenance, repair and rehabilitation - facets of maintenance - importance of maintenance – quality assurance and quality control, structural appraisal : concrete , steel and masonry structures – inspection, strength evaluation of existing structures - assessment procedure for evaluating a damaged structure- planning, precautions, protective measures - nondestructive testing methods.

Module 2: DISTRESS AND ITS CAUSES: Distress monitoring - causes for deterioration: structural causes and non-structural causes - symptom, prevention and remedy - classification of cracks – visual examination of cracks – evaluation of cracks- distress in sub structure – distress in super structure.

Module 3: INFLUENCE ON SERVICEABILITY AND DURABILITY: Concrete structures: effect on strength, permeability, thermal properties - effects due to climate, temperature, chemicals and dampness - effects of cover thickness –error in design and construction-steel structures: erection and fabrication distress - defects in joints in steel structures – mechanism of corrosion – distress due to corrosion: prevention and remedial measures- masonry structures: defects in brick masonry and stone masonry – preventive and remedial measures.

Module 4: TECHNIQUES FOR REPAIR: Epoxy injection – stitching – routing and sealing – external stressing –blanketing – overlays – judicious neglect – autogeneous healing –jacketing – polymer coating for rebars - mortar and dry pack - gunite and shotcrete - shoring and underpinning – plating - cathodic protection - miscellaneous methods – special techniques for repairing, heritage structures

Module5: RETROFITTING AND STRENGTHENING MEASURES: Methods of retrofitting - global and local- techniques of retrofitting - strengthening measures – beam and column strengthening.

Module6: DEMOLITION OF STRUCTURES: Sequence of operations- demolition of structural elements- engineered demolition techniques for structures

Text Books:

1. Varghese P. C, “Maintenance, repair and rehabilitation and minor works of buildings”, PHI Learning Pvt. Ltd.. 2014
2. Modi, Poonam I, Patel, Chirag N., “Repair and rehabilitation of concrete structures”, PHI Learning Pvt. Ltd.. 2015

Reference Books:

1. Johnson, S.M., “Deterioration, Maintenance and Repair of Structures”, McGraw-Hill book company, New York, 1965.
2. Allen, R.T., and Edwards, S.C., “Repair of concrete structures”, Blake and Sons, UK, 1987.
3. Deofferey, P .Sims, “The Rehabilitation of Dams and Reservoirs”, Brown and Root Services, UK.
4. Shetty, M.S., “Concrete Technology- Theory and Practice”, S. Chand and Company, New Delhi, 1992.
5. IS 13935 - 1993: Indian Standard Guidelines for Repair and Seismic Strengthening of Buildings

18CE2045	MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To enable to identify, formulate, and solve engineering problems related to masonry structures.
2. To familiarize with the complete knowledge of a masonry structure.
3. To understand the behavior of earthquake resistant masonry structures, and be able to design for flexure, shear, axial forces, combined flexure and axial forces.

Course Outcomes:

Student will be able to

1. Understand the production of masonry and properties of constituents
2. Layout the structural analysis of loadbearing brick and block masonry
3. Design the flexural members considering the various failure patterns
4. Study various forces acting on the masonry structures and propose suitable cross sectional dimensions
5. Evaluate the behavior of earthquake resistant masonry
6. Select materials and execute for durable masonry structures

Module 1: MASONRY MATERIALS: History of masonry – characteristics: brick, stone, clay block, concrete block, stabilized mud block masonry units –strength, modulus of elasticity and water absorption - masonry materials – classification - properties of mortars - selection of mortars

Module 2: STRENGTH OF MASONRY IN COMPRESSION: Behaviour of masonry under compression - strength - elastic properties - influence of masonry unit and mortar characteristics - effect of masonry on compressive strength - influence of masonry bonding patterns on strength - prediction of strength of masonry in Indian context - failure theories of masonry under compression - effects of slenderness and eccentricity - effect of rate of absorption - effect of curing - effect of ageing - workmanship on compressive strength

Module 3:FLEXURAL STRENGTH AND SHEAR STRENGTH: Bond between masonry unit and mortar - tests for flexural and shear bond strengths - factors affecting bond strength - effect of bond strength on compressive strength - orthotropic strength properties of masonry in flexure - shear strength of masonry – evaluation procedures for flexural and shear strength - permissible tensile and shear stresses.

Module 4: LOAD BEARING MASONRY BUILDINGS: Permissible compressive stress - stress reduction and shape reduction factors - increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses - Effective height of walls and columns - effective length - effective thickness - slenderness ratio – eccentricity - load dispersion - arching action – lintels - Wall carrying axial load - eccentric load with different eccentricity ratios -opening in walls -free standing wall

Module 5: SEISMIC BEHAVIOR OF MASONRY BUILDINGS: Behaviour of masonry: earthquakes - concepts - design procedure for earthquake resistant masonry - components - classification of masonry arches - domes and vaults - historical buildings - construction procedure - BIS codal provision on masonry structures

Module 6: CASE STUDIES: Failure - design of load bearing masonry for buildings using BIS codal provisions - Mini project

Text Books:

1. Dayaratnam P, “Brick and Reinforced Brick Structures”, Oxford and IBH, 2018
2. Sinha B.P and Davis S.R., “Design of Masonry structures”, CRC Press, 2003

Reference Books:

1. Hendry A.W., “Structural masonry”, Macmillan Education Ltd., 2nd edition, 1990
2. Curtin, “Design of Reinforced and Prestressed Masonry”, Thomas Telford Sven, 2015
3. Richard E. Klingner, “Masonry Structural Design”, McGraw-Hill Education; 1 edition (February 8, 2010)
4. James Ambrose, “Simplified Design of Masonry Structures”, Wiley; Revised edition 1997
5. Narendra Taly, “Design of Reinforced Masonry Structures”, McGraw-Hill Education; 2 edition, 2010.

18C2046	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge about surface and ground water irrigation methods
2. To acquire ideas about different types of irrigation structures
3. To enable to understand the operation of irrigation water management structures

Course Outcomes:

Student will be able to

1. State the concepts of duty, crop and crop seasons
2. Classify the irrigation methods
3. Demonstrate the irrigation methods
4. Examine irrigation management techniques
5. Appraise and design impounding structures and cross drainage works
6. Understand the concepts of irrigation projects

Module 1: INTRODUCTION: Irrigation – types of irrigation – necessity of irrigation – merits and demerits of irrigation – crop and crop seasons – optimal use of water - consumptive use of water –factors affecting crop water requirements – irrigation water standards

Module 2: WATER APPLICATION: Wilting point – base period – delta - duty –determination of irrigation and water requirements – irrigation and water efficiencies - factors affecting duty – methods of improving duty.

Module 3: IRRIGATION METHODS: Canal irrigation – lift irrigation – tank irrigation – surface irrigation – merits and demerits –sprinkler irrigation – drip irrigation

Module 4 :DIVERSION AND IMPOUNDING STRUCTURES: Weirs – elementary profile of a weir – weirs on pervious foundations - types of impounding structures - percolation ponds – tanks and sluices – gravity dams – earth dams – arch dams – spillways – factors affecting location and type of dams – forces on a dam – hydraulic design of dams.

Module 5: CANAL AND CONTROL STRUCTURES: Alignment of canals – classification of canals – canal drops – hydraulic design of drops – cross drainage works – hydraulic design of cross drainage works – canal head works – canal regulators – aqueducts.

Module 6: IRRIGATION WATER MANAGEMENT: Need for optimization of water use – minimizing irrigation water losses – water pricing - on farm development works - participatory irrigation management – water users associations – changing paradigms in water management.

Text Books:

1. Punima B.C. and Pande B.B .Lal, “Irrigation and Water Power engineering”, Laxmi Publishing, New Delhi 2007
2. Santhosh Kumar Garg, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, 2016. Karunya University 2017 Civil Engineering

Reference Books:

1. Dilip Kumar Majumdar, “Irrigation Water Management (Principles and Practices)”, Prentice Hall of India (P), Ltd, 2000
2. Basak, N.N, “Irrigation Engineering”, Tata McGraw-Hill Publishing Co. New Delhi, 1999.
3. Asawa, G.L., “Irrigation Engineering”, New Age International Publishers, 2000
4. Dr. K.R.Arora, “Irrigation, Water Power and Water Resources Engineering”, Standard Publishers Distributors

18CE2047	OPEN CHANNEL FLOW	L	T	P	C
		3	0	0	3

Course Objectives:

1. To enable understanding of various types of flows under varying conditions
2. To inculcate the principles of fluid mechanics to the solution of problems encountered in both natural and constructed water systems.
3. To provide knowledge about model studies

Course Outcomes:

Student will be able to

1. Apply their knowledge about fluid mechanics in addressing problems in open channels.
2. Estimate sediment transport in channels and reservoirs
3. Develop skills to solve problems using HEC-RAS software.
4. Make flow measurements in fields.
5. Model channel flows
6. Design channels for various regimes

Module 1: BASIC PRINCIPLES: Basic concepts of uniform flow – computations - specific energy and specific force concepts – applications.

Module 2: STEADY VARIED FLOWS IN OPEN CHANNELS: Dynamic equation for spatially varied flows - flow profile computations - Introduction to Flow modeling softwares - spatially varied flows and rapidly varied flows – applications.

Module 3: UNSTEADY FLOWS IN OPEN CHANNELS: Equations of motion - uniformly progressive wave - Rapidly varied unsteady flow – positive and negative surges - dam break problem

Module 4: SEDIMENT TRANSPORT: Sediment properties – inception of sediment motion – bed forms - bed load suspended load – total sediment transport - design of stable channels and regime channels - Reservoir sedimentation and trap efficiency.

Module 5: FLOW MEASUREMENTS: Sharp-crested weirs, broad-crested weirs, critical depth flumes - Recent advancement in open channel flow measurements.

Module 6: HYDRAULIC MODELING: Physical modeling in hydraulics - dimensional analysis - Modeling closed flows and free surface flows - distorted models - design of physical models.

Test Books:

1. Subramanya K., “Flow in Open Channels, 2nd ed.”, Tata McGraw Hill, New Delhi 2003.
2. Chaudhry M. H., “Open Channel Flow”, Prentice Hall of India, Eastern Economic Edition, New Delhi. 2008.
3. Srivastava R. “Flow through Open Channels”, Oxford University Press New Delhi 2008.

Reference Books:

1. Sturm T.W., “Open Channel Hydraulics”, 2nd edition, Tata-McGraw Hill New Delhi 2011.
2. Wurbs R.A., and James W.P. “Water Resources Engineering”. Prentice Hall of India, Eastern Economic Edition, New Delhi, 2007.
3. French, R. H., “Open Channel Hydraulics”, McGraw Hill, New York NY 1985.
4. Hubert Chanson “Environmental Hydraulics of Open Channel Flows”, Elsevier Science and Technology, 2004
5. Streeter. V. L., “Fluid Mechanics”, Tata Mc Graw Hill, 2010

18CE2048	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To enable to understand the behavior of groundwater movement
2. To provide knowledge about estimation the groundwater modeling parameters
3. To equip with analytical techniques to solve groundwater problems

Course Outcomes:

Student will be able to

1. Understand the occurrence, distribution and movement of groundwater
2. Understand the ground water potential theory and movement of groundwater
3. Determine the aquifer parameters
4. Resolve groundwater related problems including response of aquifers to pumping wells
5. Develop a basic model for contaminant transport in subsurface media
6. Model and estimate groundwater recharge

Module 1: GEOHYDROLOGY: Introduction – water bearing formations – geological formation of water supply – subsurface distribution of water – sources of groundwater – types of aquifers – aquifer parameters – groundwater in different rocks.

Module 2: GROUNDWATER MOVEMENT: Groundwater flow – permeability – transmissibility – Darcy’s law – governing equations of ground water flow – steady state flow – Dupuit Forchheimer assumptions – unsteady flow – Theis method – Jacob’s method

Module 3: WELLS AND EXPLORATION: Types of wells – construction of open wells – construction and boring of tube wells – tube well types – well development – collector wells and infiltration wells – design of strainer tube well

Module 4: EVALUATION OF AQUIFER PARAMETERS: Introduction – pumping test analysis – recuperation test – well characteristics – well capacity – hydraulics of open wells – groundwater investigation – geological methods – geophysical methods – Remote sensing methods.

Module 5: ENVIRONMENTAL GROUNDWATER: Groundwater development – hydrological maps – groundwater quality – groundwater contamination – seawater intrusion – control measures.

Module 6: GROUNDWATER MANAGEMENT: Groundwater recharge – recharge methods – groundwater modeling – applications and case studies

Text Books:

1. Raghunath .H.M, “Ground Water Hydrology”, Wiley Eastern Ltd., Second reprint, 2008.
2. David Keith Todd, Larry W.Mays, “Groundwater Hydrology”, John Wiley and Sons, 2004.

Reference Books:

1. Murthy .V.V.N, “Land and Water Management Engineering”, Kalyani Publishers, New Delhi, 1994.
2. Fitts R Charles, “Groundwater Science”. Elsevier, Academic Press, 2002.
3. Ramakrishnan, S, “Ground Water”, K.J. Graph arts, Chennai, 1998.
4. Driscoll, F., “Groundwater and Wells”, St. Paul, Minnesota, II Ed., 1986.

18CE2049	SURFACE HYDROLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge about the processes involved in water flow above the surface
2. To enable to understand the various measurement techniques
3. To inculcate the concepts of statistical applications in hydrological problems.

Course Outcomes:

Student will be able to

1. Recall the system concepts, water budget equation and hydrologic cycle
2. Describe energy, momentum and continuity principles
3. Solve the problems related to atmospheric hydrology
4. Distinguish the modeling tools to optimize hydrographs
5. Appraise the application of statistical tools to manage hydrology related problems
6. Investigate channel flow and catchment storage problems

Module 1: INTRODUCTION: Hydrologic cycle - water budget equation - Global water budget - systems concept - transfer function operators - hydrologic model classification - Hydrologic processes: Reynold's Transport Theorem – continuity equation – momentum equation – energy equation – discrete time continuity.

Module 2: ATMOSPHERIC HYDROLOGY: Atmospheric circulation – water vapor – formation of rainfall – types and forms of precipitation – perceptible water – monsoon characteristics in India

Module 3: RAINFALL MEASUREMENT: Density and adequacy of rain gauges; Thunderstorm Cell model – IDF relationships – spatial averaging methods of rainfall – Factors affecting evaporation – estimation and measurement of evaporation – energy balance method, aerodynamic method – Priestly-Taylor method and pan evaporation.

Module 4: SURFACE WATER: Catchment storage concept - Hortonian and saturation overland flow – streamflow hydrographs – base-flow separation - ϕ -index – Direct Runoff hydrograph – algorithm for abstraction using Green-Ampt equation – SCS method – overland and channel flow modeling – time area concepts and stream networks.

Module 5: HYDROGRAPH: General hydrologic system model – response functions of a linear hydrologic systems and their inter-relationships – convolution equation; definition and limitations of a UH – UH derivation from single and complex storms – Synthetic unit hydrograph, S-Curve, IUH- Flood routing and canal routing.

Module 6: HYDROLOGIC STATISTICS: Probability concepts – random variables – laws of probability – PDFs and CDFs; Normal and Binomial distributions – Statistical parameters: expected value – variance, skewness, and peakedness– Frequency analysis: return period – probability plotting – Extreme value distributions – frequency factors – Log- Pearson distribution – confidence limits.

Text Books:

1. Ven T. Chow, David R. Maidment, and Larry W Mays, “Applied Hydrology”, McGraw Hill International Editions, 2013
2. K. Subramanya “Engineering Hydrology”, Tata McGraw Hill Publishing Company, New Delhi, 2013

Reference Books:

1. Larry W. Mays, “Ground and surface water hydrology”, John Wiley and Sons Inc, 2011
2. Garg SK, “Hydrology and Water Resources Engineering”, Khanna Publisher, New Delhi, 2005
3. Dingman S.L. “Physical Hydrology”, by, 2nd Edition, Waveland press, Illinois, 2010
4. Chow, V. T., Maidment, D. R., and Mays, L. W., “Applied Hydrology”, McGraw-Hill, GB 661.2 C43, 1988

Brutsaert, W., “Hydrology an Introduction”, Cambridge University Press, 2005

18CE2050	ENVIRONMENTAL LAWS AND POLICY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To analyze the legislative and judicial responses to environmental problems
2. To apply environment advocacy and approaches for using litigation in environment protection will receive special attention
3. To expose to the administrative system of environment related laws such as air, water, land, and hazardous substances etc.

Course Outcomes:

Student will be able to

1. Recall different policies and rules framed for the environmental protection
2. Recognize the formation of boards at different levels
3. Discuss the functions of central pollution board and the state pollution boards.
4. Know about different duties of pollution control boards
5. Assess about the actions taken by government for the violation of rules
6. Enumerate about the prevention of advanced pollution

Module 1: WATER ACT: Constitution, functions and powers of central and state boards - prevention and control of water pollution – penalties, prevention and control of pollution rules; Annual report.

Module 2: AIR ACT: Constitution, functions and powers of central and state boards - prevention and control of air pollution - penalties; prevention and control of pollution rules - annual report.

Module 3: ENVIRONMENTAL (PROTECTION) ACT: General powers of the Central Government - prevention, control and abatement of environmental pollution – rules - recipient system - standards for emission - prohibition and restriction on location of industries - furnishing information to authorities and agencies - prohibition and restriction on handling hazardous substances.

Module 4: HAZARDOUS WASTES (MANAGEMENT AND HANDLING) RULES; Transboundary movement - responsibility of the occupier - grant of authorization - power to respond or cancel - packaging, labeling, transport, disposal or import - accident reporting – appeal - rules for manufacture, storage - mitigation of the major accident, safety reports - preparation of on-site and off-site emergency plans

Module 5: INTERNATIONAL ENVIRONMENTAL LAW: Introduction to International law - International humanitarian law and environment - sources of international law - law of treaties - signature ratification - evolution of international environmental law - customary principles - common but differentiated responsibility - kyoto-protocol.

Module 6: OTHER RULES AND REGULATIONS: Bio-medical waste (Management and handling) rules - ozone depleting substances (Regulations and Control) rules - recycled plastics manufacture and usage rules - Noise pollution rules.

Text Books:

1. Kaushik C P, Anubha Kaushik , “Perspectives in Environmental Studies”, 4th edition, New Age International Publishers Ltd., New Delhi, 2006
2. Layzer, J. “The Environmental Case: Translating Values into Policy”, 3rd edition, CQ Press 2012.

Reference Books:

1. Vig, N. J. and Kraft, M. E. “Environmental Policy: New Directions for the Twenty First Century”, 8th edition, CQ Press 2013.
2. Divan S. and Rosencranz A, “Environmental Law and Policy in India”, 2nd edition, Oxford, New Delhi, 2005.
3. Leelakrishnan P, “Environmental Law in India”, 3rd edition, Lexis Nexis, India, 2008.
4. Elizabeth Fisher “Environmental Law: A Very Short Introduction” Oxford University Press; 1 edition 2018

- Angus Morrison-Saunders, “Advanced Introduction to Environmental Impact Assessment”, Edward Elgar Pub, April 27, 2018

18CE2051	BASICS OF REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the basic concepts and principles of various components of remote sensing.
- To provide understanding about the satellite image analysis and interpretation
- To provide an exposure to GIS and its practical applications in civil engineering.

Course Outcomes:

Student will be able to

- Recall the principles of remote sensing and GIS
- Describe the analysis methods RS and GIS data
- Interpret the data for modeling applications
- Distinguish sensors and satellites data for specific applications
- Appraise the usage of data models
- Formulate methods to solve issues related to environment using RS and GIS techniques

Module 1: EMR AND ITS INTERACTION WITH ATMOSPHERE and EARTH MATERIAL:

Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein’s displacement law – atmospheric scattering, absorption – atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

Module 2: PLATFORMS AND SENSORS PLATFORMS AND SENSORS: Types of platforms – orbit types, sun-synchronous and geosynchronous – passive and active sensors – resolution concept – payload description of important earth resources and meteorological satellites – airborne and space borne TIR and microwave sensors.

Module 3: IMAGE INTERPRETATION AND ANALYSIS : Types of data products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – digital image processing – preprocessing – image enhancement techniques – multispectral image classification – supervised and unsupervised.

Module 4: GEOGRAPHIC INFORMATION SYSTEM: Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS software – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS)

Module 5: DATA ENTRY, STORAGE AND ANALYSIS: Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

Module 6: APPLICATION OF GIS AND REMOTE SENSING IN CIVIL ENGINEERING: Application of GIS and RS in civil Engineering field; basic demo/hands on exposure to GIS software.

Text Books:

- Lillesand T.M., Kiefer, R.W. and J.W.Chipman. “Remote Sensing and Image Interpretation” 5th Edition, John Wiley and Sons Asia Pvt. Ltd., New Delhi, 2004.
- Anji Reddy, M. “Textbook of Remote Sensing and Geographical Information System” 2nd edition. BS Publications, Hyderabad, 2001.

Reference Books:

- Lo .C.P.and.Yeung A.K.W, “Concepts and Techniques of Geographic Information Systems”, Prentice Hall of India Pvt. Ltd., New Delhi, 2002

2. Peter A. Burrough, Rachael A. McDonnell, "Principles of GIS", Oxford University Press, 2000
3. Ian Heywood "An Introduction to GIS", Pearson Education Asia, 2011
4. Robert Shcwebgerdt, "Remote sensing models and methods for image processing", III edition, 2004.
5. .Rees W.G, "Physical Principles of Remote Sensing", Cambridge University Press, 2nd edition, 2001.

18CE2052	MUNICIPAL SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge and skills with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of solid waste.
2. To impart knowledge on various recycling options available for the solid waste.
3. To educate the engineering principles, design criteria, methods and equipments available to manage the solid waste

Course Outcomes:

Student will be able to

1. Analyze the nature and characteristics of municipal solid wastes
2. Sort out the functional elements for solid waste management
3. Apply the techniques and methods used in transformation, conservation and recovery of materials from solid waste
4. Identify and design waste containment systems
5. Gain knowledge in regulatory requirements regarding municipal solid waste management
6. Apply the basic scientific principles for solving practical waste management challenges

Module 1: SOURCES AND CLASSIFICATION: Types and sources of solid waste – classification of solid waste - need for solid waste management - salient features of Indian legislations on management and handling of municipal solid wastes

Module 2: WASTE CHARACTERIZATION AND SOURCE REDUCTION: Waste generation rates – factors affecting waste generation-composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan - source reduction of wastes –waste exchange - extended producer responsibility

Module 3: STORAGE, COLLECTION AND TRANSPORT OF WASTES: Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems - need for transfer and transport – transfer stations optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes

Module 4: WASTE PROCESSING TECHNOLOGIES: objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting - thermal conversion technologies and energy recovery – incineration - treatment of biomedical wastes

Module 5: WASTE DISPOSAL: Waste disposal options – disposal in landfills: landfill classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactor - leachate and landfill gas management

Module 6: ENERGY FROM SOLID WASTE: Composting – incineration - biogas generation - case study on best practices - Swachhbharat features

Text Books:

1. Bhide A.D. and Sundaresan, B.B, "Solid Waste Management Collection", Processing and Disposal, 2001
2. Paul T Willams, "Waste Treatment and Disposal", John Wiley and Sons, 2000

Reference Books:

1. Tchobanoglous, G. Theisen, H. M., and Eliassen, R. "Solid Wastes: Engineering Principles and Management Issues". New York: McGraw Hill, 1993.
2. Manual on "Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
3. Manser A.G.R. and Keeling A.A, "Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996
4. George Tchobanoglous and Frank Kreith, Handbook of "Solid waste Management", McGraw Hill, New York, 2002
5. Government of India, "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, New Delhi, 2000

18CE2053	AIR AND NOISE POLLUTION CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the causes and effects of air pollution.
2. To enable to evaluate the behavior of air pollutants.
3. To provide knowledge about appropriate control measures of air pollution

Course Outcomes:

Student will be able to

1. Understand causes of air pollution
2. Analyze different types of air pollutants
3. Impart knowledge on different atmospheric components
4. Evaluate air pollutant behavior in the atmosphere
5. Choose appropriate control technology for air pollution
6. Develop air pollution reduction techniques

Module 1: INTRODUCTION: Air pollutants – Sources of air pollution - fugitive emissions -secondary pollutants - Pollution transport and impact on receptor - Preparation of emission inventory.

Module 2: EFFECTS OF AIR POLLUTION: Effects of air pollution: regional and global scale - air pollution episodes - Smog and ozone layer - Greenhouse effect - Effects on Health, vegetation, materials and atmosphere.

Module 3: ATMOSPHERIC METEOROLOGY: Wind profile - Reactions of pollutants in the atmosphere - their effects - topographic effects - temperature profiles in atmosphere: stability, inversion and plume behavior.

Module 4: AIR QUALITY MONITORING: Objectives - Analysis and interpretation of air pollution data - Air pollution standards and indices - Stack monitoring - Dispersion of air pollutants and modeling - Gaussian dispersion model.

Module 5: AIR POLLUTION AND CONTROL MEASURES: Removal of gaseous pollutants: adsorption, absorption, reaction and other methods - Particulate emission control - settling chambers - cyclone separation - Wet collectors - fabric filters - electrostatic precipitators.

Module 6: NOISE POLLUTION AND CONTROL: Basics of acoustics - specifications of sound: sound power, sound intensity and sound pressure levels - plane, point and line sources - multiple sources - outdoor and indoor noise propagation - psychoacoustics and noise criteria - effects of noise on health, annoyance rating schemes - special noise environments - Infrasound, ultrasound, impulsive sound and sonic boom - noise standards and limit values - noise instrumentation and monitoring procedure - Noise indices - Noise control methods

Text Books:

1. Anjaneyulu D, "Air pollution and control technologies", Allied Publishers, Mumbai, 2002.
2. Khitoliya R K, "Environmental Pollution", 2/e, S. Chand Publishing, 2012

Reference Books:

1. Rao C.S, "Environmental pollution control engineering", Wiley Eastern Ltd., New Delhi, 1996.
2. Rao M.N, and Rao H.V.N, "Air Pollution Control" Tata-McGraw-Hill, New Delhi, 1996.
3. David H.F Liu, Bela G.Liptak, "Air Pollution", Lewis Publishers, 2000.
4. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis" IK International, 2010.
5. Air Pollution act, India, 1981

18CE2054	PAVEMENT MATERIALS AND DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge in the principles of pavement design
2. To understand the analyses and design as per IRC standards
3. To adopt suitable pavement design

Course Outcomes:

Student will be able to

1. Understand the principles of pavement design
2. Summarize the Traffic Considerations
3. Choose the appropriate pavement material
4. Analyze flexible and concrete pavements
5. Design flexible and concrete pavements
6. Interpret the Pavement Evaluation Techniques

Module 1: PAVEMENT MATERIAL CHARACTERIZATION: Material inputs required for analysis and design of pavements - appropriate conditions (temperature, moisture content, loading time, etc) for characterizing pavement materials - Brief description of the principles of different laboratory and field methods adopted for characterizing pavement materials – MORTH specifications

Module 2: TRAFFIC CONSIDERATIONS: Vehicle types - axle configurations - contact shapes and contact stress distributions - concept of standard axle load - vehicle damage factor - axle load surveys - lateral placement characteristics of wheels - estimation of design traffic.

Module 3: PRINCIPLES OF PAVEMENT DESIGN: Pavements types - concept of pavement performance - structural and functional failures of pavements - different types of pavement performance criteria- different pavement design approaches - general framework for pavement design

Module 4: FLEXIBLE PAVEMENTS: Appropriate theoretical models for analysis of flexible and concrete pavements. - analysis of layered flexible pavement systems using linear elastic layered theory - need for use of advanced analytical techniques for flexible pavements - different softwares available for analysis of flexible pavements - different methods of design of flexible pavements - Indian Roads Congress guidelines - IRC:37.

Module 5: RIGID PAVEMENTS: Different theoretical models for analysis of different types of concrete pavements- Analysis of wheel load stresses, curling/warping stresses due to temperature differential, critical stress combinations - need for use of advanced analytical techniques for concrete pavements - different methods of design of concrete pavements - Indian Roads Congress guidelines - IRC:58.

Module 6: PAVEMENT EVALUATION TECHNIQUES: Functional and structural evaluation of pavements - concept of roughness - International Roughness Index - Measurement of Roughness using different types of equipment - Structural evaluation of in-service pavements using Benkelman beam and Falling weight Deflectometer methods

Text Books:

1. Yang H Huang “Pavement Analysis and Design”, Prentice Hall, 1993
2. EJ Yoder and MW Witczak, “Principles of Pavement Design”, John Wiley and Sons. 1991

Reference Books:

1. Papagiannakis AP and Masad EA, “Pavement Design and Materials”, John Wiley and Sons, 2017
2. “AASHTO Guide for Design of Pavement Structures”, American Association of State Highway and Transport Officials.
3. IRC:58-2015, Guidelines for the “Design of Plain Jointed Rigid Pavements for Highways”, 4th Revision, Indian Roads Congress, New Delhi.
4. IRC:37-2012 - Tentative Guidelines for the “Design of Flexible Pavements” Indian Roads Congress, New Delhi.
5. Standards for “Road and Bridge Works”, Ministry of Road Transport and Highway (MORTH), 5th Edition, April 2013.
6. IRC:81-1997, “Guidelines for Strengthening of Flexible Road Pavements using Benkelman beam deflection techniques”, Indian Roads Congress, New Delhi.

18CE2055	AIRPORT PLANNING AND DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge about the basic components of airports.
2. To describe the process and methods of operating and utilization of airport capacity and able to formulate the problem around airports review by obstacle limitation.
3. To impart basic understanding of the infrastructure of airports and airport connections to other modes of transport.

Course Outcomes:

Student will be able to

1. Understand and apply basic concepts of aviation regulations, and financing structure for airports
2. Design the airfield geometric elements and runway
3. Understand and apply basic concepts of capacity analysis for airside and landside planning
4. Evaluate airport capacity, safety and security
5. Demonstrate basic principles of pavement design
6. Demonstrate basic concepts of airside and landside aviation infrastructure management

Module 1: AIR TRANSPORT CHARACTERISTICS: Airport classification-airport planning: objectives, components, layout characteristics, socio-economic characteristics of the catchment area - typical airport layouts - case studies

Module 2: RUNWAY DESIGN: Airport Site selection and ICAO stipulations - geometric design of the airfield: runway design- orientation, wind rose diagram – runway length – problems on basic and actual length

Module 3: CAPACITY DETERMINATION: Determination of runway capacity and delay - taxiway and gate capacity - holding aprons - terminal aprons - airport drainage

Module 4: AIRPORT TERMINAL DESIGN: Function of airport passenger and cargo terminal - design of air freight terminals - airport access - airport landside planning - capacity; parking and circulation area.

Module 5: AIRFIELD PAVEMENT DESIGN and PASSENGER FACILITIES: Configuration and pavement design principles – elements of taxiway design – airport zones – passenger facilities and services

Module 6: AIR TRAFFIC MANAGEMENT: Navigational aids: lighting, sign, markings - ground based systems - satellite based systems – air traffic control - surveillance facilities – airfield lighting - air traffic management

Text Books:

1. Khanna S K, Arora M G and Jain S S, “Airport Planning and Design”, Nemchand and Brothers, Roorkee, 2012.
2. Subhash C. Saxena, “Airport Engineering: Planning and Design”, CBS Publisher, 2012

References:

1. Rangwala, “Airport Engineering”, Charotar Publishing House, 2013.
2. Asheesh Kumar, “Planning and Design of Airport”, Vayu Education of India, 2015
3. Norman J. Ashford , Saleh A. Mumayiz, Paul H. Wright, “Airport Engineering: Planning, Design and Development of 21st-Century Airports” , John Wiley and Sons – 5 Sep 2012
4. Robert Horonjeff, Francis X. McKelvey, William J. Sproule, Seth B. Young “Planning and Design of Airports” 5th Edition
5. Planning and design guidelines for Airport terminal facilities, Advisory circular, department of transportation, Federal Aviation Administration 1988

18CE2056	TOWN PLANNING AND ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on Architectural design concepts, principles of planning and composition are imparted.
2. To enable the student to understand town planning from ancient times to modern times.
3. To impart the concepts of town planning standards, landscaping and expansion of towns.

Course Outcomes:

Student will be able to

1. Compile the Historical Back Ground of Town Planning and architecture
2. Compose spaces of buildings using design concepts, planning principles.
3. Understand the town planning standards, landscaping features and regulations controlling expansion of the towns and the cities.
4. Distinguish architectural styles of eastern and western world.
5. Understand the importance of architecture design
6. .Analyze the importance of modern architecture methods

Module 1: BACK GROUND OF TOWN PLANNING: Town planning in India – Town plans of mythological Manasa -Town plans of Ancient towns: Harappa, Mohenjodaro, Pataliputra, Delhi, Acropolis (Greece), Jerusalem, Mecca, Rome, London.

Module 2: TOWN PLANNING THEORY: Evolution of towns: problems of urban growth – beginning of planning acts – ideal town – concept of new towns and conservative theory – comprehensive planning of towns- Survey and analysis of town: fare maps – land use classification – transportation network – intelligent transportation system –solid waste and sewage – economic studies – environmental aspects. Town planning standards

Module 3: LANDSCAPING AND EXPANSION OF TOWNS: Landscaping for the towns, Town scape - horizontal and vertical expansion of towns: garden cities, satellite towns, floating towns, sky scrapers, pyramidal cities – smart cities

Module 4: WESTERN ARCHITECTURE: Indo-Aryan, Dravidian and Mughal periods – European, Egyptian, Greek, Roman, medieval and renaissance periods- construction and architectural styles; vernacular and traditional architecture - Post-classic Architecture

Module 5: PRINCIPLES OF ARCHITECTURAL DESIGN: Definition of architecture: factors influencing architectural development- characteristic features of a style - Creative principles: function/strength, aesthetics – deciding the space and form – activity space, circulation space and tolerance space - form expressive of function-form related with material and Structural system.

Module 6: DEVELOPMENT OF CONTEMPORARY ARCHITECTURE: Architectural developments and impacts on society since industrial revolution - influence of modern art on architecture - works of national and international architects - art Novuea, Eclecticism, international styles, post modernism - deconstruction in architecture

Text Books:

1. Joy Sen, "Sustainable Urban Planning", The Energy and Resources Institute (TERI), 2013
2. Gallion A B., Eisner S., "The Urban Pattern" Van Nostrandreinhold, New York, 1993.

Reference Books:

1. Dutt, B. B, "Town Planning in Ancient India", Delhi, Isha Books, 2009.
2. Prammar, V. S. "A social history of Indian architecture", Oxford University Press India New Delhi, 2005.
3. Roth, M. L. "Understanding Architecture: Its Elements, History, and Meaning. Columbia", West-view Press, 2006
4. Jon Lang, "A concise history of Modern Architecture in India", Permanent Black Publishers, New York, 1998.
5. Taurus Parke, "A City with view Florence", I.B. Taurus Publishers, New York, 1994.

18CE2057	STRUCTURAL DESIGN OF FOUNDATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart a basic knowledge of the typical special foundations used in various situations
2. To familiarize with the soil design
3. To enlighten with structural design of foundations and retaining walls and special foundations

Course Outcomes:

Student will be able to

1. Recall the design philosophies.
2. Identify the various types of soil design
3. Determine the loads and moments acting on the structure.
4. Estimate the quantity of reinforcement.
5. Design the structure as per Indian standards.
6. Construct the appropriate structural drawing.

Module 1: LIMIT STATE DESIGN OF REINFORCED CONCRETE FOUNDATIONS: Introduction to limit state design of concrete foundations - Soil pressures for structural design - Depth of footings - Bearing capacity - settlement of shallow foundations

Module 2: STRUCTURAL DESIGN OF SPREAD FOOTINGS: Combined footings- rectangular, trapezoidal and strap footings

Module 3: MAT FOUNDATIONS: Structural design of mat foundations - beam and slab raft foundations - combined pile raft foundations

Module 4: PILE FOUNDATIONS: Design of different types of pile foundations - structural design of pile

Module 5: RETAINING WALLS: Stability analysis of retaining walls - structural design of retaining walls- cantilever and counter fort retaining walls

Module 6: SPECIAL FOUNDATIONS: Foundations for special structures like water tanks and ground storage tanks, transmission towers, silos and chimneys - coastal and offshore structures.

Text Books:

1. Ashok K Jain, "Reinforced Concrete Limit State Design", Nem Chand and Bros., Roorkee, 2007

- Swami Saran, “Analysis and Design of Substructures”, IBH Publishing Co Pvt. Ltd, New Delhi, 2006.

Reference Books:

- Bowles J.E., “Foundation Analysis and Design”, Mc. Graw Hill International Edition, New Delhi, 1997
- P.C. Varghese, “Design of Reinforced Concrete Foundations”, PHI-Ltd- New Delhi, 2009.
- Tomlinson M.J, “Foundation design and Construction” , John Wiley Interscience, New York, 2001
- Das, B. M. “Advanced Soil Mechanics”, CRC Press, 2013
- Selvadurai, A.P.S. “Elastic Analysis of Soil Foundation Interaction.”, Elsevier Scientific Publishing Company, New York, 1979

18CE2058	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the fundamentals of traffic engineering
- To enable to identify the different theories of traffic flow
- To impart the importance of traffic safety and management

Course Outcomes:

Student will be able to

- Understand the fundamentals of traffic engineering
- Carry out different traffic studies
- Design channels, intersections, signals, roundabouts and parking arrangements
- Express the application of traffic flow theory
- Enhance safety and environment in all design aspects
- Develop Traffic management Systems

Module 1: INTRODUCTION: Scope of Traffic Engineering - Elements of Traffic Engineering - road user, vehicle and road way. Road Characteristics – Road user characteristics – PIEV theory – Vehicle characteristics - IRC standards - Design speed, volume – Performance characteristics – Fundamentals of Traffic flow – Urban Traffic problems in India

Module 2: TRAFFIC SURVEY: Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting

Module 3: LEVEL OF SERVICE AND CAPACITY: Concept, applications and significance - Highway capacity - Capacity of urban and rural roads - PCU concept and its limitations – Road user facilities - Parking facilities - Cycle tracks and cycle ways - Pedestrian facilities – Traffic flow theory

Module 4: INTERSECTION DESIGN: Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated - Design of signal setting - phase diagrams - timing diagram – Signal co-ordination – Roundabouts - Grade separated intersections - Geometric elements for divided and access controlled highways and expressways

Module 5: ROAD SAFETY: Street lighting -Traffic signs including Variable Message sign and road markings – Significant roles of traffic control personnel – Networking pedestrian facilities and cycle tracks - Traffic regulation and control Traffic safety – Principles and practices – Road safety Audit – Traffic and environment hazards – Air and Noise Pollution – causes - abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport

Module 6: TRAFFIC MANAGEMENT SYSTEM: Area Traffic Management System – Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods-

Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education – Car pooling

Text Books:

1. Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 2013
2. Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan Press Ltd.1996

Reference Books:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, “Principles of Traffic and Highway Engineering”, CENGAGE Learning, New Delhi, 2010
3. John E Tyworth, “Traffic Management Planning, Operations and control”, Addison Wesley Publishing Company, 1996
4. Hobbs.F.D., “Traffic Planning and Engineering”, University of Brimingham, Peragamon Press Ltd, 2005
5. SP:43-1994, Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.

18CE2059	GREEN BUILDINGS	L	T	P	C
		3	0	0	3

Course Objectives

1. To familiarize the concepts of green building
2. To introduce holistic approach buildings
3. To provide exposure to various national and international rating systems

Course Outcomes:

Student will be able to

1. Understand the concept of holistic design
2. Implement green building concept
3. Reduce the foot print of construction operation
4. Design the green building systems
5. Evaluate the performance of green buildings
6. Asses and rate the green building

Module 1: INTRODUCTION: Definition - Green Building - environmental challenges - Green building goals - approaches to green building - Holistic design - Integrated design - codes and guidelines

Module 2: GREEN BUILDING SYSTEMS: Site design- selection of green materials - products and practices - passive design strategy - resource efficiency- internal load reduction - indoor environment quality – building water and waste management

Module 3: GREEN BUILDING IMPLEMENTATION: Site protection planning-health and safety planning- health and safety planning - construction and demolition waste-reducing the foot print of construction operation

Module 4: BUILDING COMMISSIONING: Essentials of commissioning - HVAC commissioning-commissioning of non-mechanical - cost and benefit of building commissioning

Module 5: GREEN BUILDING ASSESSMENT: Green Building Assessment USGBC LEED building assessment standard - LEED certification process – green globes building assessment protocol-international building assessment systems

Module 6: CASE STUDIES: Platinum / gold / silver building– trends in building rating systems – IGBC standards.

Text Book:

1. Charles J. Kibert, “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, Wiley, New Jersey, 2007.
2. Kibert, C. “Sustainable Construction: Green Building Design and Delivery”, John Wiley and Sons, 2005

Reference Books:

1. Jerry Yudelson, “Green building A to Z, Understanding the Language of Green Building”, New Society Publishers, Canada, 2007.
2. Green building guidelines: Meeting the demand for low-energy, resource-efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.
3. Jerry Yudelson, “Green Building through Integrated Design”, McGraw Hill, USA, 2009
4. Means, R.S., “Green building: Project Planning and Cost Estimating”, Wiley, Kingston, New Jersey, 2007.
5. Colin Porteous, “The New Eco-Architecture”, Spon Press, 2002.

18CE2060	GLOBAL CLIMATE CHANGE AND ITS IMPACT	L	T	P	C
		3	0	0	3

Course Objective:

1. To enable to understand the global climate change scenario, causes and consequences
2. To introduce the concepts about climate change modelling
3. To familiarize about the global climate and its impacts across the world

Course Outcome:

Student will be able to

1. Understand the climate and its change
2. List the factors affecting global climate change
3. Analyze the impacts of global climate change
4. Explain the importance of climate change in various fields
5. Develop Climate Change Models
6. Study the impacts of climate change across the Globe

Module 1: INTRODUCTION: Climate - the atmosphere - circulation - stability, chemistry of atmosphere - atmospheric and ocean circulation - concept of energy balance - monsoon rain – clouds – storms - climate - cloud formation and climate - global wind systems - storm - hurricanes

Module 2: CLIMATE CHANGE: Causes - internal forcing mechanism- external forcing mechanism – physical evidences – tropical – desert – polar - mid-latitude climates and their role in global climate change.

Module 3: GREEN HOUSE GASES: Green house gases - its impact – acid rains – causes – effects- solution- prevention – ozone layer – ozone depletion – ozone hole and global warming - CO₂ Emissions.

Module 4: IMPACT ON AGRICULTURE: Food security - land use – forestry - human health – water supply – sanitation - infrastructure and economy.

Module 5: IMPACT ON WATER: Importance of water – water resources- oceans- global ocean circulation - water-related adaptation to climate change in the fields of ecosystems and biodiversity- variations in past climates in ocean and lake sediment cores, ice cores, corals, tree rings - influences and feedbacks of hydrological changes on climate – climate modelling

Module 6: ROLE OF ORGANIZATION: Mission of the inter-Governmental panel on climate change - International agreements and protocols - future use of energy and fossil fuels - role of Governments, industries and individuals - case studies: Antarctica – Greenland – North Pole – India.

Text Book:

1. Singh, K. P., “Geomorphology and global climate change”, 2011.

2. Thomas R Karl , Jerry Melillo., “ Global Climate Change Impacts in the United States”, U S Global Change Research. 2009

Reference Books:

1. Syed M. H., “Climate Change”, Daya Publishing House, 2009
2. Syed M.H, Encyclopedia of SAARC Nations, Gyan Publishing House, 2003
3. Alper Baba, Gökmen Tayfur, “Climate Change and Its Effects on Water Resources” Springer Publishers, 2010
4. George Luber, Jay Lemery, “Global Climate Change and Human Health: From Science to Practice”, ISBN: 978-1-118-50557-1 November 2015,
5. Edmond Mathez “Climate Change: The Science of Global Warming and Our Energy Future”, Columbia University Press (1st edition, 2009)

18CE2061	SMART BUILDINGS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge in the concepts of intelligent buildings
2. To provide the working principles of building automation systems, office automation systems and communication systems
3. To get an exposure to air conditioning and fire safety arrangement in Intelligent buildings

Course Outcomes:

Student will be able to

1. Identify impacts and benefits of intelligent buildings
2. Understand the principles of automated buildings
3. Illustrate philosophy of building automation systems
4. Analyze the intelligent building design concepts
5. Design fire safety and security systems for intelligent buildings
6. Integrate the building management systems and adopt them in intelligent buildings

Module 1: INTRODUCTION: Introduction to intelligent buildings - basic concepts - building automation system - cost analysis of intelligent buildings – smart materials - intelligent building management system.

Module 2: HEATING VENTILATION AND AIR CONDITIONING: Introduction - Human comfort - comfort air-conditioning – classification - air conditioning systems - electrical installations and illumination - introduction, terminologies in electrical power engineering - electrical power transmission to buildings - electrical power quality in buildings - lighting systems in buildings – correlating the systems

Module 3: FIRE PROTECTION SYSTEMS: Introduction - fire service installations type - automatic fire alarm detection – sprinklers - hose reels hydrants - foam systems -microprocessor based alarm.

Module 4: SECURITY AND SAFETY SYSTEMS: Introduction - designing a security system - intrusion sensors and space sensors – access control and intrusion detection systems- closed circuit television system –selection of camera- central alarm systems – health monitoring systems.

Module 5: BUILDING ELECTRONICS: Introduction - microprocessor based control - programmable logic controller – communication principles - telephone systems - communal aerial broadcasting – satellite communication - fiber optic backbone

Module 6: CASE STUDIES: Intelligent building practice - tall building - energy saving intelligent building management

Text Books

1. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.
2. Derek Clements and Croome, “Intelligent Buildings: An Introduction”, Routledge, 2013

Reference Books

1. Derek Clements Croome, "Intelligent Building Design, Management and Operations", Thomas Telford Publishing, London, 2004.
2. Albert Ting – pat Sowai Lok Chan, "Intelligent Building Systems", Kluwer Academic Publisher, U.S.A, 1999.
3. Ehrlich, C., "Intelligent Building Dictionary: Terminology for Smart, Integrated, Green Building Design, Construction, and Management" San Francisco, Calif: Hands-on-Guide, 2007.
4. Michael Wigginton, Jude Harris, "Intelligent Skins", Routledge, 2013
5. Manolescue P., "Integrating Security into Intelligent Buildings", Cheltenham, 2003

18CE2062	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		2	0	0	2

Course Objectives:

1. To introduce the concepts and benefits of energy efficiency in buildings.
2. To enable to identify the different opportunities and measures for reducing energy use in buildings
3. To familiarize the different mechanisms for financing energy efficiency measures in buildings

Course outcomes:

Student will be able to

1. Appreciate the significance and benefits of energy efficiency in buildings.
2. Identify the methodology for the energy efficiency of buildings.
3. Determine the energy efficiency of buildings
4. Improve the energy efficiency of buildings and the potential savings.
5. Implement different mechanisms for financing energy efficiency measures.
6. Interpret policies to facilitate energy efficiency

Module 1: SUSTAINABLE DEVELOPMENT PRINCIPLES IN BUILDING DESIGN- Introduction -construction building material- Environmental impact assessment (EIA) - environmental impact analysis- energy flow in buildings - internal heat gain – delivered energy and system loss - energy performance of buildings - certifying energy efficiency

Module 2: ENERGY EFFICIENCY MEASURES IN BUILDINGS: Reducing heating demand - limiting the exposed surface area of the building - improving air tightness - improving the insulation of the building's fabric- identifying a suitable heating system - reducing cooling demand - avoiding excessive glazing - reducing the energy requirements for ventilation - energy star energy efficiency equipment and appliance labelling

Module 3 :ENERGY EFFICIENCY SIMULATION: Assessment - analysis and implementation of lighting systems - compressed air systems - heating systems, geometry of buildings - openings and shades - thermal control - lightings and cooling controls - simulation parameters - natural ventilation - zero energy home

Module 4: FINANCING AND IMPLEMENTING POLICY ON ENERGY EFFICIENCY: Internal funds- debt financing - lease or lease-purchase agreements- energy performance contracts - utility incentives- design assistance - low-interest loans - local authority and national assistance - energy efficiency policy- agency - regulator - adjudicating body

Module 5: POLICY TOOLS TO PROMOTE BUILDING EFFICIENCY: Building energy code compliances - codes and standards - residential and non-residential buildings - new constructions- refurbishing and renovations - certification and labelling

Module 6: CASE STUDIES: Sustainable energy - improving energy efficiency - efficient lighting - passive design

Text Books:

1. Mili Majumdar, “Energy-efficient Buildings in India”, The Energy and Resources Institute (TERI), 2001
2. Lal Jayamaha, “Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance”, McGraw Hill Professional, 2006

Reference Books:

1. Paul Tymkow, Savvas Tassou, Maria Kolokotroni, Hussam Jouhara, “Building Services Design for Energy Efficient Buildings”, Routledge, 2013
2. Umberto Desideri, Francesco Asdrubali, “Handbook of Energy Efficiency in Buildings: A Life Cycle Approach”, Butterworth-Heinemann Publisher, 2018
3. Matthew R Hall, “Materials for Energy Efficiency and Thermal Comfort in Buildings”, Elsevier, 2010
4. Satyajit Ghosh, Abhinav Dhaka, “Green Structures: Energy Efficient Buildings”, Ane Books, 2015
5. Bruce Harley, “Insulate and Weatherize”, The Taunton Press, 2002.

18CE3011	ADVANCED SOLID MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the concept of three dimensional stress and strain analysis.
2. To suggest solutions for selected problems in rectangular and polar coordinates as well as torsion of prismatic bars, thin walled open sections and closed tubes
3. To facilitate understanding of the plastic stress-strain relations, criteria of yielding and elasto-plastic problems

Course outcomes:

Student will be able to

1. State the basic equations of elasticity and plasticity and recognize the methods of solution of elastic, elastic-plastic and plastic problems of solid mechanics.
2. Explain the concept of stress at a point, strain at a point, stress or strain transformation, principal plane and principal stress, strain- displacement relations, yield criteria, yield surface, plastic stress-strain relation.
3. Calculate the principal stress/strain at a point in a stressed body and their associated directions.
4. Carry out rigorous analysis of a stressed body and examine its stress distribution
5. Justify the importance of rigorous analysis of solid mechanics problems by theory of elasticity and theory of plasticity for weight- sensitive applications.
6. Develop equations governing the behaviour of physical problem consistent with the Kinematic constraints.

Module 1: ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONAL CARTESIAN COORDINATES: Stress at a point – hydrostatic and deviatoric components - differential equations of equilibrium- stress transformation laws – principal stresses – displacement field – strain at a point - strain displacement relations – St.Venant compatibility conditions - strain transformations - principal strain - principle of superposition - stress-strain relations - Hooke's law - St.Venant's principle.

Module 2: TWO DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES: Two dimensional problems in cartesian coordinates: Plane stress and plane strain problems – Airy's stress function - polynomials -application to bending of a beam: simply supported beam with UDL- cantilever beam with a tip load- pure bending of a cantilever beam

Module 3: TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES: Two dimensional problems in polar coordinates: Plane stress and plane strain problems – Airy's stress function - application to simple problems -symmetrical stress distribution in thick cylinder - rotating disc -pure bending of curved bars - bending of a curved bar by force at the end- effect of circular hole on stress distribution- concentrated

force at a point of a straight boundary - forces on wedges - circular disc with diametric loading

Module 4: TORSION OF NON-CIRCULAR SECTIONS: St. Venant's warping function and Prandtl's stress function approaches - membrane analogy - torsion of thin walled open sections - torsion of hollow thin walled single and multi-celled tubs.

Module 5: BEAMS ON ELASTIC FOUNDATION: Idealization of soil medium – Winkler model – analysis of infinite beams – semi-infinite and finite beams – point load and uniformly distributed load – various boundary conditions.

Module 6: INTRODUCTION TO PLASTICITY: Strain Hardening - idealized stress-strain curve -yield criteria -Von Mises yield criterion - Tresca yield criterion -stress-space representation - Elasto-plastic problems - Beams in bending - torsion of bar of circular cross section - Nadai's sand heap analogy -plastic stress-strain relations -plastic potential.

References:

1. Chakrabarthy, T., "Theory of Plasticity", Elsevier, New Delhi, 2014.
2. Chandramouli, P.N., "Theory of Elasticity", Yes Dee Publishing Private Ltd., Chennai, 2017
3. Chow, P.C and Pagano, N.J., "Elasticity, Tensor, Dyadic and Engineering approaches", Dover Publications Inc, New York, 1992.
4. Mendelson, A., "Plasticity - Theory and Applications", MacMillan Co., NewYork, 1968
5. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi, 1995
6. Timoshenko, S. and Goodier, J.N., "Theory of Elasticity", McGraw-Hill Book Co., New Delhi, 2010

18CE3012	STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the basic principles of free and forced vibration (both un-damped and damped) of single degree of freedom system
2. To become proficient in the modal analysis of multiple degree of freedom systems as well as distributed parameter systems
3. To get exposed to the solution techniques for free and forced vibration analysis of building frames subjected to dynamic loads

Course Outcomes:

Student will be able to

1. Identify the elements of vibratory system and to choose the relevant mathematical tools for dynamic analysis of structure
2. Explain the causes and effects of structural vibration
3. Determine the fundamental frequency and mode of vibration of structural elements
4. Determine the response of the components of structural system
5. Compare the response of vibrating structural elements obtained by rigorous mathematical approach and functional approximation methods
6. Explore the applications of dynamics to various field problems.

Module 1: INTRODUCTION TO PRINCIPLES OF DYNAMICS: Principles of vibration analysis: Elements of vibratory system and simple harmonic motion - D'Alembert's principle - Hamilton's principle – principle of virtual work -idealization of a structure as SDOF system - Equation of motion - damped and undamped free vibrations - critical damping - logarithmic decrement - un-damped forced vibration.

Module 2: FORCED RESPONSE OF SDOF SYSTEM: Response to support motion - response to harmonic excitation, damped or un-damped – response to support motion - response to arbitrary periodic loading- Duhamel's integral

Module 3: FREE VIBRATION OF MDOF SYSTEM: MDOF system (Lumped mass): Mathematical model of MDOF system - free vibration of undamped MDOF systems - natural frequencies and mode shapes – orthogonality conditions - analysis for natural frequencies and mode shapes - solution of the Eigen value problems - Stodola Power method - Jacobi method - Holzer method - Transfer matrix methods - Dunkerlay's equation – Rayleigh and Rayleigh-Ritz methods

Module 4: DISTRIBUTED PARAMETER SYSTEM: MDOF (Continuous system): Mathematical model for continuous system- free and forced vibration of bars - analysis for un-damped free and forced vibration of simply supported and cantilever beams - Effect of axial loads - Rayleigh Ritz method.

Module 5: FORCED VIBRATION OF MDOF SYSTEM: Idealizations of multi-storeyed building frames for dynamic analysis - Shear buildings – stiffness, flexibility and mass matrices - Free and forced vibration with and without damping – solution by step by step direct integration - central difference method - Houbolt method - Wilson- θ -method - Newmark method.

Module 6: APPLICATION OF STRUCTURAL DYNAMICS: Vibration isolation - Tuned mass damper - vibration absorber – vibration due to: wind - earthquake, blast, impact, machine foundations.

References:

1. Anil K Chopra, “Dynamics of structures” Prentice-hall, 2015
2. Clough, R. W., and Penzien, “Dynamics of Structures”, McGraw Hill Book Co Ltd, 1986.
3. Leonard Meirovitch, “Elements of Vibration Analysis”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007
4. Paz Mario, “Structural Dynamics - Theory and Computation”, CBS Publishers and Distributors Pvt. Ltd., 2012
5. James C. Anderson, Farzad Naeim, “Basic Structural Dynamics”, John Wiley and Sons, 2012

18CE3013	FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the basic concept of finite element and the finite element procedure
2. To train in the development of shape functions, strain displacement relations, stiffness matrix and load vector for one, two and three dimensional finite elements
3. To give exposure to mesh generation techniques and commercial softwares

Course Outcomes:

Student will be able to

1. Define conservation of energy principle, variational principle and methods of weighted residual for developing finite element model
2. Explain the finite element procedure by taking a simple 2D truss problem.
3. Develop the shape function, strain displacement-relation, stiffness matrix and consistent load vector for structural members.
4. Analyze scalar and vector variable problems
5. Justify the approximate solution by finite element method by comparing with closed form solution of bench mark problem.
6. Develop the finite element model for any given problem using appropriate finite element

Module 1: INTRODUCTION: Concept of Finite element: Element types – strong and weak formulations - Variational principles - Principle of virtual work - Rayleigh-Ritz method - Galerkin's method of weighted residual - Energy Principles - Displacement, stress and hybrid models

Module 2: ANALYSIS OF ONE DIMENSIONAL PROBLEM: One dimensional problems: scalar and vector variable problems - concept of shape functions – convergence and compatibility requirements; Bar, beam and truss elements– global, local and natural coordinate systems – generation of stiffness matrix and consistent load vector– finite element procedure

Module 3: ANALYSIS OF TWO DIMENSIONAL PROBLEMS: Two Dimensional Problems: Plane stress and plane strain problems - Triangular elements - Rectangular elements – static condensation technique - Sub-Iso-super parametric elements - shape function - mapping - linear iso-parametric quadrilateral

Module 4: ANALYSIS OF THREE DIMENSIONAL PROBLEMS: Three dimensional elements: Tetrahedron element family - Hexahedron Element family - ZIB 8 and ZIB 20 elements - Numerical Integration using Gaussian Quadrature -Axisymmetric stress analysis

Module 5: ANALYSIS OF PLATES AND SHELLS: Analysis of plates: Triangular and rectangular plate bending elements - analysis of shells - faceted element for shells - degenerated shell elements – 4 noded bilinear shell element- degenerated axi-symmetric shell elements – introduction to finite strip method

Module 6: COMPUTER IMPLEMENTATION: Auto and adaptive mesh generation techniques – mesh refinement technique – h, p r methods of mesh refinement – requirement for selection of commercial software for structural analysis- principles of modeling and analysis using commercial FEA software.

References:

1. Bathe, K.J., “Finite Element Procedure”, Prentice Hall of India, New Delhi, 2014
2. Cook R.D., ‘Concepts and Applications of Finite Element Method”, Wiley John and Sons, 2014
3. Hutton David, “Fundamentals of Finite Element Analysis”, Mc-Graw Hill, 2004
4. Rajasekaran, S., “Finite Element Methods in Engineering Design”, S.Chand and Co Ltd., New Delhi, 2015
5. Reddy, J.N., “An Introduction to Finite Element Method”, McGraw-Hill International edition, 2008
6. Tirupathi, R.Chandrupatla and Ashok, D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India Private Limited., New Delhi, 2004.
7. Zienkiewicz, O.C., “The Finite Element Method Vol. 1 and 2”, Mc Graw Hill Book Company, New York, 1999.

18CE3014	SEISMIC ANALYSIS AND DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the principles of plate tectonics and seismology
2. To enrich with expertise to analyze the forces in the members as per IS 1893 and ductile detailing as per IS 13920
3. To enlighten with the principle of vibration control methods and retrofitting techniques

Course Outcomes:

Student will be able to

1. Sequence the basic principles of engineering seismology
2. Estimate the forces on the structures
3. Assess the methods for seismic resistant design
4. Illustrate the codal provisions for seismic resistant design
5. Recommend suitable alternate techniques
6. Formulate repair and rehabilitation methods for damaged structures

Module 1: EARTHQUAKES AND GROUND MOTION: Engineering seismology -seismotectonics - earthquake monitoring - seismic instrumentation (Indian scenario) - estimation of earthquake parameters - seismic zoning of India- microzonation- peak horizontal acceleration (PHA).

Module 2: ANALYSIS OF STRUCTURES FOR SEISMIC FORCES: Dynamics of structures (SDOFS/ MDOFS) - response spectra - evaluation of earthquake forces as per codal provisions – static and dynamic methods- lessons learnt from past earthquakes

Module 3: EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES: Structural systems - building types - causes of damage - planning considerations - philosophy and principle of

earthquake resistant design - guidelines for earthquake resistant design - earthquake resistant masonry buildings - design consideration

Module 4: EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES: Earthquake resistant design of R.C.C. Buildings – ductile detailing of structures – rigid frames – shear walls.

Module 5: VIBRATION CONTROL TECHNIQUES: Vibration control - principles and application- Case studies -important structures- methods of retrofitting.

Module 6: CASE STUDIES: Learning from failures - repairs and rehabilitations

References:

1. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2004.
2. Brebbia C.A. “Earthquake Resistant Engineering Structures VIII”, WIT Press, 2011
3. Duggal, S.K. “Earthquake Resistant Design of Structures”, Oxford University Press, 2007
4. Mohiuddin Ali Khan “Earthquake-Resistant Structures: Design, Build and Retrofit”, Elsevier Science and Technology, 2012
5. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2009.
6. Paulay, T and Priestley, M.J.N., “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1992.

18CE3015	THEORY OF STRUCTURAL STABILITY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart the basic principles of stability of structures
2. To educate on equilibrium and energy approaches for the buckling of compression members and beam columns made of solid as well as thin walled open sections
3. To facilitate understanding of the buckling behaviour of plates and shells and imperfection sensitivity

Course Outcomes:

Student will be able to

1. Gain knowledge of the stability criteria, energy theorems, and basic mathematical techniques used to determine the critical loads of structural elements.
2. Explain the cause of bifurcation and limit point buckling of structural elements.
3. Apply equilibrium and energy approaches and develop mathematical equations for buckling of structural elements.
4. Carry out buckling analysis of structural elements and determine the buckling loads and the associated buckling modes.
5. Justify the applicability of approximate solution techniques for buckling of structures.
6. Predict the buckling behaviour of a portal frame by critical equilibrium approach and by using linear elastic stiffness and geometric stiffness

Module 1: CRITERIA FOR DESIGN OF STRUCTURES: Stability, strength, and stiffness, states of equilibrium - stability criteria - static and dynamic approach -classical concept of stability of discrete and continuous systems - linear and nonlinear behavior

Module 2: STABILITY OF COLUMNS: Axial and flexural buckling, lateral bracing of columns, combined axial, flexural and torsional buckling of columns; various boundary conditions - initially bent column - eccentrically loaded column – effect of shear on buckling - large deflection of columns – inelastic buckling of columns: double modulus theory - tangent modulus theory

Module 3: STABILITY OF FRAME: Effect of axial force on bending stiffness - stability of frames with and without sway– buckling versus global buckling - buckling analysis critical equilibrium and by finite element method

Module 4: TORSIONAL AND LATERAL STABILITY: Lateral stability of beams - lateral buckling of beams in pure bending - lateral buckling of cantilever and simply supported I beams -buckling of thin-walled open sections - torsional buckling - torsional flexural buckling.

Module 5: STABILITY OF PLATES: Stability of plates: equilibrium and energy concepts - critical load of a thin plate under uniaxial and biaxial compression –critical load of plate in shear - post-buckling strength- Galerkin’s method and Finite difference method

Module 6: BUCKLING OF SHELLS: Buckling of shells -Donnel’s equation - symmetrical buckling of cylinder under uniform axial compression - cylinder under uniform external lateral pressure - cylinder subjected to torsion -imperfection sensitivity - perfect systems - imperfect systems - sensitive and insensitive systems - symmetric and asymmetric bifurcation - bifurcation and limit points

References:

1. Ashwini Kukar, “Stability of Structures”, Allied Publishers Limited, New Delhi, 1998.
2. Brush, D.O., and Almorth, B.O., “Buckling of Bars, Plates and Shells”, Mc Graw Hill, 1975.
3. El Naschie, M.S., “Stress, Stability and Chaos in Structural Engineering: An Energy Approach”, McGraw Hill International Editions, 1992.
4. Iyengar, N.G.R., “Elastic Stability of Structural Elements”, Macmillan India Ltd., New Delhi, 2007.
5. Murali, L. Gambir, “Stability Analysis and Design of Structures”, Springer-Verlog, Berlin, 2013.
6. Robert Millard Jones, “Buckling of Bars, Plates and Shells”, McGraw-Hill, 2006
7. Simister G.J. and Hodge D.H., “Fundamentals of Structural Stability”, Elsevier Ltd., 2008
8. Timoshenko, S.P., and Gere, J.M., “Theory of Elastic Stability”, McGraw-Hill, 2013.

18CE3016	NUMERICAL ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To impart knowledge in the solution of linear and nonlinear equations
2. To enable to solve linear systems of equations
3. To train to integrate software and to carry out numerical integration and solve ordinary differential equations.

Course Outcomes:

Student will be able to

1. Solve the linear and nonlinear equations.
2. Analyze static and dynamic problems
3. Integrate software to solve the problems

List of Experiments:

1. Solution of cubic equation- Cardon-solution
2. Find the Roots of Non-Linear Equation using Bisection Method.
3. Find the Roots of Non-Linear Equation using Newton’s Method.
4. Curve Fitting by Least Square Approximations.
5. Solve the System of Linear Equations using Gauss – Elimination Method.
6. Solve the System of Linear Equations using Gauss - Seidal Iteration Method.
7. Solve the System of Linear Equations using Gauss – Jorden Method.
8. Numerical Integration using Trapezoidal Rule.
9. Numerical Integration using Simpson’s Rules.
10. Numerical Solution of Ordinary Differential Equations by Euler’s Method.
11. Numerical Solution of Ordinary Differential Equations by Runge- Kutta Method.
12. Newmark’s integration method for SDoF system

References:

1. Rajasekaran, S., “ Numerical Methods in Engineering and Science”, S.Chand Ltd., 2003

- Williams, P.W. "Numerical Computations", The English Language Book Society, South Ampton, Great Britain, 1972
- Bilal Ayyub, Richard H. McCuen, "Numerical Analysis for Engineers: Methods and Applications", 2nd Edition, CRC Press, 2015

18CE3017	ADVANCED CONCRETE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

- To demonstrate the mix-design of high strength concrete
- To impart practical knowledge on the experimental behaviour of structural elements.
- To train to conduct Non Destructive Tests on existing concrete structures

Course Outcomes:

Student will be able to

- Design high grade concrete and study the parameters affecting its performance.
- Conduct Non Destructive Tests on existing concrete structures.
- Apply engineering principles to understand behaviour of structural elements.

List of Experiments:

- Concrete mix design for high strength concrete
- Study of stress-strain behaviour of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
- Test on dynamic behaviour of frames
- Behaviour of Beam / slab under flexure
- Behaviour of Beams under Shear
- Behaviour of short columns under axial compression
- Evaluation of connection/joint strength of steel
- Durability studies on concrete elements using RCPT
- Permeability studies on concrete
- Non-Destructive testing of existing R.C.C members
- Corrosion studies on RCC elements
- Identification of rebar using cover meter

References

- Neville A. M, "Properties of Concrete", 5th Edition, Prentice Hall, 2012
- Shetty M. S., "Concrete Technology", S. Chand and Co., 2006
- Zongjin Li, "Advanced Concrete Technology", John Wiley and Sons, 2011

18CE3018	MODEL TESTING LAB	L	T	P	C
		0	0	4	2

Course Objectives:

- To demonstrate the various models for structural elements
- To facilitate the determination of the response of the models due to static and dynamic loads
- To enable to carry out the cyclic load tests on frames

Course Outcomes:

Student will be able to

- Demonstrate various models for structural elements
- Determine the response of the models for static and dynamic loads
- Examine the behavior of models for static and dynamic loads

List of Experiments:

- Testing of cylindrical shell

2. Testing of doubly curved shell
3. Testing of Funicular shell
4. Testing of thin plate
5. Testing of thick plate
6. Test of frame models- static loading
7. Natural frequency and Mode shape of cantilever
8. Natural frequency and mode shape of simply supported beam
9. Natural frequency and Mode shape of MDoF system
10. Cyclic Load test on beam- column joint
11. Cyclic load test on frames
12. Wind load test on frames

References:

1. Harry G.Harris and Gajanan M.Sabnis, “ Structural Modeling and Experimental Techniques”, CRC Press, 1999
2. Suryanarayana C, “Experimental Techniques in Materials and Mechanics”, CRC Press, 2011
3. Jack Philip Holman, “Experimental methods for engineers”, McGraw-Hill, 2010

18CE3019	STRUCTURAL DESIGN LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To build in confidence in the analysis and design of RC framed buildings and Industrial structures
2. To impart knowledge in the design of slab bridge and raft foundation
3. To train in the software and carry out pushover analysis of building frames

Course Outcomes:

Student will be able to

1. Model the structural elements
2. Analyse the RCC and steel frame
3. Design and detail complete Multi-Storey Frame Buildings.

List of Experiments

1. Analysis and Design of RCC building frame for static loads
2. Analysis and Design of RCC building frame for wind load
3. Seismic Analysis and Design of RCC building by Response spectrum method
4. Seismic Analysis and Design of RCC building with shear wall
5. Analysis and Design of Industrial building with Truss
6. Analysis and Design of Industrial building with Frame members
7. Analysis and design of slab bridge
8. Analysis and Design of Raft foundation
9. Analysis of Plate using ANSYS
10. Analysis of Solid beam using ANSYS
11. Analysis of RCC frame with flat slab
12. Pushover analysis of building frame

References:

1. ANSYS user guide and Reference Manual, 2016
2. ETABS 2016 - Reference manual
3. SAP 2016 - Reference manual
4. STAAD Pro 2007 V8i – Analysis Reference Manual, 2015

18CE3020	THEORY OF THIN PLATES AND SHELLS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on various plate and shell theories
2. To enable to carry out static analysis of plates
3. To enrich with skill in the static analysis of shells

Course Outcomes:

Student will be able to

1. List the assumptions made in the linear theory of plates and shells
2. Classify various type of plates and shells
3. Use analytical methods for the analysis of thin plates
4. Use analytical methods for the analysis of thin shells.
5. Justify the approximate methods for the complex problems in thin plates.
6. Develop the appropriate shell model for the pipes and pressure vessels

Module 1: INTRODUCTION: Space Curves: Surfaces, shell co-ordinates - strain displacement relations - Assumptions in shell theory - displacement field approximations -Stress resultants - equation of equilibrium using principle of virtual work – boundary conditions.

Module 2: STATIC ANALYSIS OF PLATES: Governing equation for a Rectangular plate - Navier solution for simply - supported rectangular plate under various loadings - Levy solution for rectangular plate with other boundary conditions.

Module 3: CIRCULAR PLATES: Analysis under Axi- symmetric loading - Governing differential equation in polar co-ordinates - approximate methods of analysis- Rayleigh-Ritz approach for simple cases

Module 4: STATIC ANALYSIS OF SHELLS: Membrane theory of shells- cylindrical, conical and spherical shells

Module 5: SHELLS OF REVOLUTION WITH BENDING RESISTANCE: Cylindrical and conical shells - application to pipes and pressure vessels

Module 6: CASE STUDIES: Thermal stresses in plate/shell - case studies - learning from failures

References:

1. Chandrashekhara K, “Theory of Plates”,., Universities Press, 2001
2. Gould P.L., “Analysis of Shells and Plates,” Springer Verlag, New York, United States, July 2012
3. Reddy, J. N., “Theory and Analysis of Elastic Plates and Shells,” CRC, 2nd edition, December 2006
4. Rudolp Szilard, “Theory and Analysis of Plates”, John Wiley and Sons, New York, United States, 2004.
5. Timoshenko, S. “Theory of Plates and Shells, McGraw Hill Book Co., New York, 1990.
6. UguralAnsel C., “Stresses in Plates and Shells”, McGraw Hill, 2009
7. IS:2210-1988 “Criteria For Design of Reinforced Concrete Shell Structures and Folded Plates”, BIS, New Delhi

18CE3021	THEORY AND APPLICATIONS OF CEMENT COMPOSITES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on various type of Composite materials
2. To educate the mechanical behavior of cement composites
3. To enable to analyze and design cement composite structural elements

Course Outcomes:

Student will be able to

1. List the various classification of composite materials

2. Explain the mechanical behavior of cement composites
3. Classify the materials as per orthotropic and anisotropic behaviour
4. Estimate elastic constants using theories applicable to composite materials
5. Formulate the constitutive laws of composite materials – ferrocement, SIFCON and FRC
6. Analyze and design structural elements made of cement composites.

Module 1: INTRODUCTION: Classification and characteristics of composite materials - basic terminology, advantages - stress-strain relations - orthotropic and anisotropic materials - engineering constants for orthotropic materials - restrictions on elastic constants - Plane stress problem - Biaxial strength - Theories for an orthotropic lamina.

Module 2: MECHANICAL BEHAVIOUR: Mechanics of materials approach to stiffness-determination of relations between elastic constants, elasticity approach to stiffness - bounding techniques of elasticity - exact solutions - elasticity solutions with continuity, Halpin, Tsai equations - comparison of approaches to stiffness.

Module 3: CEMENT COMPOSITES: Types of cement composites – terminology - constituent materials and their properties - construction techniques for fibre reinforced concrete – ferrocement - SIFCON - polymer concretes - preparation of reinforcement - casting and curing.

Module 4: MECHANICAL PROPERTIES OF CEMENT COMPOSITES: Behavior of ferrocement - fiber reinforced concrete: tension, compression, flexure, shear, fatigue and impact - durability and corrosion.

Module 6: ANALYSIS AND DESIGN: Analysis and design of cement composite structural elements – ferrocement - SIFCON and fibre reinforced concrete.

Module 5: APPLICATION OF CEMENT COMPOSITES: FRC and ferrocement: Housing, water storage, boats and miscellaneous structures: case studies – learning from failures

References:

1. Jones R. M, “Mechanics of Composite Materials”, 2nd Ed, BSP Books, 1998.
2. Shah S.P, “Application of Fracture Mechanics to Cementitious Composites”, Springer Science and Business Media, 2012
3. Pama R. P., “Ferrocement – Theory and Applications”, IFIC, 1980.
4. Swamy R.N., “New Concrete Materials”, 1st Ed., Blackie, Academic and Professional, Chapman and Hall, 1983
5. Chris L. Page, M M Page, “Durability of Concrete and Cement Composites”, Elsevier, 2007

18CE3022	ADVANCED STEEL DESIGN	L	T	P	C
		3	0	0	3

Course Objectives:

1. To give exposure to the behaviour of steel connections
2. To train in the Analysis and design of the Industrial buildings
3. To help evaluate the performance of light gauge steel structures

Course Outcomes:

Student will be able to

1. Identify appropriate structural steel section
2. Understand the behavior of different steel structural elements
3. Perform analysis of steel structures
4. Design the components of steel structural elements and connections
5. Appraise on the quality parameters for steel structures
6. Investigate the reasons for failure of a steel structure

Module 1: STRUCTURAL STEEL: Properties of steel: Mechanical properties, Hysteresis, ductility – Hot rolled sections: compactness and non-compactness, slenderness, residual stresses

Module 2: DESIGN OF STEEL ELEMENTS: Limit state method - design of members subjected to combined forces – design of purlins and gable column – design of slab base and gusseted bases and moment resisting base plates.

Module 3: DESIGN OF CONNECTIONS: Types of connections – welded and bolted – throat and root stresses in fillet welds – seated connections – unstiffened and stiffened seated connections – moment resistant connections – clip angle connections – eccentric connections - split beam connections – framed connections.

Module 4: ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS: Types of roof system - loads - analysis and design of roof truss – analysis and design of industrial buildings – pre-engineered buildings - sway and non-sway frames – seismic design of steel buildings

Module 5: PLASTIC ANALYSIS OF STRUCTURES: Introduction, shape factor, moment redistribution, combined mechanisms, analysis of portal frames, effect of axial force - effect of shear force on plastic moment - design of continuous beams - transmission line structure - loads - bracing system - design of microwave towers

Module 6: DESIGN OF COLDFORMED STEEL STRUCTURES: Behaviour of compression elements - effective width for load and deflection determination – behaviour of unstiffened and stiffened elements – design of webs of beams – flexural members – lateral buckling of beams – shear lag – design of compression members – wall studs

References:

1. Jayagopal, L.S. and Tensing.D, “ Design of Steel structures”, Vikas Publishing, Chennai, 2015
2. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, 1990.
3. Narayanan.R., “Teaching Resource on Structural steel Design”, INSDAG, Ministry of Steel Publishing, 2000.
4. Subramanian. N, “Design of Steel Structures”, Oxford University Press, 2008.
5. Wie Wen Yu, “Design of Cold Formed Steel Structures”, Mc Graw Hill Book Company, 1996.

18CE3023	DESIGN OF ADVANCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To equip with the basic understanding of the behaviour of reinforced concrete structures
2. To educate the behavior of various structures
3. To instill competence in the design of the special structural elements as per various codes of practice

Course Outcomes:

Student will be able to

1. Interpret the concept of RC design
2. Compute design loads acting on a RC structure according to codal provisions.
3. Design the RC structures for its behavior.
4. Design and detail the structural drawings for execution citing relevant IS codes.
5. Adopt the RC structure based on the field requirement.
6. Identify the solution for failure of structures

Module 1: SERVICEABILITY CRITERIA: DEFLECTION AND CRACK WIDTH: Limit state of serviceability – short term deflection –long term deflection - mechanism of flexural cracking - crack width: IS, BS and ACI Codes – Shrinkage and thermal cracking

Module 2: INELASTIC BEHAVIOUR OF REINFORCED CONCRETE BEAMS: Inelastic behaviour – Stress-strain characteristics of concrete – Moment rotation behavior - Strut-and- Tie Method - concept of plastic hinges – moment redistribution

Module 3: DESIGN OF SPECIAL RC ELEMENTS: Behaviour of cantilever walls - ordinary and shear walls - Design of RC walls -interaction of shear walls and rigid jointed frames- Strut and tie method

Module 4: YIELD LINE BASED DESIGN: Characteristic features of yield lines – patterns – moment capacity – ultimate load on slabs - design of slabs

Module 5: DESIGN OF SPECIAL STRUCTURE: Introduction – behaviour of bunker and silo - Design of Bunkers – Design of Silo

Module 6: PRECAST ELEMENTS: Principle of precast construction - advantages - methods of precasting - Design of Precast concrete components – Poles - Column brackets

References:

1. Bhavikatti S.S, “Advanced RCC Design”, New age International Pvt. Ltd. 2006.
2. Krishna Raju, “Advanced Reinforced Concrete Design”, CBS Publishers and distributors, New Delhi, 2016
3. PCI Design Handbook – Precast and Prestressed Concrete (6th Edition), ISBN – 0- 937040-71-1
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007.
6. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 1978.
7. IS 4995: Part II- 1974, Criteria for “Design of Reinforced concrete Bins for storage of granular and powdery materials”, Bureau of Indian Standards, New Delhi
8. ACI 313: 1977. Standard practice for design and construction of concrete silos and stacking tubes for storing granular materials, American Concrete Institute. 1977.

18CE3024	STRUCTURAL OPTIMIZATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on optimization Techniques
2. To differentiate traditional and non-traditional algorithms
3. To apply nontraditional for optimal structural design

Course Outcomes:

Student will be able to

1. Identify different optimization problems
2. Interpret linear, nonlinear, geometric and dynamic programming problems
3. Use various optimization techniques
4. Choose suitable optimization method for a specific problem
5. Formulate the optimization algorithm for real time complex problems
6. Carry out optimization of civil engineering problems

Module 1: LINEAR AND NON LINEAR PROBLEMS: Basic concepts of minimum weight - minimum cost design – objective function, constraints - linear and non-linear programming; Formulation of problems simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm - exhaustive and unrestricted search - Dichotomous search - Fibonacci method - Golden section method - Interpolation methods – unconstrained optimization techniques.

Module 2: GEOMETRIC AND DYNAMIC PROGRAMMING PROBLEMS: Unconstrained and constrained problems with zero difficulty - concept of solving problems with one degree of difficulty - Dynamic Programming: Bellman’s principle of optimality - representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods.

Module 3: GENETIC ALGORITHM: Genetic algorithms – operators – reproduction – mutation – cross over – evolution strategies – methods for optimal design of structures, continuous beams and single storeyed frames – minimum weight design for truss members

Module 4: ANT COLONY ALGORITHM: Ant algorithm – network – The ant – initial population – Ant movement – Ant tours – Pheromone – evaporation – sample problem.

Module 5: ARTIFICIAL NEURAL NETWORKS TO STRUCTURAL OPTIMIZATION: Basic concepts – biological systems - artificial neural network - application characteristics - overview of learning methods - review of probability concepts.

Module 6: FUZZY LOGIC IN CIVIL ENGINEERING: Fuzzy set theory and logic – fuzzy sets operation – fuzzy relations - membership function defuzzification - fuzzy based rule systems – application to civil engineering problems

References:

1. Belegundu A. and T. Chandrupatla, “Optimization Concepts and Applications in Engineering”, Prentice Hall, 1999.
2. David Corne, Marco Dorigo and Fred Glover, “New Ideas in Optimization”, McGraw Hill Company, London, 1999.
3. Gary Parker, R. and Ronald, L., “Discrete Optimization”, Academic press 1988.
4. Rajasekaran, S. and Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm”, Prentice Hall of India Pvt. Ltd, Delhi, 2003
5. Rao, S.S., “Engineering Optimization, Theory and Practice”, New Age International (p) Ltd., New Delhi, 2002.
6. Ross, T.J., “Fuzzy Logic with Engineering Applications”, Mc.Graw Hill, 1995.
7. Goldberg, D.E., “Genetic Algorithm in Search, Optimization and Machine Learning”, Addison – Wesley, 1989.
8. Spunt, L., “Optimum Structural Design”, Prentice Hall, New Jersey, 1971.

18CE3025	DESIGN OF HIGH RISE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the behaviour of tall buildings
2. To facilitate to acquire skill in the analysis of the resultant forces in various structural forms
3. To get exposure to the stability behavior of tall buildings

Course Outcomes:

Student will be able to

1. Identify the loads on tall buildings
2. Illustrate the behaviour of various structural forms
3. Adopt suitable techniques for analysis
4. Analyse the forces in the structures
5. Assess the long term effects in tall buildings
6. Integrate second order effects into the analysis.

Module 1: LOADING AND DESIGN PRINCIPLES: Loading- sequential loading, gravity loading, wind loading, earthquake loading, - equivalent lateral force, modal analysis - combination of loading, – static and dynamic approach - design philosophy – limit state method and plastic design.

Module 2: BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS: Factors affecting growth, height and structural form - High rise behavior: rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger- braced and hybrid mega systems.

Module 3: ANALYSIS AND DESIGN: Modeling for approximate analysis - accurate analysis and reduction techniques - analysis of buildings as total structural system - analysis for member forces, drift and twist - computerized three dimensional analysis – assumptions in 3D analysis – simplified 2D analysis

Module 4: SECOND ORDER EFFECTS: Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance, P-Delta analysis, translational, torsional instability, out of plumb effects, effect of foundation rotation

Module 5: STABILITY ISSUES: Overall analysis of frames, wall frames - approximate methods

Module 6: APPLICATION: Application of software in analysis and design - case studies - learning from failures

References:

1. Beedle.L.S, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.
3. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
4. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988
5. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

18CE3026	DESIGN OF FORMWORK	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the requirements for design of formwork
2. To train in the selection of the type of formwork materials
3. To get exposed to analyse and design various type of formwork

Course Outcomes:

Student will be able to

1. Understand the requirements for design of formwork
2. Select proper formwork, accessories and material.
3. Design the form work for Beams, Slabs, Columns, Walls and Foundations.
4. Design the form work for Special Structures.
5. Understand the working of flying formwork.
6. Judge the formwork failures through case studies

Module 1: INTRODUCTION: Requirements - selection of formwork.

Module 2: FORMWORK MATERIALS: Timber, plywood, steel, aluminium, plastic and accessories. Horizontal and vertical formwork supports.

Module 3: FORMWORK DESIGN: Concepts - formwork systems and design for foundations, walls, columns, slab and beams.

Module 4: FORMWORK DESIGN FOR SPECIAL STRUCTURES: Special structures: shells, domes, folded plates, overhead water tanks, natural draft cooling tower, bridges.

Module 5: FLYING FORMWORK: Table form, tunnel form, slip form - formwork for precast concrete - formwork management issues –pre-and post-cure.

Module 6: CASE STUDIES: Formwork failures: causes and case studies in formwork - failure formwork issues in multi- story building construction

References:

1. Pourify , “Formwork for Concrete Structures,” , Mc Graw Hill India,2015.
2. Kumar Neeraj Jha , “Formwork for Concrete Structures” , , Tata McGraw Hill Education, 2012.

3. Christopher Souder, “Temporary Structure Design”, John Wiley and Sons, 2014
4. Garold (Gary) D. Oberlender, Robert L. Pourif Formwork for Concrete Structures” McGraw Hill Professional, 2010
5. IS 14687: 1999, “False work for Concrete Structures – Guidelines”, BIS

18CE3027	DESIGN OF MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on various masonry design approaches
2. To train in the evaluation of shear strength and ductility of reinforced masonry members
3. To impart proficiency in performing elastic and inelastic analyses of masonry walls

Course outcomes:

Student will be able to

1. Understand the masonry design approaches.
2. Analyze reinforced masonry members.
3. Determine interactions between members.
4. Determine shear strength and ductility of reinforced masonry members.
5. Check the stability of walls
6. Perform elastic and In-elastic analysis of masonry walls.

Module 1: INTRODUCTION: Historical perspective - masonry materials - masonry design approaches - overview of load conditions - compression behaviour of masonry - masonry wall configurations - distribution of lateral forces.

Module 2: FLEXURAL STRENGTH: Flexural strength of reinforced masonry members: In plane and out-of-plane loading.

Module 3: INTERACTIONS: Structural wall, columns and pilasters, retaining wall, pier and foundation.

Module 4: SHEAR STRENGTH AND DUCTILITY: Shear strength and ductility of reinforced masonry members.

Module 5: PRESTRESSED MASONRY: Stability of walls – coupling of masonry walls - openings – columns - beams.

Module 6: ELASTIC AND INELASTIC ANALYSIS: Modeling techniques - static pushover analysis - use of capacity design spectra - case studies: learning from failures

References:

1. Hamid Ahmad A. and Drysdale Robert G “Masonry Structures: Behavior and Design”, Masonry Society, 2008
2. Maurizio Angelillo, “Mechanics of Masonry Structures”, Springer Science and Business Media, 2014.
3. Narendraty, “Design of Reinforced Masonry Structures”, ICC, 2ndEdn, McGraw Hill Professional, 2010
4. TomaeviMiha, “Earthquake-resistant Design of Masonry Buildings”, Imperial College Press, 1999.
5. William George Curtin, Gerry Shaw, J. K. Beck, “Design of reinforced and prestressed masonry”, Thomas Telford, 1988

18CE3028	ADVANCED DESIGN OF FOUNDATION STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn principles of subsoil exploration
2. To get expertise in the design of substructures
3. To help in evaluation of the soil shear strength parameters.

Course Outcomes:

Student will be able to

1. Assimilate the principles of subsoil exploration
2. Identify and evaluate the soil shear strength parameters.
3. Determine the load carrying capacity of each type of foundation.
4. Understand the concepts of settlement analysis.
5. Select appropriate foundations type based on available soil conditions.
6. Design of reinforced concrete shallow foundations, pile foundations, well foundations and machine foundations.

Module 1: SHALLOW FOUNDATIONS: Soil investigation – methods of subsurface exploration, methods of borings along with various penetration tests - shallow foundations in clay - shallow foundation in sand and C- Φ soils - footings on layered soils and sloping ground - design for eccentric or moment loads settlements of footings and rafts - proportioning of foundations using field test data

Module 2: PILE FOUNDATIONS: Methods of estimating load transfer of piles - settlements of pile foundations - pile group capacity and settlement - laterally loaded piles - pile load tests - analytical estimation of load- settlement behavior of piles - proportioning of pile foundations - lateral and uplift capacity of piles.

Module 3: WELL FOUNDATION: IS and IRC code provisions - Elastic theory and ultimate resistance methods - design principles - well construction and sinking

Module 4: SPECIAL FOUNDATIONS: Foundation on expansive soils – choice of foundation – under-reamed pile foundation - foundation for concrete towers, chimneys – design of anchors

Module 5: MACHINE FOUNDATIONS: Introduction – types of machine foundation – basic principles of design of machine foundation – vibration analysis of machine foundation – design of foundation for Reciprocating machines and Impact machines – vibration isolation

Module 6: TUNNELS, OPEN CUTS AND COFFER-DAMS: Tunnels and arching in soils, pressure computations around tunnels - open cuts - sheeting and bracing systems in shallow and deep open cuts in different soil types - coffer dams: various types, analysis and design, foundations under uplifting loads

References:

1. Bowles J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York, 1986.
2. Nainan P. Kurian, “Design of foundation system, Narosa Publishing House, 2005
3. Swamy Saran, "Analysis and Design of substructures", Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
4. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.
5. Varghese.P.C, “Design of Reinforced Concrete Foundations” –PHI learning private limited, New Delhi, 2009.
6. Winterkorn. H. F., and Fang, H. Y., “Foundation Engineering Hand Book”, Van Nostrand, Reinhold, 1976.

18CE3029	DESIGN OF BRIDGES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge of the loading standards of IRC
2. To get exposed to the design principles of bridges
3. To facilitate to acquire expertise in analysis and design of different types of bridges.

Course Outcomes:

Student will be able to

1. Classify bridges according to loading and site conditions

2. Understand the behavior of different bridges
3. Analyze different types of bridges
4. Design the different components of bridges
5. Appraise on the quality investigation of bridge structures
6. Investigate the reasons for the failure of bridge structures

Module 1: SHORT SPAN RC BRIDGES: Types of bridges and loading standards - choice of type - I.R.C. specifications for road bridges – design of RCC solid slab bridges - analysis and design of slab culverts, Tee beam and slab bridges.

Module 2: LONG SPAN RC BRIDGES: Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – arch bridges – box culverts - cable stayed and suspension bridges.

Module 3: PRESTRESSED CONCRETE BRIDGES: Flexural and torsional parameters – Courbon's theory – design of girder section – maximum and minimum prestressing forces – eccentricity – live load and dead load shear forces – cable zone in girder – check for stresses at various sections – check for diagonal tension – diaphragms – End block

Module 4: STEEL BRIDGES: General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – vertical and horizontal stiffeners.

Module 5: BEARINGS AND SUBSTRUCTURES: Different types of bearings – design of bearings – design of piers and abutments of different types – types of bridge foundations – design of foundations.

Module 6: CASE STUDIES: Case Studies- learning from failures

References:

1. Jagadeesh.T.R. and Jayaram. M.A., “Design of Bridge Structures”, Prentice Hall of India Pvt. Ltd. 2004.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Oxford and IBH Publishing Co. New Delhi, 2001.
3. Krishna raju N, “Design of Bridges”, Oxford and IBH Publishing, New Delhi, 2010
4. Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, New Delhi, 2008.
5. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, Delhi, 1988

18CE3030	SOIL STRUCTURE INTERACTION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To teach the basics of soil structure interaction, soil foundation models.
2. To impart knowledge on finite difference and finite element analysis
3. To help in acquiring skill in the elastic analysis of piles and piled raft.

Course Outcomes:

Student will be able to

1. Understand various soil response models applicable to soil-foundation interaction analysis.
2. Come up with elastic solutions for problems of pile.
3. Analyse soil-foundation system using software packages.
4. Understand interaction analysis on piles and pile groups.
5. Predict load deflection on laterally loaded piles.
6. Carry out design of pile raft system.

Module 1: SOIL - FOUNDATION INTERACTION: Introduction to soil – foundation interaction problems - soil behaviour - foundation behaviour, interface behaviour - scope of soil-foundation interaction analysis - soil response models - Winkler - elastic continuum - two parameter elastic models - elastic – plastic behaviour -time dependent behaviour

Module 2: BEAMS ON ELASTIC FOUNDATION - SOIL MODELS: Infinite beam - two parameters -isotropic elastic half space - analysis of beams of finite length - classification of finite beams in relation to their stiffness – analysis through application packages.

Module 3: FRAMED STRUCTURE ON STRATIFIED SOILS: Analysis of different types of framed structures founded on stratified natural deposits with linear and non-linear stress-strain characteristics

Module 4: PLATE ON ELASTIC MEDIUM: Infinite plate – Winkler -two parameters - isotropic elastic medium -thin and thick plates - analysis of finite plates - rectangular and circular plates - numerical analysis of finite plates - simple solutions - analysis of braced cuts – application packages.

Module 5: ELASTIC ANALYSIS OF PILE: Elastic analysis of single pile - theoretical solutions for settlement and load distribution - analysis of pile group - interaction analysis - load distribution in groups with rigid cap – piled-raft – application packages

Module 6: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles - subgrade reaction and elastic analysis - interaction analysis –pile-raft system - solutions through influence charts – application packages

References:

1. Hemsley, J.A., “Elastic Analysis of Raft Foundations”, Thomas Telford, 1998.
2. Poulos, H.G., and Davis, E.H., “Pile Foundation Analysis and Design”, John Wiley, 2008.
3. McCarthy, R.N., “Essentials of Soil Mechanics and Foundations: Basic Geotechnics”, Sixth Edition, Prentice Hall, 2002.
4. Murthy, V.N.S., “Advanced Foundation Engineering”, CBS Publishers, New Delhi, 2007.
5. Saran, S., “Analysis and design of substructures”, Taylor and Francis Publishers, 2006.
6. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Delhi, 1988

18CE3031	DESIGN OF INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the requirements and functional planning of industrial structures
2. To train in the analysis of the industrial structures
3. To train in the design of towers and chimneys

Course Outcomes:

Student will be able to

1. Identify the suitable industrial roofing system
2. Explain the requirements of industrial building
3. Analyse transmission towers with required foundations
4. Design various components of industrial buildings
5. Discuss the behaviour of machine foundation
6. Plan industrial structures for functional requirements

Module 1: PLANNING AND FUNCTIONAL REQUIREMENTS: Classification of industries and industrial structures - planning for layout requirements regarding lighting, ventilation and fire safety - Protection against noise and vibration - guidelines of factories act.

Module 2: PORTAL FRAMES: Design of portal frame with hinge base - design of portal frame with fixed base - gable structures

Module 3: INDUSTRIAL BUILDINGS: Steel and RCC - Gantry girder - crane girders - design of Corbels and nibs – design of staircase

Module 4: POWER PLANT STRUCTURES: Types of Power plants – containment structures - cooling towers - bunkers and silos - pipe supporting structures

Module 5: TRANSMISSION LINE STRUCTURES AND CHIMNEYS: Analysis and design of transmission line towers - sag and tension calculations, testing of towers – design of self-supporting chimney - design of chimney bases.

Module 6: FOUNDATION: Design of foundation for Towers, chimneys and cooling towers - machine foundation - design of turbo generator foundation

References:

1. Jurgen Axel Adam, Katharina Hausmann, Frank Juttner, Klaus Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers, 2004.
2. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., “Transmission Line Structures”, Tata McGraw Hill, 1992.
4. K.G. Bhatia , “Foundations for Industrial Machines: Handbook for Practising Engineers”, Taylor and Francis, 2009
5. Julian Weyer, Sergio Baragaño, “Industrial Building Planning and Design”, Design Media Publishing Limited, 2014

18CE3032	ANALYSIS OF LAMINATED COMPOSITE PLATES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on laminated plate theory
2. To train in the analysis of laminate composite plate by analytical methods
3. To give exposure to the finite element analysis of laminated composite plate

Course Outcomes:

Student will be able to

1. State the assumptions made in laminated plate theory
2. Distinguish between various shear deformation theories
3. Explain the relevance of various laminated plate theories and the solutions
4. Analyse the rectangular composite plates using the analytical methods.
5. Analyse the composite plates using advanced finite element method.
6. Develop the computer programs for the analysis of composite plates.

Module 1: INTRODUCTION: Introduction to Kirchhoff thin plate theory

Module 2: CLPT AND FSDT: Displacement field approximations for classical laminated plate theory (CLPT) and first order shear deformation theory (FSDT) - analytical solutions for bending of Rectangular laminated plates using CLPT.

Module 3: NAVIER SOLUTIONS: Governing Equations -Navier solutions of cross-ply and angle-ply laminated simply- supported plates - determination of stresses.

Module 4: LEVY’S SOLUTIONS: Levy solutions for plates with other boundary conditions - Analytical solutions for bending of rectangular laminated plates using FSDT.

Module 5: FINITE ELEMENT SOLUTIONS USING CLPT: Bending of rectangular laminated plates using CLPT.

Module 6: FINITE ELEMENT SOLUTIONS USING FSDT: Finite element solutions for bending of rectangular laminated plates using FSDT - finite element model - Coelement formulation - post computation of stresses.

References:

1. Reddy J. N ., “Mechanics of Laminated Composites Plates and Shells”, CRC Press, 2004
2. Mohd Sultan Ibrahim, “Free Vibration Analysis of Laminated Composite Plates Based on Higher Order Shear Deformation Theory Using Finite Element Method” International Islamic University Malaysia, 2002

3. Turvey G.J, I.H. Marshall, “Buckling and Post buckling of Composite Plates”, Springer Science and Business Media, 2012
4. Jianqiao Ye, “Laminated Composite Plates and Shells: 3D Modelling”, Springer Science and Business Media, 2011
5. Reddy J. N., Antonio Miravete, “Practical Analysis of Composite Laminates”, CRC Press, 2018

18CE3033	FRACTURE MECHANICS OF CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To facilitate understanding of the types of cracks
2. To impart knowledge on crack models
3. To enable to apply damage mechanics for concrete

Course Outcomes:

Student will be able to

1. Learn the various type of cracks
2. Understand the fundamentals of fracture mechanics
3. Identify and classify cracking of concrete structures based on fracture mechanics.
4. Implement stress intensity factor for notched members
5. Apply fracture mechanics models to high strength concrete and FRC structures.
6. Compute J-integral for various sections understanding the concepts of LEFM.

Module 1: INTRODUCTION: Fundamentals of fracture mechanics – type of cracks – stress intensity factor

Module 2: STRUCTURAL CRACKS: Crack in a structure - mechanisms of fracture in structural concrete - crack growth - cleavage fracture - ductile fracture - fatigue cracking - environment assisted cracking - service failure analysis.

Module 3: STRESS AT CRACK TIP: Stress at crack tip - linear elastic fracture mechanics, Griffith's criteria - stress intensity factors - crack tip plastic zone - Erwin's plastic zone correction - R curves – compliance - J integral - concept of CTOD and CMD.

Module 4: MATERIAL MODELS: General concepts, crack models, band models - models based on continuum damage mechanics

Module 5: APPLICATIONS: Applications to high strength concrete - fibre reinforced concrete - crack concepts – numerical modeling.

Module 6: FEM MODEL: Crack tip element- finite element model for crack tip

References:

1. Broek David,” Elementary Engineering Fracture Mechanics”, 3rd Rev. Ed. Springer, 1982.
2. Elfgreen L., “Fracture Mechanics of Concrete Structures – Theory and Applications”, RILEM Report, Chapman and Hall, 1989.
3. Suri C. T. and Jin Z.H., “Fracture Mechanics”, 1st Edition, Elsevier Academic Press, 2012.
4. Victor, Li C., Bazant Z. P., “Fracture Mechanics – Applications to Concrete”, ACI SP 118, ACI Detroit, 1989
5. Alberto Carpinteri, “Applications of Fracture Mechanics to Reinforced Concrete”, CRC Press, 2014

18CE3034	DESIGN OF PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on the principles of pre-stressing
2. To get exposure to analysis and design of the prestressed concrete elements
3. To teach the concepts of prestressing techniques

Course Outcomes:

Student will be able to

1. List the prestressing techniques
2. Understand the concepts of prestressing techniques
3. Analyse prestressed concrete structures
4. Design prestressed concrete structural elements
5. Appraise on the quality parameters of PSC structures
6. Investigate the rationale for failure of a PSC structure

Module 1: INTRODUCTION: Review - basic concepts of prestressing- IS 1343-2012 code provisions - factors affecting strength and deflection - layout of cables - introduction to ACI and BS codal provisions

Module 2: DESIGN FOR FLEXURE, SHEAR AND TORSION: Behaviour of flexural members - determination of ultimate flexural strength – various codal provisions - design of flexural members - design for shear, bond and torsion.

Module 3: DESIGN OF CONTINUOUS AND CANTILEVER BEAMS: Analysis and design of continuous beams - methods of achieving continuity - concept of linear transformations - concordant cable profile and gap cables – analysis and design of cantilever beams

Module 4: DESIGN OF POST TENSIONED CONCRETE SLAB: Design of one way and two way spanning floors - flexure in flat slab - tendon profile - anchorage bursting reinforcement - design of railway sleepers

Module 5: DESIGN OF PIPES AND COLUMNS: Analysis and design of prestressed concrete pipes - columns with moments

Module 6: DESIGN OF COMPOSITE MEMBERS: Composite beams - applications - analysis and design, ultimate strength - partial prestressing - advantages and applications.

References:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Lin.T.Y, and Burns.H, “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, New York, 2009.
4. RajagopalanN, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.
5. Sinha N.C and Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

18CE3035	ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about atmospheric pollution.
2. To introduce various measurement techniques and control measures.
3. To enable to make use of different tools available for atmospheric environmental pollution.

Course Outcomes:

Student will be able to

1. Understand the principles of atmospheric chemistry in air pollution
2. Classify, characterize and quantify different types of air pollutants
3. Analyze the effects of air pollution on environment
4. Choose appropriate technology to control air pollution
5. Apply suitable measures in controlling air pollution
6. Develop model for atmospheric pollution

Module 1: BASIC CONCEPTS: Sources and types of air pollutants - effects on environment - sampling and measurement of particle and gaseous pollutants.

Module 2: TRANSPORT AND DISPERSION OF AIR POLLUTANTS: Atmospheric stability and inversion-plume rise estimation - dispersion theories.

Module 3: CONTROL OF PARTICULATES: Control methods - selection of control equipment - principle and design aspects of settling chambers - cyclone separators – scrubbers – filters - electrostatic precipitators - engineering control concept.

Module 4: CONTROL OF GASEOUS POLLUTANTS: Control methods - selection of control equipment - principle and design aspects of absorption – adsorption – condensation - incineration – direct combustion - thermal incineration - catalytic incineration - engineering control concept.

Module 5: AIR POLLUTION EMISSION STANDARDS AND LEGISLATION: Standards and legislation for air pollution emission control - control measures for industrial application

Module 6: INTRODUCTION TO AIR POLLUTION MODELS: CALINE, SCREEN 3, ISCST3 - basics of AERONET - case studies.

References:

1. Rao C S, “Environmental Pollution Control Engineering”, New Age International (p) Limited, 2006.
2. Lawrence K.Wang, Norman C Perelra, Yung-Tse Hung, “Air Pollution Control Engineering”, Tokyo, 2004.
3. Anjaneyulu.Y, “Air Pollution and Control Technologies”, Allied Publishers (P) Ltd, India, 2002.
4. Mudakavi, J R, “Principles and Practices of Air Pollution Control and Analysis” IK International, 2010.
5. David H.F Liu, BelaG. Liptak, “Air Pollution”, Lewis Publishers, 2000.

18CE3036	SURFACE FLOW HYDROLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide a basic knowledge on different components of hydrologic cycle
2. To impart practical experience in hydrological data acquisition, analysis
3. To interpret hydrologic components on temporal and spatial scales

Course Outcome

Student will be able to

1. Possess a thorough knowledge of the hydrological processes associated with surface water
2. Analyze basic hydrologic data
3. Estimate the surface runoff
4. Measure flow in the streams
5. Conduct probability analysis for extreme events
6. Conduct water budget analysis

Module 1: BASIC HYDRAULICS AND HYDROLOGY: Definition and introduction to hydraulics and hydrological science - structure and properties of water - conservation of mass and energy – atmosphere – atmospheric air circulation – cyclones – fronts - clouds - hydrologic cycle - global to local scales - radiation balance – evaporation and condensation.

Module 2: FREQUENCY ANALYSIS AND STOCHASTIC HYDROLOGY: Return period - Random variable – Frequency distributions – Frequency analysis – Correlation coefficient – Method of least squares – Variance analysis - Simple and multiple regression analysis – Deterministic approach in hydrology - Stochastic hydrology - Introduction to: time series, deterministic and stochastic models.

Module 3: PRECIPITATION: Precipitation - precipitation types - temporal and spatial distribution of precipitation - precipitation measurement: precipitation gauges, satellite estimates of precipitation, radar measurement of precipitation - interpretation of precipitation data - estimating missing precipitation data - double-mass analysis - average precipitation over area - Isohyets and Thiessen polygon - depth-area-

duration analysis.

Module 4: RUNOFF: Phenomenon of runoff - surface retention – infiltration runoff cycle - estimating the volume of storm runoff: storm analysis - basin characteristics

Module 5: STREAMFLOW MEASUREMENTS: Stream flow measurements and rating curves - flood estimation - unit hydrograph - flood frequency analysis - flood routing - sediment yield and reservoir sedimentation.

Module 6: HYDROLOGIC ABSTRACTIONS: Factors affecting evaporation process - water budget - determination of reservoir evaporation - energy budget - determination of reservoir operation-estimation of evaporation using pan Evaporimeter data Thornthwaite and Penman -Monteith methods - Lysimeter determination of evapotranspiration - interception – soil moisture - infiltration loss estimation.

References:

1. Subramanya K., “Hydrology”, Tata McGraw Hill Co., New Delhi, 2017.
2. Rangunath H.M., “Hydrology”, Wiley Eastern Ltd., New Delhi, 2011.
3. VenTe Chow, “Hand book of Hydrology”, McGraw Hill Publications, New York, 1995.
4. JeyaRamiReddy.P., “Hydrology”, Laxmi Publications, New Delhi, 2005.
5. Vijay P.Singh, “Elementary Hydrology, Prentice Hall of India, New Delhi, 2004.

18CE3037	ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge on the transformation of chemicals in the environment
2. To educate the basics of microbiology involved in air, water and soil.
3. To study the basics of environmental chemistry, chemical reactions and electro kinetic properties.

Course Outcome

Student will be able to

1. Learn basic chemical contents in the context of environmental studies
2. Gain competency in solving environmental issues of chemicals based pollution
3. Able to determine chemical calculations required for treatment purpose
4. Identify contaminating chemicals and learn the conceptual skills required for environmental chemistry research
5. Apply micro-organisms for the treatment of wastes, bioleaching and bio-augmentation
6. Have insight into type, growth metabolism and culturing techniques of micro- organisms and their application to environmental engineering

Module 1: INTRODUCTION: Stoichiometry and mass balance - solubility product - chemical kinetics principles of green chemistry- Beer Lambert’s law - limitations - UV visible spectroscopy - atomic spectroscopy -principles and applications

Module 2: AQUATIC CHEMISTRY: Environmental significance and determination - fate of chemicals in aquatic environment – colloidal and surface chemistry- treatment– oxidation and reduction – sorption-adsorption - Freundlich and Langmuir Isotherms – applications in water and wastewater treatment.

Module 3: ATMOSPHERIC AND SOIL CHEMISTRY : Atmospheric structure - chemical and photochemical reactions in the atmosphere – photochemical smog- ozone layer depletion – acid rain-agricultural chemicals in soil reclamation of contaminated land - electrokinetic remediation.

Module 4: CLASSIFICATION OF MICROORGANISMS: Prokaryotic, eukaryotic, structure, characteristics, culturing of micro-organisms - environmental factors influencing microbial growth - growth kinetics - distribution of microorganisms - water, air and soil - indicator organisms - coliforms, fecal coliforms, E-coli, streptococcus, clostridium, MPN and MFT.

Module 5: PATHOGENS IN WASTEWATER: Introduction to water borne pathogens and parasites and their effects on human, animal and plant health - transmission of pathogens – control of microorganisms; microbiology of biological treatment processes – microbiology of sewage sludge

Module 6: BIODEGRADATION AND TOXICOLOGY: Microbiology of wastewater treatment – Biodegradation, bioaugmentation, biomagnification, bioassay, microbial leaching - Ecotoxicology – toxicity testing.

References:

1. Sawyer C. N., P. L. McCarty, and G. F. Parkin, “Chemistry for Environmental Engineering”, 5th Edition, Tata McGraw-Hill, New Delhi, 2003.
2. Pelczar, M. J., Chan E. C. S. and Krieg, N. R., “Microbiology”, 5th Edition, Tata McGraw Hill, New Delhi, 1993.
3. Tortora. G. J., B. R. Furke, and C. L. Case, “Microbiology- An introduction” 11th Ed., Benjamin/Cummings publ. Co., Inc., California, 2013.
4. Vanloon G. W. and S. J. Duffy “Environmental chemistry -a global perspective”, Oxford University press, 3rd Edition, Newyork, 2010.

18CE3038	WATER RESOURCES PLANNING AND SYSTEMS ENGINEERING		L	T	P	C
			3	0	0	3

Course Objectives:

1. To introduce application of systems concepts to water resources planning
2. To enlighten with the optimization techniques in modeling water resources systems
3. To impart knowledge on National Water Policy

Course Outcome

Student will be able to

1. Understand the steps involved in planning a water resources project in an integrated way
2. Gain knowledge about different components of National Water Policy
3. Understand the economic policy to carryout cost-benefit analysis
4. Formulate the objective function and constraints
5. Apply few optimization tools and techniques
6. Develop reservoir operation policy

Module 1: CONCEPTS OF SYSTEMS ANALYSIS: Definition - approach to water resources planning and management- water resources management - reservoir operation and water allocation policy

Module 2: OPTIMIZATION TECHNIQUES: Overview - objectives and constraints - formulation of linear programming models- Graphical method - simplex method - sensitivity analysis - application of linear programming in water resources

Module 3: DYNAMIC PROGRAMMING: Bellman’s principle of optimality - forward and backward recursive dynamic programming - curse of dimensionality - application of dynamic programming for resource allocation - reservoir capacity expansion.

Module 4: WATER RESOURCES PLANNING: concepts and definitions - functions and role of water resources - phases of water resources planning - data requirements for water resources planning - National water policy - constitutional provisions for water resources development.

Module 5: WATER RESOURCES PROJECTS: Planning objectives - public involvement in identifying objectives - project scale - implementation of water resources projects - planning strategies for water resources projects

Module 6: ECONOMIC POLICY: Water allocation priorities - Master plan approach - mechanics of water resources plan - shadow pricing on project costs - International funding agencies.

References:

1. Vedula, P.P., and Mujumdar, S., “Water Resources Systems: Modelling Techniques and Analysis”, TataMcGraw Hill, 2005.
2. Leonard Douglas James and Robert Rue Lee, “Water Resources Economics”, Oxford Publishers, 2005.
3. Bhawe, P. R., “Optimal Design of Water Distribution Networks”, Narosa Publishing house, 2003.
4. Loucks, Daniel P., van Beek, Eelco; Stedinger, Jerry R., Dijkman, Jozef P.M., Villars, “Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications”, UNESCO publishing, 2005.
5. Quentin Grafton R., and Karen Hussey, “Water Resources Planning and Management”, Cambridge University Press, 2011.

18CE3039	WATER AND WASTEWATER TREATMENT TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on characteristics of water and wastewater, primary and secondary treatment
2. To educate the methods of disposal of sludge and treated wastewater.
3. To educate on the working principles and design of various physical, chemical treatment systems for water and wastewater.

Course Outcome

Student will be able to

1. Impart knowledge on characteristics and standards of water and wastewater
3. Understand principle of water and wastewater treatment systems
4. Design water and wastewater treatment systems
5. Evaluate efficiency of treatment units
6. Illustrate the design principles of industrial wastewater
7. Apply knowledge on the disposal and treatment of sludge

Module 1: INTRODUCTION: Importance of water- quality and characteristics of water - physical-chemical- biological treatment- standards - need of treatment- treatment methods for surface and ground water – natural treatment principles.

Module 2: WATER TREATMENT: Principle and design – sedimentation – aeration – types of aerators – coagulation – filtration – rapid sand filtration – disinfection methods – softening – lime soda process- carbonation – ion exchange – reverse osmosis – dialysis – removal of colour – de-fluoridation

Module 3: WASTEWATER TREATMENT: Principle and design - screens, grit chamber- skimming tank- primary sedimentation tank- secondary treatment- activated sludge process- trickling filter- oxidation ponds- RBC- towers- tertiary treatment.

Module 4: INDUSTRIAL WASTEWATER TREATMENT: Differences between domestic and industrial wastewater- characteristics- equalization- proportionating- neutralization-removal of oils and fats- removal of organic solids- precipitation- removal of nitrogen and phosphorous compounds.

Module 5: SLUDGE TREATMENT DISPOSAL: Characteristics of sludge- sludge treatment methods- reduction of moisture content- anaerobic and anaerobic treatment methods – disposal methods- sludge as fertilizer.

Module 6: ADVANCED TREATMENT: Advanced technologies available –depth filtration – surface filtration – membrane filtration absorption – gas stripping – advanced oxidation process.

References:

1. “Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.

2. Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Simla, 2003.
3. Metcalf and Eddy, "Wastewater engineering, Treatment and Reuse", Tata McGraw-Hill, New Delhi, 2003.
4. Kuruvilla Mathew, Stewart Dallas, Goen Ho, "Decentralized Water and Wastewater Systems", IWA Publications, 2008.
5. Parimal Pal, "Industrial Water Treatment Process Technology", Butterworth-Heinemann, 2009

18CE3040	HYDROLOGY LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To impart practical knowledge in hydrologic processes
2. To equip with the understanding of the practical implications of aquifer parameters
3. To enable them to conduct field experiments

Course Outcome

Student will be able to

1. Gain better understanding of hydrologic processes
2. Estimate the aquifer parameters
3. Analyze the subsurface characteristics

List of Experiments:

1. Measurement of Rainfall data using natural siphon recording type raingauge
2. Mass curve and hyetograph from obtained data
3. Determination of Φ - index by double ring type infiltrometer
4. Measurement of permeability
5. Determination of rate of evaporation
6. Conduction of Pumping test on well
7. Average rainfall by Thiessen polygon method
8. Determination of crop water requirement
9. Determination of soil particle size distribution for textural analysis
10. Determination of hydraulic conductivity
11. Determination of field density by sand replacement method
12. Conduction of Electrical resistivity test

References:

1. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Wiley and Sons Inc., 2007.
4. Bear, J., "Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 2008
6. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York.

18CE3041	ADVANCED ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To demonstrate the sampling techniques and analytical methods in assessing air and water quality in the laboratory
2. To introduce the principles of instrumentation in air and water quality analysis
3. To enable the Student to conduct characterization studies on solid waste

Course Outcome

Student will be able to

1. Collect the samples for analysis
2. Monitor and assess air and water quality of samples
3. Design suitable treatment method and control measures for water and air pollution problems

List of Experiments:

1. Color and Heavy metals in the sample using UV Spectrophotometer
2. Total Organic Carbon (TOC)
3. Dissolved Oxygen and Biological Oxygen Demand (BOD)
4. Chemical Oxygen Demand (COD)
5. Phosphorous and Nitrates present in wastewater
6. Microbiological analysis(MPN)
7. Sedimentation column analysis
8. Rotating biological contactor (RBC)
9. Synthesis of Nanoparticles
10. Solid Waste Analysis (Density, Components and Energy value)
11. Noise Measurement by using sound level meter
12. Air Quality by air sampler.

References:

1. “Standard Methods for the Examination of Water and Wastewater”, 14th ed, American Public Health Association, Washington, DC, 1999.
2. http://cpcb.nic.in/upload/NewItems/NewItem_171_guidemanual and www.analysis.pdf.

18CE3042	GIS LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To demonstrate the application of different components of GIS and computational techniques in environmental and water resources systems
2. To impart soft computing skills
3. To enable to apply tools for decision making

Course Outcome

Student will be able to

1. Understand the utilization of satellite images
2. Apply GIS for temporal and spatial data acquisition and analysis
3. Develop tools for decision making based on the criteria

List of Experiments:

1. Digitization and geo-referencing
2. Creation and Editing of Shape files
3. Layout map preparation
4. Preparation of Composite and Mosaic Images
5. Image classification
6. Land use/land cover map preparation
7. Groundwater potential map preparation
8. Watershed delineation
9. Morphometric analysis
10. Water quality mapping
11. Air quality mapping
12. Network analysis for solid waste management

References:

1. Ian Heywood Sarah, Cornelius and Steve Carver, “An Introduction to Geographical Information Systems”, Pearson Education, New Delhi, 2002.

18CE3043	COMPUTATIONAL TECHNIQUES LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To demonstrate the application of different computational techniques in environmental and water resources systems
2. To impart soft computing skills
3. To enable to apply statistical tools

Course Outcomes

Student will be able to

1. Understand and analyze numerical solutions for linear and nonlinear systems
2. Develop soft computing techniques for prediction and forecasting
3. Apply multivariate statistical methods

List of Experiments:

1. Rainfall data analysis
2. Testing and validation of simple monthly rainfall-runoff model
3. Estimation of evapo-transpiration using Penman-Monteith Method
4. DO fluctuation model in streams and rivers
5. Groundwater Quality Assessment using GIS
6. Curve fitting
7. Correlation and regression analysis
8. Factor Analysis
9. Prediction using Artificial Neural Network
10. Water budgeting
11. Air quality modeling
12. Monitoring of Climate change

References:

1. Rastogi, A.K., “Numerical Groundwater Hydrology”, Penram International Publishing (India), 2006
2. John, E. G., “Introduction to Hydraulics and Hydrology with Applications for Stormwater Management”, DELMAR, Thomson Learning, USA, 2002.

18CE3044	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on solid and hazardous wastes.
2. To enable to choose appropriate method for solid and hazardous waste handling.
3. To provide knowledge about suitable techniques for disposal of solid and hazardous waste.

Course Outcomes

Student will be able to

1. Classify waste in different categories
2. Understand the characteristics of different types of solid and hazardous wastes
3. Identify suitable methods of storage, collection and transport
4. Suggest suitable technical solutions for processing and treatment
5. Propose suitable waste disposal method
6. Explore techniques for hazardous wastes handling

Module 1: CLASSIFICATION AND REGULATORY FRAMEWORK: Sources of solid and hazardous waste – classification of solid and hazardous waste - need for waste management - salient features of Indian legislations on management and handling of solid wastes

Module 2: WASTE CHARACTERIZATION: Waste generation rates – factors affecting generation-composition, physical, chemical and biological properties of solid wastes –waste sampling and characterization plan - source reduction of wastes –waste exchange - extended producer responsibility

Module 3: HANDLING AND TRANSPORT OF WASTES: Handling and segregation of wastes at source – storage and collection of municipal solid wastes – analysis of collection systems - need for transfer and transport – transfer stations optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes

Module 4: WASTE PROCESSING TECHNOLOGIES: Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of composting - thermal conversion technologies and energy recovery – incineration - treatment of biomedical wastes

Module 5: WASTE DISPOSAL: Waste disposal options – disposal in landfills: landfill classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactor - leachate and landfill gas management

Module 6: HAZARDOUS WASTES: Identification – classification - regulations in India - generations-on-site storage – collection - transfer and transport - processing – disposal planning.

References:

1. Rao M. N, “Solid and Hazardous Waste Management”, BS Publications, 2014
2. Kanti L. Shah, “Basics of Solid and Hazardous Waste Management Technology”, Prentice Hall, 2000
3. John Pichtel, “Waste Management Practices: Municipal, Hazardous, and Industrial, Second Edition”, CRC Press. 2014
4. George Tchobanoglous and Frank Kreith, “Hand book of solid waste management”, McGraw-Hill, 2nd edition, 2002
5. Tchobanoglous, Theissen and Vigil, “Integrated solid waste management”, McGraw Hill Publication, 2002

18CE3045	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To enable Student to acquire necessary skills to assess the impact of environmental and water resources projects
2. To help Student in taking necessary steps to bring down the adverse environmental impacts during inception of new projects
3. To make the Student prepare environmental audit reports for EIA projects.

Course Outcomes

Student will be able to

1. Identify environmental attributes to be considered for the EIA study
2. Prepare environmental base map based on impact evaluation and analysis
3. Specify methods for prediction of the impacts
4. Conduct environmental audit
5. Evaluate the audit data and prepare the report
6. Formulate environmental management plan

Module 1: INTRODUCTION TO EIA: Basic concept of EIA: initial environmental examination - elements of EIA - factors affecting EIA - impact evaluation and analysis – preparation - classification of environmental parameters.

Module 2: DESCRIPTION OF THE BASELINE ENVIRONMENT: Purposes for defining the environmental setting - selection of parameters - monitoring of physical environmental parameters - collection and interpretation of baseline data for various environmental attributes

Module 3: METHODS OF EIA: EIA methodologies: introduction, criteria for selection of EIA methodology- EIA methods: Ad-hoc methods, matrix methods, network method, environmental media quality index method, overlay methods - cost/benefit analysis.

Module 4: ENVIRONMENTAL IMPACTS: Hydrologic and water quality impacts – ecological and biological impacts – social and cultural impacts – soil and landscape changes – agro economic issues – human health impacts – ecosystem changes.

Module 5: ENVIRONMENTAL AUDITING: Environmental audit and environmental legislation - objectives of environmental audit- types of environmental audit - audit protocol - stages of environmental audit - onsite activities - evaluation of audit data - preparation of audit report.

Module 6: CASE STUDIES: Case studies - preparation of environmental impact assessment statement for environmental and water resources development projects.

References:

1. John, G., Riki, T., Andrew, C., “Introduction to Environmental Impact Assessment”, Routledge Taylorand Francis Group, III Edition, 2005.
2. Prabhakar, V.K., “Environmental Impact Assessment”, Anmol Publications, 2001.
3. Marriott, Betty B., “Environmental Impact Assessment: a Practical Guide”, McGraw-Hill, 1997.
4. Richard, K.M., “Environmental Impact Assessment - a Methodological Perspective”, Kluwer Academic publishers, 2002
5. Anji Reddy Mareddy, Anil Shah, Naresh, “Environmental Impact Assessment: Theory and Practice”, Butterworth-Heinemann, 2017

18CE3046	CLEANER PRODUCTION AND SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the importance and different approaches of cleaner production in industries
2. To impart knowledge on the process of pollution prevention and reduction along with operating costs reduction.
3. To give exposure to methodology of cleaner production projects, methods of their implementing into industrial establishment.

Course Outcomes

Student will be able to

1. Apply different approaches in clean production
2. Understand and choose the different principles of sustainable development
3. Implement green building concepts and conduct material balance studies
4. Comment on the evolution of corporate environmental management strategies
5. Describe cleaner production measures
6. Conduct energy and waste audit

Module 1: SUSTAINABLE DEVELOPMENT: Indicators of sustainability – industrialization and sustainable development – cleaner production in achieving sustainability - regulations to encourage pollution prevention and cleaner production – regulatory versus market based approaches.

Module 2: POLLUTION PREVENTION: Historical evolution – importance of pollution prevention – role of industry, government and institutions - environmental management hierarchy – source reduction techniques.

Module 3: PRINCIPLES OF CLEANER PRODUCTION: Benefits, promotion and barriers – environmental management hierarchy – relation of CP and EMS – integrated prevention and pollution limitation – best available technology concept (BAT).

Module 4: CLEANER PRODUCTION PROJECT DEVELOPMENT: Assessment steps and skills - information gathering and process flow diagram - material balance - CP option generation technical and environmental feasibility analysis - economic valuation of alternatives - total cost analysis - CP financing-organizing a program - preparing a program plan - measuring progress - pollution prevention and cleaner production awareness plan - waste audit.

Module 5: SUPPORT INSTRUMENTS OF PREVENTION METHODS: Life cycle analysis – eco labelling – International environmental standards – ISO 14001 – Green building and green energy concepts and management.

Module 6: CASE STUDIES: Industrial applications of CP, LCA, EMS and Environmental audits - green energy and green process management.

References:

1. Paul L. Bishop, “Pollution prevention: Fundamentals and Practice”, McGraw Hill International, 2000.
2. Prasad modak C. Visvanathan and Mandarparasnis, “Cleaner Production Audit”, Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.
3. World Bank Group, “Pollution Prevention and Abatement Handbook- Towards Cleaner Production”, World Bank and UNEP, Washington D.C, 2005.
4. Rajiv Kumar Sinha, Sunil Herat, “Cleaner Production: Greening of Industries for Sustainable Development”, Pointer Publishers, 2005
5. Kalam Azad, Subhash Sharma, “Clean Energy for Sustainable Development: Comparisons and Contrasts of New Approaches”, Academic Press, 2012

18CE3047	ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To equip with the skills needed for interpreting laws, policies and judicial decisions.
2. To analyze the legislative and judicial responses to environmental problems.
3. To expose to the administrative system of environment related laws.

Course Outcomes

Student will be able to

1. Recall different policies and rules framed for the environmental protection.
2. Recognize the formation of boards at different levels
3. Discuss the functions of Central and State Pollution Control Board
4. Know about different duties of pollution control boards
5. Assess about the actions taken by government for the violation of rules
6. Enumerate about the prevention of advanced pollution

Module 1: INTRODUCTION: An introduction to the legal system - concept of laws and policies - origin of environmental law - introduction to environmental laws and policies in India - Constitutional provisions - Stockholm conference

Module 2: PRINCIPLES IN ENVIRONMENTAL LAW: Environment and governance - overview of legislations and basic concepts - Precautionary principle - Polluter pays principle - sustainable development; public trust doctrine

Module 3: REMEDIES FOR ENVIRONMENTAL POLLUTION : Common law remedies - remedies under law of tort – penal remedies – Indian penal code and code of criminal procedure – remedies under constitutional law – writs – public interest litigation - Public liability insurance act, 1991 – the National Green Tribunal act 2010

Module 4: ENVIRONMENT PROTECTION LAWS AND LARGE PROJECTS: Legal framework on environment protection - environment protection act as the framework legislation – strength and weaknesses – EIA - National Green tribunal.

Module 5: – AIR, WATER AND MARINE LAWS: National Water Policy and some state policies laws relating to prevention of pollution - access and management of water and institutional mechanism - water act, 1974 - Water cess act, 1977 – EPA 1986 - Pollution Control Boards - Ground water and law judicial remedies - procedures - Marine laws of India - coastal zone regulations - legal framework on air pollution - Air act, 1981

Module 6: INTERNATIONAL ENVIRONMENTAL LAW: An introduction to International law - International Humanitarian law and environment - sources of International law - law of treaties – signature – ratification - evolution of International environmental law - customary principles - common and differentiated responsibility - Kyoto protocol

References:

1. Divan S. and Rosencranz A, “Environmental Law and Policy in India”, 2nd edition, Oxford, New Delhi, 2005.
2. Leelakrishnan P, “Environmental Law in India”, 3rd edition, Lexis Nexis, India, 2008.
3. Kaushik C P, AnubhaKaushik, “Perspectives in Environmental Studies”, 4th edition, New Age International Publishers Ltd.-New Delhi, 2006
4. Layzer, J. “The Environmental Case: Translating Values into Policy”, 3rd edition, CQ Press, 2012.
5. Vig, N. J. and Kraft, M. E. “Environmental Policy: New Directions for the Twenty-First Century”, 8th edition, CQ Press, 2013.

18CE3048	NANOTECHNOLOGY IN ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce nanotechnology and nano-science
2. To demonstrate the various techniques for synthesis of nano-materials
3. To know about the novel developments of nanotechnology in environmental applications.

Course Outcomes:

Student will be able to

1. Understand the principles of nanotechnology
2. Synthesis different types of nano-particles for various applications
3. Conduct characterization studies of nanomaterial
4. Develop nano-sensors
5. Analyze the impact of nanomaterial on environment
6. Design efficient and effective treatment method

Module 1: INTRODUCTION AND SYNTHESIS OF NANOMATERIALS: History – overview of existing application of nano-materials in water and wastewater treatment - synthesis of nano-materials - magnetic nano-particles - carbonaceous nano-particles - nano-composites - clay supported nano-particles – aerogels - methods of synthesis - sol-gel method - micro-emulsion method - electro-spinning method - plasma technique - chemical vapour deposition (CVD)

Module 2: METHODS FOR STRUCTURAL AND CHEMICAL CHARACTERIZATION OF NANOMATERIALS: Separation techniques - morphology studies - scanning electron microscopy (SEM) - surface charge and optical properties of nano-particles: zeta potential - UV-V's spectrometry - elemental

composition of single nano-particles using EDAX - elemental composition of bulk nano-particles-X-ray diffraction - FTIR

Module 3: MEMBRANE PROCESSES: Overview of membrane technology - membrane filtration types - microfiltration - ultra filtration - nano-filtration - reverse osmosis – transport principles - membrane fabrication and characterization - Nano-particle membrane reactor

Module 4: NANOMATERIALS AS ADSORBENTS AND OXIDANTS: Metals oxides (Titanium oxides, Iron oxides, Copper, Zinc) – Carbon nano-adsorbents: CNTs (single and multi-walled), Fullerenes-molecularly imprinted polymers for removal of micro pollutants - advanced oxidation process - photocatalytic oxidation - Fenton process

Module 5: FATE AND TOXICITY OF NANOPARTICLES AND NANOMATERIALS: Processes determining the fate of NMs /NPs in environment: aggregation, reaction, adsorption, deposition - ecotoxicity of NMs/NPs - effect on human health and environment- introduction to nano-sensors

Module 6: CHARACTERIZATION OF NANO PARTICLES: Exposure on nano particle preparation and interpretation of results

References:

1. Lens P., Virkutyte J., Jegatheesan V., and Al-Abed S., “Nanotechnology for Water and Wastewater Treatment”, IWA Publishing, 2013
2. Eugene T, Michele De Kwaadsteniest, “Nanotechnology in Water Treatment Applications”, Caister Academic Press, 2010 4.
3. Edi-Bharat Bhushan, “Handbook of Nanotechnology”, Springer, 2004.
4. Fulekar M. H., Bhawana Pathak, “Environmental Nanotechnology”, CRC Press, 2017
5. Chaudhery Mustansar Hussain, Ajay Kumar Mishra, “Nanotechnology in Environmental Science”, John Wiley and Sons, 2018

18CE3049	ELECTROCHEMICAL WATER PROCESSING AND WATER TREATMENT	L 3	T 0	P 0	C 3

Course Objectives:

1. To introduce the basic concepts of electrochemistry
2. To help the Student understand the electrochemical methods in wastewater treatment
3. To familiarize the Student with design concepts

Course Outcomes

Student will be able to

1. Understand the basic concepts of electrochemistry
2. Analyze the characteristics of the effluent and sludge produced
3. Design electrochemical reactor
4. Understand the mechanism of electro dialysis for desalination
5. Apply electrochemical methods for heavy metal removal
6. Develop new electrodes for electro coagulation and capacitive deionization

Module 1: BASIC ASPECTS OF ELECTROCHEMISTRY: Chemistry and electricity - electro neutrality and potential differences at interfaces - electrochemical cells - transport of charge within the cell- conductivity of electrolyte solutions - cell description conventions - electrodes and electrode reactions- standard half-cell potentials and reference electrode - Faraday’s laws of electrolysis.

Module 2: ELECTROCHEMICAL REACTORS DESIGN: Costing an electrolytic process- figures of merit - materials yield-current efficiency - percentage conversion - product quality - energy consumption- space time yield - electrolysis parameters - principles of cell design - typical cell designs - tank cells and flow cells - monopolar and bipolar cells.

Module 3: BIOCIDES TECHNOLOGY: Bio-ciding technology - electrolytic production of free halogens- chlorination process description - bromination process description

Module 4: ELECTROCHEMICAL METAL RECOVERY: Metal ion removal and metal recovery - treatment of liquors containing dissolved chromium - electrolytic method of phase separation - flue gas desulphurization – electro-dialysis - electrochemical process for the removal of iron in acid baths.

Module 5: ELECTRODIALYSIS (ED): Electro-dialysis - performance characteristics – purpose of electro-dialysis unit - ED units for specialized application - De-mineralizer - advantages of electro-dialysis - general characteristics - desalination system.

Module 6: ELECTROCOAGULATION: Electrocoagulation in water treatment - principle of electrocoagulation - reactions at the electrodes and solutions - electrode passivation and activation - comparison between electrocoagulation and chemical coagulation - typical designs of the EC Reactors - factors affecting Electrocoagulation.

References:

1. Ralph Zito, “Electrochemical Water Processing”, Wiley 2011.
2. Derek Pletcher, “Industrial Electrochemistry”, Chapan and Hall Ltd 1982.
3. Allen J Bard, Larry R Faulkner, “Electrochemical methods – Fundamentals and applications”, John Wiley & Sons, Inc, 2001
4. Comninellis C. and G. Chen, “Electrochemistry for the environment” Springer 2010.
5. Vivek V. Ranade, Vinay M Bhandar, “Industrial Wastewater Treatment, Recycling and Reuse”, Butterworth-Heinemann, 2014

18CE3050	NOISE POLLUTION AND CONTROL TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the fundamental concepts in the field of noise pollution and control.
2. To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.
3. To impart knowledge on measurement and analysis of noise.

Course Outcomes

Student will be able to

1. Identify the nature and characteristics of noise pollution
2. Analyze the noise pollution problems
3. Detect the various effects of noise pollution
4. Apply suitable preventive measures and identify the technologies and methods to control of noise
5. Choose suitable noise adsorbent materials
6. Gain knowledge about the various noise pollution regulations

Module 1: SOURCES OF NOISE POLLUTION: Sources of noise pollution, indices, environmental and industrial noise - types - units and measurements of noise – standards.

Module 2: CHARACTERIZATION OF NOISE POLLUTION: Characterization of noise from construction, mining, transportation and industrial activities – airport noise- control measures - noise pollution analyzers.

Module 3: EFFECTS OF NOISE POLLUTION: Introduction - auditory effects - non-auditory effects - noise menace - psycho - acoustics and noise criteria - annoyance rating schemes.

Module 4: PREVENTION and CONTROL OF NOISE POLLUTION: Fundamental definitions – prevention and control of noise pollution – outdoor and indoor noise propagation - control of noise - annoyance rating schemes - sound absorbent materials –auditorium designing – anti noise device.

Module 5: ACOUSTICS OF NOISE: Industrial noise control – special noise environments - noise indices - Osha noise standards – public education – other non-legislative measures.

Module 6: REGULATORY ASPECTS OF NOISE POLLUTION: Legislation and administrative function – The Rajasthan noise control act 1963 - Railway act 1890 (Related to noise only) - The Aircraft

act 1934 (Related to noise only) - Factories act 1948 (Related to noise only) - The Environmental protection act 1986 – Noise pollution remedies.

References:

1. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David and Charles PLC, 2009.
2. Singal S. P, “Noise Pollution and Control Strategy”, Alpha Science International, 2005
3. Malcolm J. Crocker, “Noise and Noise Control”, Volume 2, CRC Press, 2018
4. Malcolm J. Crocker, “Handbook of Noise and Vibration Control”, John Wiley and Sons, 2007
5. Peters R J, “Acoustics and Noise Control”, Routledge, 2011

18CE3051	OCCUPATIONAL HEALTH AND SAFETY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about the occupational hazards, industrial safety issues, control measures and emergency procedures.
2. To assist the student in implementing the safe healthy practices in workplace.
3. To enable to review methods and controls in order to evaluate occupational safety and health.

Course Outcomes

Student will be able to

1. Identify hazards in workplace
2. Analyze the industrial toxicology
3. Understand the significance of health and safety in the workplace
4. Propose methods to eliminate the hazard
5. Understand the emergency procedures and safety law
6. Implement safe work practices

Module 1: INDUSTRIAL CONTAMINANTS AND HEALTH HAZARDS: Theory of accidents - industrial atmospheric contaminants – industrial health hazards – asbestos hazards – hazard reorganization - evaluation and control

Module 2: INDUSTRIAL TOXICOLOGY AND INDUSTRIAL HYGIENE SURVEY: Hazards in workplace modes of entry of toxic substances into the human body - industrial toxicology – cleaning chemical spills - threshold limit values - industrial hygiene survey – diagnosis – remedial measures – Occupational Health and Safety Management System (OHSMS) - BSOSHAS18001

Module 3: INDUSTRIAL VENTILATION: Industrial ventilation - general principles of air flow - general dilution ventilation - comfort ventilation - local exhaust ventilation - principles of hood and duct design - duct system design - fans.

Module 4: CONTROL MEASURES: Air cleaning devices - relative efficiencies - testing of local exhaust ventilation systems - industrial noise control - general engineering principles of control standards – rationale for health and safety training – ergonomics – emergency preparedness.

Module 5: INDUSTRIAL ILLUMINATION AND INDUSTRIAL PLANT SANITATION: Industrial illumination - glare – types and levels of illumination - industrial plant sanitation - housekeeping - worker facilities

Module 6: CASE STUDIES: Case studies on occupational health and safety

References:

1. Sharon Clarke, “Occupational Health and Safety”, CRC Press, 2016
2. Danuta Koradecka, “Handbook of Occupational Safety and Health”, CRC Press, 2010
3. Friend, Mark A., Kohn, John P, “Fundamentals of Occupational Safety and Health”, 6th edition, Bernan Press, 2010

4. Pradeep Chaturvedi, "Occupational Safety, Health and Environment And Sustainable Economic Development", Concept Publishing Company, 2007
5. Charles D. Reese, "Occupational Health and Safety Management: A Practical Approach", 3rd Edition, CRC Press. 2015

18CE3052	GROUNDWATER HYDROLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the behavior of groundwater movement
2. To estimate the groundwater modeling parameters
3. To equip the student with analytical techniques to solve groundwater problems

Course Outcomes

Student will be able to

1. Understand the occurrence, distribution and movement of groundwater
2. Enumerate the properties of groundwater
3. Determine the aquifer parameters
4. Resolve groundwater related problems including response of aquifers to pumping wells
5. Develop a basic model for contaminant transport in subsurface media
6. Model and estimate groundwater recharge

Module 1: INTRODUCTION TO GROUNDWATER: Groundwater in hydrologic cycle – occurrence of groundwater – vadose zone water - soil-water relationship - hydrogeology – hydrometeorology – soil sample analysis - water bearing materials - types of aquifers

Module 2: GROUNDWATER HYDRAULICS: Groundwater movement - Darcy's law and its limitations - stream lines and flow net analysis – discharge and draw down for various condition of groundwater flow - principles of groundwater flow and its equation – dupuit – Forchheimer assumptions – influent and effluent streams - evaluation of well loss parameters – partial penetration of wells – interference of wells – collector wells and infiltration galleries.

Module 3: PUMPING TEST ANALYSIS: Determining aquifer parameters for unconfined - leaky and non-leaky aquifers – steady and transient conditions - slug test – locating hydro geological boundaries – determination of well characteristics and specific capacity of wells – well characteristics of large diameter wells.

Module 4: GROUNDWATER TRANSPORT PROCESSES: Mass balance for transport of an ideal tracer – contaminant transport mechanisms: advection, dispersion and diffusion – 1D, 2D and 3D solute transport – pulse and step inputs – solutions to advection, dispersion equation.

Module 5: GROUNDWATER RECHARGE: Methods of artificial groundwater recharge – groundwater assessment and balancing – seawater intrusion in coastal aquifers – land subsidence - wells in hard rock areas - Geophysical survey – infiltration test – permeability test – drum culture experiment –

Module 6: GROUNDWATER MODELLING: Groundwater data analysis – Groundwater models – MODFLOW, MODPATH and MT3D - regional groundwater modeling.

References:

1. Todd D.K., "Groundwater Hydrology", John Wiley and Sons, Inc, New York, 2011.
2. Raghunath H.M. "Groundwater", 3rd Edition, Wiley Eastern Limited, New Delhi, 2007.
3. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
4. Driscoll, "Groundwater and Wells", Johnson Filtration Systems, Inc., 1986.
5. Ojha, C.S.P, Berndtsson, R and Bhunya, P., "Engineering Hydrology", Oxford University Press, New Delhi, 2008.

18CE3053	DESIGN OF HYDRAULIC AND CONVEYANCE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge about various types of hydraulic structures
2. To introduce the planning and design concepts of hydraulic structures.
3. To inculcate the importance of basic water supply and drainage systems in society

Course Outcomes

Student will be able to

1. Understand the design criteria for various types of dams
2. Analyze and design various hydraulic structures
3. Design a water supply distribution network
4. Design irrigation channels and cross drainage works
5. Estimate the hydropower potential
6. Design penstocks and surge tanks

Module 1: INTRODUCTION TO HYDRAULIC STRUCTURES: Introduction - types of hydraulic structures: storage, diversion, conveyance and distribution structures, reservoirs - capacity of a reservoir - reservoir silting

Module 2:DAMS: Types of dams - factors governing selection of type of dam - selection of site for dam -preliminary and final investigations of dam sites -dam safety - design and construction of gravity and earth dams - flow-nets.

Module 3: DAM OUTLET WORKS: Principles and classification, design of ogee and open channel spillways - cavitations in spillway -energy dissipation devices, basins, buckets and gates- canals: types, components, selection.

Module 4: DESIGN OF IRRIGATION CHANNELS: Theory and design principles - design of canal sections in alluvial soil and hard rock zones - canal inlets and sluices - gates maintenance problems - design examples of regulators and canal falls - canal head works- canal masonry works- canal outlets- maintenance of canals - cross drainage works - flow measuring devices.

Module 5: WATER DISTRIBUTION NETWORKS: Flow through pipes - solving pipe network - flow problems - use of computer software for network analysis - cross country pipelines - hydraulic transient analysis.

Module 6: HYDROPOWER STRUCTURES: Hydropower structures types - components of a hydropower structure: intakes and trash racks, water conductor systems, penstocks, power canals, tunnels, surge tanks, anchor blanks.

References:

1. Punmia and Pandey, "Irrigation and Water Power Engg." Laxmi Publications (P) Ltd., New Delhi, 2016.
2. Dandekar M.M and Sharma K.N., "Water Power Engineering", 2nd edition Vikas publishers, 2013.
3. Asawa G.L. "Irrigation and Water Resources engineering" -New Age International (P) Ltd. Publishers, 1st edition, 2005.
4. Garg S.K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers N.D. 13th edition, 2009.
5. Modi, "Irrigation, Water Resources and water power engineering", P.N. -Standard Book House, New Delhi, 2nd edition, 2008.

18CE3054	PRINCIPLES OF INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the concepts of IWRM and highlight the inter-disciplinary nature
2. To expose to sustainable water resources management, water security and public-private partnership issues
3. To brief about integrated multi-sectoral and multi-dimensional issues in developing water resource management plans

Course Outcomes

Student will be able to

1. Understand the concepts of IWRM principles
2. Plan integrated water resources development projects considering sustainability aspects
3. Involve in water management projects from a multi-objective and multi-purpose perspective
4. Develop various water conservation techniques
5. Understand Private Public Partnership (PPP)
6. Analyze the environmental and health issues due to different water issues

Module 1: CONCEPTS, PRINCIPLES AND TERMINOLOGIES: IWRM: definition and principles- social, economic, environmental and institutional factors in water management - water needs for human beings and nature - concepts of 'blue', 'green' and 'grey' water - ecosystem approach- Global climate change - its effect on water resources.

Module 2: SUSTAINABLE WATER RESOURCES MANAGEMENT: Concept of sustainable development - Dublin conference and earth summit- National water policy - highlights and limitations

Module 3: RIVER BASIN MANAGEMENT: River basin approach – small watershed management- environmental flows- minimum water table.

Module 4: WATER RELATED ENVIRONMENTAL AND HEALTH PROBLEMS: Floods – droughts - soil erosion - reservoir sedimentation - salinity intrusion into surface and groundwater sources- water logging in command areas - sand mining - Impact of population and anthropogenic activities on water resources

Module 5: TRADITIONAL AND MODERN TECHNIQUES FOR WATER SECURITY: Role of water in development - Rainwater harvesting – Artificial recharge – Conjunctive use of surface and groundwater-Inter basin transfer-Conservation of 'green' water – Treatment of 'grey' water- Basics of desalination and water treatment and recycling

Module 6: PPP AND PRIVATE MARKETS: Introduction to water economics- Water pricing - Private sector involvement in water resources management: PPP objectives, options, process and limitations-PPP case studies

References:

1. Negi S.S., "Integrated Watershed Management", Oriental Enterprises, 2001
2. Roberto Lenton, Mike Muller, "Integrated Water Resources Management in Practice: Better Water Management for development" Routledge, 2012
3. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York, 2003.
4. Cap-Net, "Tutorial on Basic Principles of Integrated Water Resources Management", Cap-Net, IRC, IWMI, HR Wallingford, IUCN, WSS, UNDP (www.cap.net.org).
5. Integrated Water Resources Management Plans, Training Manual and Operational Guide, CIDA, 2005.

18CE3055	HYDRO POWER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide knowledge about the working principles of different power plants
2. To enable to design power canals, silting basin, types of dams
3. To give exposure about transmission system, financial implications etc.,

Course Outcomes

Student will be able to

1. Estimate the hydropower potential
2. Analyze the financial implications and maintenance of hydropower systems
3. Design various components of hydropower system
4. Understand the construction details of a hydropower plant
5. Analyze the implication of hydropower plant in water demand and evaluation
6. Design silting basin

Module 1: INTRODUCTION: Development of water power - estimation of hydropower potential - comparison of hydro, thermal and nuclear power - firm power - secondary power - load and load duration curves - load factor etc.

Module 2: HYDROPOWER PLANTS: Classification of hydropower plants - run-of-river plants - valley dam plants - high head diversion plants - diversion canal plants - pumped storage plants - tidal power plants.

Module 3: WATER CONVEYANCE SYSTEM: Power canals – alignment - design of power canals – flumes - covered conduits and tunnels - drainage and ventilation in tunnels.

Module 4: PENSTOCKS: Alignment - types of penstocks - anchor blocks - spillways: types; spillway gates - design of stilling basins - types of turbines - their utility

Module 5: POWER HOUSE: Fore bay - intakes - balancing reservoir – escape - surge shafts/ inclined shafts - underground power stations - general transmission system:

Module 6: POWERPLANT CONSTRUCTION: General introduction - basic principles of design and construction - financial implications of hydropower plants - maintenance of hydro power plant.

References:

1. Birdie, “Irrigation Engineering (including Water Power Engineering)”, Dhanpat Rai Publishing Company, New Delhi, 2012.
2. Modi P.N, “Irrigation Water Resources and Water Power Engineering”, Standard Book House-Rajsons Publication Private Limited, New Delhi, 2012.
3. Santosh Kumar Garg, “Irrigation Engineering and Hydraulic Structures” 28th Revised Edition, Khanna Publishers, Delhi, 2014.
4. Manual on “Planning and design of small hydroelectric scheme”, publication no. 280, Central Board of Irrigation and Power, 2001.
5. “Guidelines for Hydraulic Design of Small Hydro Plants”, Alternate Hydro Energy Research Centre, 2011.

18CE3056	RIVER MECHANICS AND SEDIMENT TRANSPORT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the concepts of flow through rivers and the theoretical and empirical formulation of energy and momentum principles
2. To demonstrate the sediment transport in terms of first principles
3. To enable the Student understand the causes of river channel change and river training

Course Outcomes

Student will be able to

1. Identify the various types of flow and their profile

2. Analyze the transport of sediments
3. Estimate the sediment load
4. Develop strategies for sediment routing
5. Analyze the impact of erosion, deposition and sedimentation on flow
6. Design a sedimentation basin

Module 1: BASIC CONCEPTS AND EQUATIONS: Basic mathematical concepts - fluid continuum, fluid element – kinematics and dynamics – continuity equations - equations based on conservation of momentum and energy - potential energy and kinetic energy

Module 2: VARIED FLOWS: Free surface flow - uniform flow - gradually varied flow - flow profiles – Prismatic channels energy and momentum principles - flow measurements: weirs, flumes - basic equations of various flows - velocity of flood wave discharge - flood routing

Module 3: ORIGIN AND PROPERTIES OF SEDIMENTS: Incipient movement of sediments - shields analysis - bed formation and flow regimes - sampling and measurement techniques of sediment load

Module 4: SEDIMENT ENTRAINMENT: Geo-morphological concepts: load-discharge relations, sediment yield and denudation rate – forces on sediment particles

Module 5: SEDIMENT TRANSPORT: Forms of sediment transport - estimation of bed load transport - shield's diagram - Hjulstrom curves –sediment transport and bed forms - settling, deposition, consolidation, attrition, erosion, Rouse profile

Module 6: RESERVOIR SEDIMENTATION: Aggradations and degradation - design of stable channels, river training methods, bank protection - Groynes or spurs, deflectors, cut off - Sedimentation basin

References:

1. Garde, R.J. and Ranga Raju, K.G. “Mechanics of Sediment Transport and Alluvial Stream Problems”, NewAge International (P) Ltd. Publications, New Delhi, 2006.
2. Subramanya. K, “Open channel flow”, Tata McGraw Hill, 3rd Edition, 2010.
3. Yang, C.T. “Sediment transport theory and Practice”, McGraw-Hill, New York, 1996.
4. Garde, R.J. “History of Fluvial Hydraulics”, New Age International (P) Ltd. Publishers, New Delhi, 1995.
5. Garde, R.J. “River Morphology”, New Age International (P) Ltd. Publishers, New Delhi, 2006.

18CE3057	FOREST, URBAN AND AGRICULTURAL WATERSHED MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on underlying hydrologic processes associated with the flow of water through forested watersheds
2. To give exposure about nutrient budget and agricultural management practices
3. To familiarize with water conservation techniques in a watershed

Course Outcomes

Student will be able to

1. Understand the hydrologic principles in forest, urban and agricultural management
2. Apply the techniques for soil erosion control, flood management and storm management
3. Develop an integrated watershed management plan
4. Determine nutrient budget for a watershed
5. Develop storm water management strategy for a watershed
6. Apply water conservation techniques in green buildings

Module 1: INTRODUCTION TO WATERSHED: Watershed development - definition and concepts, objectives and need - integrated and multidisciplinary approach for watershed management- characteristics

of watershed: size, shape, physiographic, slope, climate, drainage, land use, vegetation, geology and soils - Watershed delineation.

Module 2: FOREST WATERSHED MANAGEMENT: Influence of forests on hydrologic processes - causes of deterioration of watershed – forests and water yield/low flows - forests and peak flows – deforestation and accelerated erosion – forests and snow.

Module 3: AGRICULTURAL WATERSHED MANAGEMENT: Global agricultural trends – agricultural impacts on soil and water: non-point source pollution, erosion and sediment, drainage, storage and irrigation - nutrient budget

Module 4: WATERSHED DEVELOPMENT: Soil and water conservation – watershed development projects – indicators – monitoring and evaluation.

Module 5: URBAN WATERSHED MANAGEMENT: Impacts of urbanization on hydrology - urban site design – land use planning and conservation – stormwater management - flooding and floodplain management – urban water supply – water and green buildings.

Module 6: CASE STUDIES: Case study on forest hydrology of Western Ghats – case study on cultivated watersheds – case study on urban watershed

References:

1. Murthy, J.V.S., “Watershed Management”, New Age International Publishers, 1998.
2. Martin, M.K., Daniel T.R., and Kent, S.M., “Urban Watersheds: Geology, Contamination, and Sustainable Development”, CRC press, Taylor and Francis Group, 2011.
3. Ghanshyam D., “Hydrology and Soil Conservation Engineering”, Prentice-Hall of India Pvt. Ltd., New Delhi. 2000.
4. Das Madan Mohan and Saikia Mimi Das, “Watershed Management”, PHI publishers, 2012.
5. Kenneth N. Brooks, Peter F. Folliott, Joseph A. Magner, “Hydrology and the Management of Watershed”, John Wiley and Sons, 2012.

18CE3058	WETLAND HYDROLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on hydrology of wetland ecosystems
2. To introduce about the management and conservation of wetlands
3. To impart the concepts of wise use of wetlands

Course Outcomes

Student will be able to

1. Understand different aspects of wetland management
2. Conduct water balance studies in wetland
3. Apply the hydrological principles in wetland management
4. Estimate the exchange processes in coastal wetlands
5. Model sediment dynamics in wetland conservation
6. Develop suitable wetland management strategy in catchment and coastal hydrology

Module 1: INTRODUCTION TO WETLAND: Classification of wetlands - wetlands types according to Ramsar Bureau - hydrologic features of aquatic ecosystems - terrestrial ecosystems - wetland ecosystem

Module 2: HYDROLOGY OF WETLANDS: Hydro period - signature of a wetland - water balance of wetland - residence time - turnover time - conceptual model showing relationship between hydrologic, chemical and biological processes - chemical cycles in wetlands

Module 3: WATER MANAGEMENT AND CONSERVATION VALUES OF WETLANDS: recharging - flood containing - water purification – agriculture - aquatic tourism - drinking water - inland navigation – fisheries - biodiversity

Module 4: WISE USE OF WETLANDS: Integrated river basin management in relation to wise use of wetlands - sustainability concept in relation to wetland management

Module 5: ESTIMATION OF EXCHANGE PROCESSES: Exchange processes in estuaries - modified tidal prism method - coefficient of eddy diffusivity - flushing time - sediment dynamics

Module 6: CASE STUDIES: Impact of man-made structures on downstream wetlands - success stories in wetland conservation - Chilika and Loktak.

References:

1. William J. Mitsch, James G. Gosselink, "Wetlands", John Wiley and Sons. Copyright. Inc, 2007.
2. Michael J. Vepraskas, Christopher B, "Wetland Soils: Genesis, Hydrology, Landscapes, and Classification", CRC Press, 2016
3. Mitsch W.J, M. Strakraba, S.E. Jorgensen, "Wetland Modelling", Elsevier Science Publishers B.V, 1988.
4. Deanne Hickey, "The Role of Wetland Hydrology on Vegetative Structure in a Coastal Wetland Environment", University of Sydney, 2009.
5. Jos T.A. Verhoeven, Boudewijn Beltman, Roland Bobbink, Dennis F. Whigham., "Wetlands and Natural Resource Management", Springer-Verlag Berlin Heidelberg, 2006.

18CE3059	IMPACT OF CLIMATE CHANGE ON WATER RESOURCES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the hydrologic cycle with reference to climate
2. To assess the impact on ecosystem services
3. To diagnose the cause of climate related water issues

Course Outcomes

Student will be able to

1. Enumerate the characteristics of climate change
2. Assess the impact of climate change
3. Utilize the tools for vulnerability assessment
4. Incorporate the adaptation techniques
5. Plan the mitigation activities
6. Implement the mitigation activities as per the policies

Module 1: INTRODUCTION TO CLIMATE : Definitions - climate, climate system, climate change – drivers of climate change – characteristics of climate system components – large-scale climate - greenhouse effect – carbon cycle – wind systems - trade winds and the Hadley cell – ozone hole in the stratosphere - el nino, la nina, enso-regional differences

Module 2: IMPACTS OF CLIMATE CHANGE: Global climatology – Indian scenario –observed changes and projected changes of IPCC – monsoon onsets, withdrawals and breaks –cyclones in India – Indian rainfall in different seasons – inter annual variability of monsoon -impacts on sectoral vulnerabilities – SRES – different scenarios

Module 3: TOOLS FOR VULNERABILITY ASSESSMENT: Need for vulnerability assessment – steps for assessment –approaches for assessment – models – quantitative models, economic model, impact matrix approach - box models - zero-dimensional models -radioactive-convective models - higher-dimension models - EMICs (Earth-system models of intermediate complexity) - GCMs (global climate models or general circulation models) – sectoral models

Module 4: CLIMATE CHANGE ADAPTATION AND MITIGATION: Water-related adaptation to climate change in the fields of ecosystems and biodiversity - agriculture and food security, land use and forestry, human health, water supply and sanitation, infrastructure and economy (insurance, tourism, industry and transportation) - adaptation, vulnerability and sustainable development sector

Module 5: CLIMATE CHANGE MITIGATION: Specific mitigation - carbon dioxide capture and storage (CCS) -land-use change and management, cropland management, afforestation and reforestation - potential water resource conflicts between adaptation and mitigation - implications for policy and sustainable development.

Module 6: CASE STUDIES: Water resources assessment case studies – Ganga Damodar Project, Himalayan glacier studies - Ganga valley project - adaptation strategies in assessment of water resources- hydrological design practices and dam safety- operation policies for water resources projects - flood management strategies - drought management strategies - temporal and spatial assessment of water for irrigation -land use and cropping pattern - coastal zone management strategies.

References:

1. Sangam Shreshta, Mukund S. Babel and Vishnu Prasad Pandey., “Climate Change and Water Resources”, CRC Press, 2014.
2. Anil Markandya , “Climate Change and Sustainable Development: Prospects for Developing Countries”, Routledge, 2002
3. UNFCCC Technologies for Adaptation to climate change, 2006.
4. Shukla P R, Subobh K Sarma, NH Ravindranath, Amit Garg and Sumana Bhattacharya, “Climate Change and India: Vulnerability assessment and adaptation”, University Press(India) Pvt Ltd, Hyderabad, 2003.
5. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007
6. Preliminary consolidated Report on “Effect of climate change on Water Resources”, GOI, CWC, MOWR, 2008.
7. IPCC Report Technical Paper VI – “Climate change and water”, 2008.

18CE3060	URBAN WATER HYDROLOGY AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To familiarize the concepts of urbanization and its impact on the natural water cycle
2. To impart knowledge on the utilization of urban storm water models for better storm water management
3. To enable to prepare urban storm water master plan

Course Outcomes

Student will be able to

1. Identify factors affecting urban hydrological cycle
2. Estimate urban water demand and storm water quantity
3. Maintain the elements of drainage systems
4. Determine the runoff and peak flow
5. Plan and design storm water control and disposal systems
6. Develop integrated urban water management system

Module 1: URBAN HYDROLOGIC CYCLE: General introduction to urbanization and its effect on water cycle – urban hydrological cycle – trends in urbanization – effect of urbanization on hydrology- urban hydrological cycle

Module 2: STORMWATER ANALYSIS: Determination of runoff and peak –time of concentration – importance of short duration of rainfall and runoff data – methods of estimation of time of concentration for design of urban drainage systems - design of storm water network systems – water distribution networks.

Module 3: URBAN WATER MANAGEMENT MODELS: Types of models – physically based– conceptual or unit hydrograph based – urban surface runoff models – various model available for storm water management - management models for flow rate and volume control rate – quality models

Module 4: URBAN STORMWATER MANAGEMENT: Stormwater management practices (structural and non-structural management measures) – detention and retention concepts – modeling concept – types of storage – magnitude of storage – hydraulic analysis and design guidelines – flow and storage capacity of urban components – system tanks.

Module 5: MASTER DRAINAGE PLANS: Master drainage plans – issues to be concentrated upon – typical content of an urban drainage master plan – interrelation between water resources investigation and urban planning processes – planning objectives – comprehensive planning – use of models in planning.

Module 6: OPERATION AND MAINTENANCE: Elements of drainage systems – open channel– underground drains – appurtenances – pumping – source control - operation and maintenance of urban drainage system – interaction between stormwater management and solid waste management

References:

1. Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), “Manual on Drainage in urbanized areas”, Vol.1 and Vol.II, UNESCO, 1987.
2. Hengeveld, H. and C. De Vocht (Ed)., “Role of Water in Urban Ecology”, Elsevier, Amsterdam, 1982.
3. Martin, P. Wanelista and Yousef, A. Yousef., “Stormwater Management”, John Wiley and sons, 1993.
4. Stahre, P., and Urbonas, B., “Storm water Detention for Drainage, water quality and CSO Management”, Prentice Hall, New Jersey, 1990
5. Wanielista, M.P., and Yousef, Y.A., “Stormwater Management”, John Wiley and Sons, Inc., New York, 1993

18CE3061	REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

Course Objectives:

1. To familiarize the principles of Remote Sensing and GIS
2. To demonstrate temporal and spatial data acquisition and analysis
3. To impart knowledge in digital image processing

Course Outcomes

Student will be able to

1. Understand the principles and components of Remote Sensing and GIS
2. Analyze and interpret satellite images using digital image processing
3. Create thematic maps for various applications
4. Implement overlay analysis for various environmental and water resources application
5. Create spatial and temporal variation maps
6. Apply GIS and RS tool in environmental and water resources projects

Module 1: REMOTE SENSING : Basic concepts of remote sensing - electromagnetic radiation (EMR) - interaction of EMR with atmosphere, earth surface, soil, water and vegetation - Remote sensing platforms – monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS – scanners, radiometers - data types and format.

Module 2: DIGITAL IMAGE PROCESSING: Satellite data analysis - image interpretation - multi-spectral, multi temporal and multi-sensoral – digital image processing – image preprocessing – image enhancement – image classification – data merging

Module 3: GEOGRAPHIC INFORMATION SYSTEM: Definition – components of GIS – map projections and co-ordinate systems – data structures - raster, vector – spatial relationship – topology – integrated GIS database - sources of error

Module 4: SPATIAL ANALYSIS: Thematic mapping – measurement in GIS: length, perimeter and areas – query analysis – reclassification – buffering - neighbourhood functions - map overlay: vector and raster overlay – spatial interpolation

Module 5: ENVIRONMENTAL AND WATER RESOURCES APPLICATIONS: Spatial data sources – GIS approach for water resources system – thematic maps - rainfall-runoff modeling – groundwater potential mapping – water quality modeling - flood inundation mapping and modeling

Module 6: SOFTWARE APPLICATION: Introduction to software in GIS and Remote sensing data analysis and modeling

References:

1. Lillesand T.M. and Kiefer, R. W., “Remote Sensing and Image interpretation”, 6th edition of John Wiley and Sons, 2000.
2. John R. Jensen, “Introductory Digital Image Processing: A Remote Sensing Perspective”, 2nd Edition, 1995.
3. John A. Richards, “Remote Sensing Digital Image Analysis”, Springer –Verlag, 1999.
4. Ian Heywood Sarah, Cornelius and Steve Carver, “An Introduction to Geographical Information Systems”, Pearson Education, New Delhi, 2002.
5. Victor Mesev, “Integration of GIS and Remote Sensing”, John Wiley and Sons, 2008

18CE3062	SUBSURFACE INVESTIGATIONS AND FIELD TESTING	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge in excavations and boring techniques
2. To study in-situ soil testing methods
3. To gain knowledge on geophysical methods

Course Outcomes

Student will be able to

1. Recall the different methods of soil investigation.
2. Evaluate the properties of soil at different depths.
3. Identify the samplers to collect the disturbed and undisturbed soil
4. Conduct field test for bearing capacity.
5. Design suitable field instrumentation.
6. Prepare subsoil investigation reports.

Module 1: GENERAL: Scopes and objectives of explorations – planning a subsurface exploration – stages in sub surface exploration – explorations for preliminary and detailed design – spacing and depth of exploration

Module 2: OPEN EXCAVATION AND BORINGS OF EXPLORATION: Pits and trenches – drifts and shafts – methods of boring – auger borings – wash borings –rotary drilling –percussion drilling – core drilling.

Module 3: SOIL SAMPLES AND SAMPLING METHODS: Types of soil samples – disturbed samples –undisturbed samples – design features affecting the sample disturbance – preservation and handling of samples.

Module 4: SOIL SAMPLERS: Split spoon samplers – scraper bucket samplers –shell by tubes and thin walled samplers – piston samplers – Denis samplers.

Module 5: IN-SITU TESTING: Field tests – standard penetration tests – cone penetration tests – in-situ vane shear test–plate load test – monotonic and cyclic –field permeability tests – in-situ tests using pressure meter – observation of ground water table - instrumentation in soil engineering, strain gauges, resistance and inductance type

Module6: GEOPHYSICAL METHODS: Geophysical methods – types - seismic methods – electrical resistivity methods – electrical profiling method – electrical sounding method – seismic refraction method – sub-soil investigation report.

References:

1. Murthy V.N.S., SaiKripa, “Soil Mechanics and Foundation Engineering Vol 2”, CBS Publishers & Distributors, 1997.
2. Clayton C.R., Matthews M.C., Simons N.E., “Site Investigation”, Thomas Telford Ltd, 1995.
3. Brahma S.P., “Foundation Engineering”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1985.
4. Shamsheer Prakash, Gopal Ranjan and Swami Saran, Meerut, “Analysis and Design of Foundations and Retaining Structures”, Sarita Prakasham, 1979.
5. IS:1892-1979, IS:4453-1980, IS:4464-1967, IS:2132-1986.

18CE3063	ADVANCED FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge in selection of foundations.
2. To design the foundation based on bearing capacity and settlement.
3. To study different types of shallow foundation.

Course Outcomes

Student will be able to

1. Identify the requirements of good foundation.
2. Select suitable foundation based on bearing capacity.
3. Explain the soil structure interaction.
4. Evaluate the foundation settlement.
5. Design shallow and special foundations
6. Suggest suitable measures for expansive and difficult soils.

Module 1: PLANNING OF SOIL EXPLORATION: Planning of soil exploration for different projects - methods of subsurface exploration- methods of borings along with various penetration tests.

Module 2: SHALLOW FOUNDATIONS: Requirements for satisfactory performance of foundations - methods of estimating bearing capacity - settlements of footings and rafts - proportioning of foundations using field test data - IS codes.

Module 3: PILE FOUNDATIONS: Methods of estimating load transfer of piles- settlements of pile foundations - pile group capacity and settlement - negative skin friction of piles - laterally loaded piles- pile load tests - analytical estimation of load- settlement behavior of piles - proportioning of pile foundations - lateral and uplift capacity of piles.

Module 4: WELL FOUNDATION: IS and IRC codal provisions - elastic theory and ultimate resistance methods.

Module 5: FOUNDATIONS ON PROBLEMATIC SOILS: Foundations for collapsible and expansive soil

Module 6: COFFER DAMS: Various types- analysis and design Foundations under uplifting loads.

References:

1. Day, R.W., “Geotechnical and Foundation Engineering, Design and Construction”, McGraw Hill, 2010.
2. Swami Saran, “Soil Dynamics and Machine Foundation”, Galgottia Publications Pvt. Ltd., New Delhi, 2010.
3. Varghese, P.C., “Limit State Design of Reinforced concrete”, Prentice-Hall of India 2009.

4. Bowles, J.E. "Foundation Analysis and Design", McGraw Hill, New York, 2001.
5. Winterkorn, H.F and Fang, Y.F., "Foundation Engineering Handbook", Van Nostrand Reinhold, 1994.

18CE3064	STRENGTH AND DEFORMATION CHARACTERISTICS OF SOILS	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge on stress-strain characteristics of soils.
2. To study the behaviour in the form of stress path.
3. To gain knowledge on the concepts of yield and failure criteria.

Course Outcomes

Student will be able to

1. Determine the compressibility of soil.
2. Distinguish stress strain behavior between cohesionless and cohesive soil.
3. Illustrate stress path for different conditions.
4. Examine the failure criteria of soils.
5. Design Rheological models and stress paths.
6. Justify Elasto plastic and visco- elastic laws.

Module 1: COMPRESSIBILITY OF SOIL: Consolidation theories - one, two and three dimensional consolidation theories – consolidation in layered soil – consolidation for time dependent loading – determination of coefficient of consolidation.

Module 2: SHEAR STRENGTH OF COHESIONLESS SOILS: Shear strength of granular soils – direct shear – triaxial testing – drained and undrained – stress-strain behaviour – dilatation – contraction and critical states – liquefaction and liquefaction potential - factors influencing – stress-strain – volume change behaviour of soils.

Module 3: SHEAR STRENGTH OF COHESIVE SOILS: Shear strength of clays – stress-strain behaviour – vane shear – UCC – triaxial testing and stress path plotting – pore pressure parameter of Skempton and Henkel – total stress and effective stress approach – shear strength of partially saturated clay in terms of stress state variables – drained and undrained – factors influencing stress-strain and shear strength.

Module 4: YIELD CRITERION: Concepts of yield and failure in soils – yield criteria of Von Mises, Tresca, Kvikpatriak, Drucker and Prager - their extended form – their applicability to soils – Mohr–Coulomb failure criterion.

Module 5: STRESS PATH AND STRESS – STRAIN LAWS: Stress path for different cases – stress path tests – stress-strain laws for soils – hyperbolic law – linear visco-elastic and elasto – plastic laws – yield functions, hardening law, flow rules and plastic strain computation – Elastic module – cyclic loading – limitation of linearity elastic model – hyperbolic stress-strain model.

Module 6: CRITICAL STATE SOIL MECHANICS AND RHEOLOGICAL MODELS: Introduction to critical state soil mechanics –boundary surface – Roscoe and Hvorslev's – rheological models of Kelvin, Maxwell and Burger as applied to soils.

References:

1. Braja, M. Das., "Advanced soil mechanics", McGraw Hill, 2010.
2. Atkinson, J.H and Brandsby, P.L., "Introduction to critical state soil mechanics", Cambridge University Press, New York, 1990.
3. Hotlz, R.D. and Kovais, W.D., "Introduction of Geotechnical Engineering", Prentice – Hall, 1981.
4. Lambe, T.W. and Whitman R.V., "Soil Mechanics in S.I. Units" John Wiley, 1979.
5. IS :2720 (Part 15-1986 ,Part 40-1977,Part 41- 1977), IS:2720(Part 10-1973,Part 11- 1971,Part 12-1981,Part 13-1986)

18CE3065	THEORETICAL SOIL MECHANICS WITH FINITE ELEMENT APPLICATIONS	L 3	T 0	P 0	C 3

Course Objectives

1. To impart knowledge on basic equations of theory of elasticity for linear material.
2. To impart understanding on finite element analysis procedure by solving a simple problem.
3. To give exposure to finite element discretization and analysis of seepage and consolidations problems and stress analysis of soil structure interaction problems.

Course Outcomes

Student will be able to

1. List the basic equations of elasticity.
2. Distinguish between the applications of different types of finite elements.
3. Explain the finite element procedure.
4. Apply the variational and weighted residual principles to formulate element stiffness matrix.
5. Justify linear stress analysis of soil structure interaction problems.
6. Develop the finite element discrimination for seepage, consolidation soil structure interaction problems.

Module 1: BASIC EQUATIONS OF ELASTICITY: Concept of continuum - state of stress at a point – differential equations of equilibrium – stress transformation – principal stresses; state of strain at a point – strain deformation relations – St. Venant compatibility conditions – strain transformation – principal strains; Generalized Hook’s law’ - principle of superposition - geotechnical considerations – total stress analysis pore pressure calculation – effective stress.

Module 2: TWO DIMENSIONAL PROBLEMS IN RECTANGULAR AND POLAR COORDINATES: Plane stress and plane strain problems – basic equations – Airy’s stress functions – axisymmetric problems - Boussinesq problem and its applications

Module 3: FINITE ELEMENT THEORY FOR LINEAR MATERIAL: Concept of finite element – concept of shape functions - Finite element procedure – principles of discretization - element stiffness formulation - direct, variational and weighted residual techniques and displacements approach; convergence criteria for displacement model - numerical integrations

Module 4: FINITE ELEMENT STRESS ANALYSIS: Displacement formulation for stress analysis: axial element and beam element for one dimensional problems – Triangular and rectangular elements isoparametric quadrilateral for analysis of plane stress and plane strain problems - hexahedral and tetrahedral elements for 3 dimensional stress analysis – axis-symmetric stress analysis – plate and shell elements

Module 5: FINITE ELEMENT ANALYSIS OF SEEPAGE AND CONSOLIDATION PROBLEMS: Settlement analysis - 2-D elastic solutions for homogeneous - isotropic medium - steady seepage analysis: finite element solutions of Laplace’s equation - consolidation analysis - Terzaghi consolidation problem - choice of soil properties for finite element analysis

Module 6: FINITE ELEMENT ANALYSIS OF SOIL STRUCTURE INTERACTION PROBLEMS: Analysis of foundations – stress in soil - shallow foundations – dam foundation – pile foundation - underground structures and earth retaining structures – application to geotechnical designs – requirement of software for analysis of stress in foundation and for stability analysis

References:

1. Andrew Lees., “Geotechnical Finite Element analysis – A Practical Guide”, Thomas Telford Ltd., 2016.
2. Desai C.S., and Musharaf Zamen., “Advanced Geotechnical Engineering”, CRC Press, 2014.
3. Potts D.M., and Zdravcovic L., “Finite Element Analysis in Geo-technical engineering”, Thomas Telford, 2001.
4. Rajasekaran S., “Finite Element Analysis in Engineering Design”, Wheeler publishing 1993.

5. Desai C.S., “Elementary Finite Element Method”, Prentice Hall, Inc, 1979.

18CE3066	DYNAMICS OF SOILS AND FOUNDATIONS	L	T	P	C
		3	0	0	3

Course Objectives

1. To gain knowledge on different types of machine foundation.
2. To understand the dynamic properties of soils.
3. To impart knowledge on exposure on vibration isolation techniques.

Course Outcomes

Student will be able to

1. Describe the theories of vibration to solve dynamic soil problems.
2. Evaluate the dynamic properties of soil using laboratory and field tests.
3. Analyse the different types of machine foundation.
4. Design of machine foundation.
5. Compare vibration of foundation studies.
6. Implement vibration isolation techniques

Module 1: FUNDAMENTALS OF VIBRATIONS: Single, two and multiple degree of freedom systems - vibration isolation - vibration absorbers - vibration measuring instruments

Module 2: WAVE PROPAGATION: Elastic continuum medium - semi-infinite elastic continuum medium - soil behaviour under dynamic loading.

Module 3: LIQUEFACTION OF SOILS: Liquefaction mechanism - factors affecting liquefaction, studies by dynamic tri-axial testing - oscillatory shear box, shake table and blast tests - assessment of liquefaction potential.

Module 4: DYNAMIC ELASTIC CONSTANTS OF SOIL: Determination of dynamic elastic constants - various methods including block resonance tests - cyclic plate load tests - wave propagation tests - oscillatory shear box test.

Module 5: MACHINE FOUNDATIONS: Design criteria for machine foundations - Elastic homogeneous half space and lumped parameter solutions - analysis and design of foundations: reciprocating and impact type machines, turbines - effect of machine foundation on adjoining structures.

Module 6: BEARING CAPACITY OF FOUNDATIONS: Bearing capacity of dynamically loaded foundations: water towers, chimneys and high rise buildings - response of pile foundations.

References:

1. Steven Kramer., “Geotechnical Earthquake Engineering”, Pearson, 2008.
2. Kameswara Rao, N.S.V., “Vibration analysis and foundation dynamics”, Wheeler Publication Ltd., 1998.
3. Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier, 1983.
4. Prakash, S., “Soil Dynamics”, McGraw Hill, 1981.
5. IS 5249:1977: Method of test for determination of dynamic properties of soil.

18CE3067	SOIL MECHANICS LABORATORY - I	L	T	P	C
		0	0	4	2

Course Objectives

1. To attain adequate knowledge in assessing index properties.
2. To gain knowledge on Compaction and Compressibility of soils.
3. To enrich knowledge in field practices.

Course Outcomes

Student will be able to

1. Understand the origin of the soil and geological cycle.

2. Perform laboratory experiments to estimate various Atterberg's limits and evaluate index properties of soils.
3. Determine the permeability and compaction of soils through various laboratory and field tests.

List of Experiments:

1. Determination of Moisture Content and Specific gravity of soil
2. Grain size distribution using Sieve Analysis
3. Grain size distribution using Hydrometer Analysis
4. Atterberg's Limits (Liquid Limit, Plastic limit, Shrinkage limit)
5. Visual Classification Tests
6. Free swell Test
7. Vibration test for relative density of sand
8. Standard proctor's compaction test
9. Modified proctor's compaction test
10. Falling head permeability test and Constant head permeability test
11. Consolidation test
12. Chemical analysis of soil (Chlorides and Sulphates)

References:

1. Alam Singh and Chowdary, G.R., "Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation", CBS Publishers and Distributors, New Delhi, 2006.
2. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Cooperative Society, Chennai, 1996.
3. Head, K.H., "Manual of Soil Laboratory Testing", Vol.I and II, Pentech Press, London 1990.
4. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
5. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

18CE3068	SOIL MECHANICS LABORATORY - II	L	T	P	C
		0	0	4	2

Course Objectives

1. To provide with basic understanding of physical and mechanical properties of soil.
2. To identify factors controlling soil behavior and methods to determine soil properties
3. To interpret the results and write technical reports.

Course Outcomes

Student will be able to

1. Identify and classify soils with reference to their characteristics.
2. Determine graphically and analytically the stress state in any plane of the soil mass.
3. Perform various shear strength tests and appreciate the different field conditions which they simulate.

List of Experiments:

1. California Bearing ratio test
2. Swell Pressure Test
3. Unconfined compression test
4. Direct shear test
5. Tri-axial compression test – UU, CU, CD tests
6. Laboratory vane shear test

References:

1. Alam Singh and Chowdary, G.R., "Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation", CBS Publishers and Distributors, New Delhi, 2006.
2. Head, K.H., "Manual of Soil Laboratory Testing Vol.I, II and Vol.III", Pentech Press, London, 1998.

3. Kameswara Rao, N.S.V., “Dynamics Soil Tests and Applications”, Wheeler Publishing, New Delhi, 2000.
4. Das, B.M., “Soil Mechanics Laboratory Manual, Engineering”, Press, Austin, 1997
5. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

18CE3069	SUBSOIL EXPLORATION LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To gain knowledge in various field investigation
2. To attain adequate knowledge in geophysical methods
3. To adopt appropriate test based on the available conditions.

Course Outcomes

Student will be able to

1. Understand various site investigation techniques and their in-situ applications.
2. Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent within the ground.
3. Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT, etc.

List of Experiments:

1. Exploratory borings by different methods including auger boring, wash boring, percussion drilling and rotary drilling.
2. Standard penetration test
3. Dynamic cone penetration test
4. Static cone penetration test
5. Plate load test
6. Pressure meter test
7. Geophysical exploration tests

References:

1. Murthy V.N.S, SaiKripa., “Soil Mechanics and Foundation Engineering Vol 2”, CBS Publishers & Distributors, 1997.
2. CR Clayton, MC Matthews, NE Simons., “Site Investigation”, Thomas Telford Ltd, 1995.
3. S.P. Brahma., “Foundation Engineering”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1985.
4. Shamsheer Prakash, Gopal Ranjan and Swami Saran, Meerut, “Analysis and Design of Foundations and Retaining Structures” Sarita Prakasham, 1979.
5. IS : 1892-1979 , IS : 1888-1982 , IS:2131 -1981, IS:4434-1978.

18CE3070	GEOTECHNICAL DESIGN STUDIO	L	T	P	C
		0	0	4	2

Course Objectives

1. To introduce the application of FEM in Software Packages.
2. To analyze and design various structural elements using software packages.
3. To impart knowledge on computer application in civil engineering.

Course Outcomes

Student will be able to

1. Recall the appropriate loading as per the standards.
2. Estimate the design stresses.
3. Evaluate foundation settlement.

List of Experiments:

1. Stability Analysis

2. Excavation Design
3. Walls and Gabions
4. Shallow foundations
5. Deep foundations
6. Settlement analysis
7. Tunnels and shafts

References:

1. ANSYS 17.1 - Analysis Reference Manual, 2016.
2. STAAD Pro 2007 V8i Analysis Reference Manual, 2015.
3. Plaxis 2d Reference Manual, 2018.
4. <https://www.finesoftware.eu/geotechnical-software>

18CE3071	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge to identify weak soils.
2. To suggest suitable improvement methods.
3. To be familiar with equipment used for improvements.

Course Outcomes

Student will be able to

1. Define the parameters of weak soil.
2. Describe field compaction methods
3. Apply drainage techniques in soil improvements
4. Analyze the reinforcement techniques in soil.
5. Design load carrying capacity of stone columns.
6. Adopt suitable ground improvement techniques.

Module1: INTRODUCTION: Introduction to dewatering – scope and necessity of ground improvement – new technologies – basic concepts – drainage methods – ground water lowering by well points – deep well, vacuum and electro – osmosis methods.

Module2: COMPACTION AND SAND DRAINS: In-situ compaction of cohesionless and cohesive soils – Shallow and deep compaction – Vibration methods – vibro-compaction, blasting, vibrating probe, vibratory rollers, vibro-displacement compaction, vibroflotation – concept - factors influencing compaction – heavy tamping – vertical drains – preloading with sand drains, fabric drains, wick drains – design of sand drains – relative merits of different methods – limitations.

Module3: STONE COLUMN AND CONSOLIDATION: Precompression and consolidation – dynamic consolidation – electro-osmotic consolidation – stone column – functions – methods of installation – design estimation of load carrying capacity of stone column – settlement of stone column – lime piles – earth reinforcement – soil nailing – types of reinforcement material – applications.

Module4: STABILIZATION: Introduction – stabilization methods – mechanical, cement, lime, bitumen, chemical stabilization – electrical stabilization – stabilization by thermal and freezing techniques – ground improvement by excavating and replacing – stabilization of expansive clays – prewetting – special methods – introduction to geopolymer, nano and bio stabilization.

Module5: GROUTING: Functions – characteristics of grouts – types of grout – suspension and solution grouts – basic requirements of grout – displacement – compaction grouting, displacement – soil fracture grouting, jet – displacement grouting, permeation grouting – grouting equipment – injection methods – grout monitoring.

Module6: APPLICATIONS: Applications of compaction - sand drains - applications of stone column - consolidation - applications of grouting - applications of soil reinforcement.

References:

1. Shroff, A.V., “Grouting Technology in Tunneling and Dam”, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.
2. Purushothama Raj, P., “Ground Improvement Techniques”, Laxmi Publications (P) Ltd., New Delhi, 2005.
3. Koerner, R.M., “Designing with Geosynthetics” (fourth edition), Prentice Hall, New Jersey, 1999.
4. Moseley M.D., “Ground Treatment”, Blackie Academic and Professional, 1998.
5. IS:4558:1983,IS:4721-1968,IS:5050-1968,IS:4999-1968.

18CE3072	PAVEMENT ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

1. To gain knowledge on stress assessment.
2. To design Flexible and rigid pavements.
3. To impart knowledge on different rehabilitation techniques.

Course Outcomes

Student will be able to

1. Identify the properties of various road materials.
2. Indicate the factors affecting the pavements.
3. Examine the distress in pavements for stability.
4. Design the pavements as per Indian standards
5. Suggest stabilization techniques for soft soils.
6. Compare causes remedial measures for rehabilitation.

Module1: BASIC CONCEPTS: Pavement- types – historical developments – approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – stresses and deflections in layered systems.

Module 2: FLEXIBLE PAVEMENT: Factors affecting flexible pavements – material characterization for analytical pavement design – CBR and stabilometer tests – resilient modulus – fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines

Module3: RIGID PAVEMENT: Factors affecting rigid pavements – design procedures for rigid pavement – IRC guidelines – airfield pavements - Highway pavement – CRC pavements

Module 4: PAVEMENT EVALUATION AND REHABILITATION: Pavement evaluation and rehabilitation, condition and evaluation surveys – causes and types of distress in flexible and rigid pavements – PSI models – serviceability index of rural roads – pavements maintenance management and construction.

Module 5: STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS: Need for a stabilized soil – design criteria and choice of stabilizers – testing and field control – stabilization for rural roads – use of geofabrics in road construction – case studies.

Module 6: MATERIAL CHARACTERISATION AND DRAINAGE: Material characterization – failure criteria - reliability - comparison of different pavement design approaches – design overlays - drainage system.

References:

1. Wright, P.H., “Highway Engineers”, Johwiley and Sons, Inc. New York, 2009.
2. Kadiyali, L.R., “Transport planning and Traffic Engineering”, Khanna Publishers, 2008.
3. Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
4. Yoder, R.J and Witchak, M.W., “Principles of Pavment Design”, John wiley, 2000.
5. IRC: 37 – 2001, IRC: 58 – 1998, The Indian Roads Congress, New Delhi

18CE3073	ENVIRONMENTAL GEOTECHNOLOGY	L 3	T 0	P 0	C 3

Course Objectives

1. To acquire knowledge on the geotechnical engineering problems associated with soil contamination.
2. To study various methods of safe disposal of waste, stabilization of waste and transportation of contaminant.
3. To suggest site remediation techniques.

Course Outcomes

Student will be able to

1. Identify the causes of soil pollution and suggest suitable methods of remediation for the contaminated sites.
2. Classify the various techniques of waste disposal.
3. Illustrate the contaminant transport and the transformation processes.
4. Evaluate the bearing capacity of compacted fills.
5. Explain the case studies on utilization of solid waste and soil improvement.
6. Implement suitable methods of remediation for contaminated sites.

Module 1: SOIL AS A MULTIPHASE SYSTEM: Soil- environment interaction – properties of water in relation to porous media – water cycle with special reference to soil medium.

Module 2: SOIL – POLLUTANT INTERACTION: Introduction to Geo-environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil – pollutant interaction – failures of foundations due to pollutants – case studies.

Module 3: SITE SELECTION AND SAFE DISPOSAL OF WASTE: Safe disposal of waste – site selection for landfills – characterization of landfill sites– risk assessment – stability of landfills – current practice of waste disposal – monitoring facilities – passive containment system – application of geosynthetics in solid waste management – rigid and flexible liners.

Module 4: TRANSPORT OF CONTAMINANTS: Contaminant transport in subsurface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in landfill design – groundwater pollution – bearing capacity of compacted fills – foundation for waste fill ground – pollution of aquifers by mixing of liquid waste – protection of aquifers.

Module 5: WASTE STABILIZATION AND DISPOSAL: Hazardous waste control and storage system – stabilization/solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation – detoxification – mechanism of stabilization – organic and inorganic stabilization – utilization of solid waste for soil improvement – case studies.

Module 6: REMEDIATION OF CONTAMINATED SOILS: Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – ex-situ and in-situ remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, vitrification, bio-venting – ground water remediation – pump and treat, air sparging, reactive well – case studies.

References:

1. Lagrega, M.D., Buckingham, P.L., and Evans, J.C., “Hazardous Waste Management”, McGraw Hill, Inc. Singapore, 1994.
2. Daniel, B.E., “Geotechnical Practice for waste disposal”, Chapman and Hall, London, 1993.
3. Proceedings of the International symposium of “Environmental Geotechnology” (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. Ott, W.R., “Environmental Indices - Theory and Practice”, Ann. Arbor, 1978.
5. Fried, J.J., “Ground Water Pollution”, Elsevier, 1975.

18CE3074	MECHANICS OF UNSATURATED SOILS	L 3	T 0	P 0	C 3

Course Objectives

1. To impart knowledge on the study of the soil water system.
2. To interpret the results of direct shear and triaxial test.
3. To learn development of hydraulic conductivity models.

Course Outcomes

Student will be able to

1. Identify the physical properties of air and water.
2. Explain the interdisciplinary nature of unsaturated soil.
3. Estimate the effective stress state variable and shear strength parameters.
4. Prepare suction and moisture profile.
5. Develop hydraulic conductivity models.
6. Interpret soil water characteristic curves.

Module 1: STATE OF UNSATURATED SOIL: Definition – interdisciplinary nature of unsaturated soil – soil classification – nature and practice – stress profiles, stress state variables - material variables – constitutive law – suction potential of soil water

Module 2: SOIL SUCTION: Soil suction - nature of water in clays, repulsive potential, repulsive pressure, capillary action, matric suction, osmotic suction, soil water characteristic curve (SWCC)

Module 3: PHYSICS OF SOIL WATER SYSTEM: Physical properties of air and water – partial pressure and relative humidity density of moist air – surface tension – cavitation of water - solubility of air in water – air – water solid interface – vapour pressure lowering – soil water characteristic-curve - capillary tube model – contacting sphere model - Young laplace equation – height of capillary rise – rate of capillary rise – capillary pore size distribution – theoretical basis – determination – laboratory method

Module 4: STRESS STATE VARIABLES AND SHEAR STRENGTH: Effective-stress – stress between two spherical particles – hysteresis in SWCC – stress parameter, stress tensor – stress control by axis translation - analytical representation of stress –volume change characteristics - extended Mohr Coulomb’s criterion – shear strength parameters–interpretation of direct shear test results and tri axial test results – unified representation of failure envelope – influence of suction in earth pressure distribution.

Module 5: STEADY AND TRANSIENT FLOWS: Driving mechanism – permeability and hydraulic conductivity – capillary barriers – steady infiltration and evaporation – vapor flow – air diffusion in water - principles for pore liquid flow – rate of infiltration, transient suction and moisture profiles - principles for pore gas flow barometric pumping analysis.

Module 6: MATERIAL VARIABLE MEASUREMENT AND MODELLING: Measurement of total suction – psychrometers – filter paper measurement of matric suction – high air entry disks – direct measurements – tensiometers – air-translation technique – indirect measurements – thermal conductivity sensors – measurement of osmotic suction – squeezing technique – soil water characteristic curves and hydraulic conductivity models.

References:

1. Ng Charles, W.W., Menzies Bruce, “Advanced unsaturated Soil Mechanism and Engineering”, Taylor and Francis Group, 2007.
2. Ning Lu and William, J. Likes, “Unsaturated Soil Mechanics”, John Wiley and sons, INC. New Jersey, 2004
3. Fredlund, D.G. and Rahardjo, H. “Soil Mechanics for unsaturated soils”, John Wiley and Sons, INC, New York.2003.
4. Geoffrey E Blight., “Unsaturated Soil Mechanics in Geotechnical Practice”, 1985.
5. Ning Lu, Laureano R. Hoyes and Lakshmi Reddi, “Advances in unsaturated soil, seepage and Environmental Geotechnics”, ASCE, Geotechnical special publication No.148.

18CE3075	ROCK MECHANICS IN ENGINEERING PRACTICE	L 3	T 0	P 0	C 3

Course Objectives

1. To understand the properties of rock and pattern of failure.
2. To inculcate the evaluation of stresses.
3. To enable to interpret the stability considerations of rock masses.

Course Outcomes

Student will be able to

1. Recall the formation and classification of rocks in India.
2. Explain the strength parameters of rocks.
3. Evaluate the in-situ stresses developed and methods of measurement.
4. Analyze slope stability.
5. Summarize the design aspects in rocks.
6. Select the appropriate reinforcement of rocks.

Module 1: CLASSIFICATION OF ROCKS: Rocks of peninsular India and the Himalayas – index properties and classification of rock masses, competent and incompetent rock – value of RMR and ratings in field estimations.

Module 2: STRENGTH CRITERIA OF ROCKS: Behaviour of rock under hydrostatic compression and deviatoric loading – Modes of rock failure – planes of weakness and joint characteristics – Joint testing, Mohr – Coulomb failure criterion and tension cut-off, Hoek and Brown strength criteria for rocks with discontinuity sets.

Module 3: DESIGN ASPECTS IN ROCKS: Insitu stresses and their measurements, flat jack - over and under coring methods – stress around underground excavations – design aspects of openings in rocks – case studies.

Module 4: SLOPE STABILITY OF ROCKS: Rock slopes – role of discontinuities in slope failure, slope analysis and factor of safety – Remedial measures for critical slopes – case studies.

Module 5: REINFORCEMENT OF ROCKS: Reinforcement of fractured and jointed rocks – shotcreting – bolting – anchoring – installation methods – case studies.

Module 6: APPLICATION OF ROCK MECHANICS IN CIVIL ENGINEERING: Rock tunneling - rock slope stability - bolting, blasting, grouting and rock foundation design - Modern modelling techniques - analyses in rocks.

References:

1. John A Hudson, John P Harrison., “Engineering Rock Mechanics: An Introduction to the Principles”, Pergamon Press Ltd, 2005
2. Goodman, R.E., “Introduction to Rock Mechanics”, John Wiley and Sons, 1989.
3. Bazant, Z.P., “Mechanics of Geomaterials Rocks, Concrete and Soil”, John Wiley and Sons, Chichester, 1985.
4. Hool, E and Bray, J., “Rock Slope Engineering”, Institute of Mining and Metallurgy, U.K. 1981.
5. Hoek, E and Brown, E.T., “Underground Excavations in Rock”, Institute of Mining and Metallurgy, U.K. 1981.
6. Obvert, L. and Duvall, W., “Rock Mechanics and the Design of Structures in Rock”, John Wiley, 1967.

18CE3076	EARTH RETAINING STRUCTURES	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge on earth pressure theories.
2. To inculcate the design of retaining walls with and without geosynthetic reinforcements.
3. To study sheet pile walls with and without geosynthetic reinforcements.

Course Outcomes

Student will be able to

1. Define various classical earth pressure theories.
2. Classify different types of earth retaining structures.
3. Demonstrate braced excavation with practical examples.
4. Evaluate forces on the structures under different conditions.
5. Design earth retaining structures based on stability considerations.
6. Adopt appropriate retaining structures based on field observations.

Module 1: EARTH PRESSURE THEORIES: Introduction – state of stress in retained soil mass – classical earth pressure theories – active and passive earth pressures – earth pressure at rest- earth pressure due to external loads – empirical methods – wall movements and complex geometry – graphical method of computing earth pressure – Rehmann’s and Culmann’s approach.

Module 2: COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES: Retaining structure – selection of soil parameters - lateral pressure: compaction, strain softening, wall flexibility, drainage arrangements - its influence – stability analysis of retaining structure for regular and earthquake forces.

Module 3 RETAINING WALLS: Retaining walls – uses and types – forces on retaining walls – design of retaining walls by limit state method – general principles – design and construction details – Design of solid gravity walls, Semi – gravity walls, cantilever walls, counterfort walls – Stability of retaining walls – Drainage arrangements and its influence

Module 4: SHEET PILE WALLS: Earth retaining structures – selection of soil parameters – analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchor – diaphragm and bored pile walls – design requirements.

Module 5: BRACED EXCAVATION: Braced cuts in sand and clay – lateral pressure on sheeting in braced excavation – stability against piping and bottom heaving – computation of lateral earth pressure for braced cuts and flexible bulk heads – soil anchors – soil nailing – soil pinning – methods of design.

Module 6: REINFORCED EARTH RETAINING WALL: Reinforced earth retaining wall – general principles - concepts and mechanism of reinforced earth – design consideration of reinforced earth – Geotextile, geogrids, metal strips and facing elements – construction – selection of type of retaining structures – construction practice – field observations.

References:

1. McCarthy D.F., “Essentials of soil Mechanics and foundations; Basic Geotechnics” (sixth Edition) Prentice Hall, 2002.
2. Rowe R.K., “Geotechnical and Geo environmental Engineering Hand Book”, Kluwer Academic Publishers, 2001.
3. Winterkorn H.F. and Fang H.Y., “Foundation Engineering Hand book”, Galgotia Book-source, 2000.
4. Militisky .J and Woods R., “Earth and earth retaining structures”, CRC Press, 1992.
5. IS 14458 (Part 2): Retaining Wall for Hill Area--Guidelines, Part 2: Design of Retaining/Breast Walls

18CE3077	REINFORCED SOIL STRUCTURES	L 3	T 0	P 0	C 3

Course Objectives

1. To impart knowledge on geosynthetics.
2. To study the design principles and mechanism of reinforced soil and soil nailing.
3. To enlighten the applications in dams, embankments, pavements and foundation structures.

Course Outcomes

Student will be able to

1. Recall the soil reinforcement interaction mechanism.
2. Classify the materials used in reinforced soil structure.
3. Demonstrate various testing and prevention methods.
4. Design various soil reinforcement structures.
5. Summarize the concepts of geosynthetics in earth reinforcement.
6. Judge the performance of reinforced structures.

Module 1: PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT: Historical background – initial and recent developments – principles – concepts and mechanisms of reinforced soil – factors affecting behaviour and performance of soil – reinforcement interactions

Module 2: MATERIALS AND MATERIAL PROPERTIES: Materials used in reinforced soil structures: fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – bamboo – timber – facing elements – properties – methods of testing – advantages and disadvantages – preservation methods.

Module 3: DESIGN PRINCIPLES AND APPLICATIONS: Design aspects of reinforced soil – soil reinforcement function – separator, filtration, drainage, barrier function – design and applications of reinforced soil of various structures – retaining walls – foundations - embankments and slopes.

Module 4: GEOSYNTHETICS AND APPLICATIONS: Introduction – historical background – applications - design criteria – geosynthetics in roads – design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – design of landfills – barrier walls.

Module 5: SOIL NAILING AND CASE HISTORIES: Soil nailing – overview – soil – nail interaction – behaviour – design procedure – behaviour in seismic conditions - performance studies of reinforced dams, embankments, pavements, railroads, foundations - case studies.

Module 6: DURABILITY OF REINFORCEMENT MATERIALS: Measurement of corrosion factors, resistivity - redox potential - water content – pH - electrochemical corrosion - bacterial corrosion – influence of environmental factors on the performance of Geosynthetic materials.

References:

1. Hoe I. Ling, Guido Gottardi , Daniele Cazzuffi ., “Design and Practice of Geosynthetic-Reinforced Soil Structures”, 2013.
2. Ramanatha Ayyar, T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., “Comprehensive Reference Book on Coir Geotextile”, Centre for Development for Coir Technology, 2002.
3. Koerner, R.M., “Designing with Geosynthetics”, (Third Edition), Prentice Hall, 1997.
4. Jewell, R.A., “Soil Reinforcement with Geotextile”, CIRIA, London, 1996.
5. Gray, D.H., and Sotir, R.B., “Biotechnical and Soil Engineering Slope Stabilization”. A Practical Guide for Erosion Control, John Wiley and Son Inc., New York, 1996.
6. Colin J F P Jones., “Earth Reinforcement and Soil Structures”, Butterworths & Co. Ltd., 1988.
7. John, N.W.M., “Geotextiles”, John Blackie and Sons Ltd., London, 1987.
8. IS 14715: IRC, SP 102.

18CE3078	GEOLOGY IN GEOTECHNICAL ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives

1. To enable to understand the microscopic study of rocks.
2. To impart knowledge on geophysical exploration of ground water and structural geology.
3. To familiarize the causes and preventing measures of landslides.

Course Outcomes

Student will be able to

1. Identify mineral content, texture and structural behaviour of rocks using microscopic study.
2. Classify different faults in rocks.
3. Demonstrate various geophysical investigations.
4. Analyze the causes of landslides.
5. Explain the scope of ground water investigations in civil Engineering.
6. Interpret the causes of faults based on field recognition of unconformity.

Module 1: INTRODUCTION: Soil formation – survey – soils of India – texture and structure of igneous, sedimentary and metamorphic rocks - microscopic study – microscopic study of rocks with particular reference to texture – microscopic study of unconsolidated sediments with reference to their grain size and mineral content

Module 2: GEOPHYSICAL INVESTIGATION: Geophysical methods of exploration – electrical, magnetic, gravitational, seismic, radioactive and geochemical methods – influence of structure and texture of rocks, engineering properties, foundation problems in igneous, sedimentary and metamorphic rocks including recent sediments- case histories - investigations for foundation of dams and reservoirs – problem encountered and treatment - case studies – investigation of canals and deep cuts – case studies.

Module 3: BOREHOLE LOGGING AND CORE SAMPLING TECHNIQUES: Bore logging techniques – Resistivity log, Neutron log, sonic log, gamma log etc. - Bore logging methods, interpretation - drilled core sections – rocks and soil sampling methods - core logging.

Module 4: LAND SLIDES: Landslides – causes – preventive and control measures – engineering problems related to earthquakes - case studies.

Module 5: GROUND WATER: Ground water problems – location of water tables, composition of ground water – groundwater surveys – conservation of groundwater – scope of ground water investigation in civil engineering.

Module 6: STRUCTURAL GEOLOGY: Altitude of beds – dip and strike –characteristics –folds types - causes and mechanism of folding –faults classification -causes and mechanism of faults- field evidences and recognition of faults - joint systems – classification and its types - difference between faults and joints – definition - importance and field recognition of unconformity.

References:

1. Parbin Singh, “Engineering and General Geology”, Katson Publication House, 2009.
2. Legget, “Geology and Engineering”, McGraw Hill Book Company, 1998.
3. Krynine and Judd, “Principles of Engineering Geology and Geo techniques”, CBS Publishers and Distributors 1998.
4. Robert S. Yeats, Robert S. Yeats, Kerry Sieh, Kerry E. Sieh., “The Geology of Earthquakes”, Oxford University Press, 1997.
5. Blyth, “Geology for Engineering”, ELBS 1995.

18CE3079	SLOPE STABILITY AND LANDSLIDES	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge on investigation of slopes
2. To study stabilization techniques of slopes
3. To gain knowledge on analysis and design of slopes

Course Outcomes

Student will be able to

1. Identify the purpose of computing slope stability.
2. Classify irregular slopes with different approaches.
3. Evaluate pore water pressure.
4. Analyze the stability of slopes.
5. Interpret the failures of case studies.
6. Execute suitable ground improvement techniques in the field.

Module 1: INTRODUCTION: Introduction – importance – characteristics - types of failures – causes of failures – purpose of stability computation – investigation of failures – procedure – case studies.

Module 2: STABILITY ANALYSIS: Stability analysis – method of slices – friction circle method – soils with cohesion – soils with cohesion and angle of internal friction - critical states for design of embankments – stability computations – evaluation of pore water pressure.

Module 3: IRREGULAR SLOPES: Non-uniform soils – Janbu’s analysis – Taylor’s analysis – Bishop’s analysis – total stress and effective stress approaches – composite surfaces of sliding – block sliding.

Module 4: LAND SLIDES: General characteristics - sources–stability of hill side slopes – open cuts – engineering problems involving the stability of slopes – cuts in sand – cuts in loess – homogeneous and soft clay slopes – sudden spreading of clay slopes – clay flows - clays containing pockets and sand masses – slides in stiff clay slopes on shale – slopes on weathered rock; talus slopes, slopes on over consolidated clays – slides along coastal areas and tropically weathered residual soils – long term stability of clay slopes.

Module 5: FIELD OBSERVATIONS: Field instrumentation – observation studies during construction – post construction - piezometers – settlement plates – inclinometer – case histories.

Module 6: SLOPE STABILIZATION: Compaction of new embankments – compaction of natural masses of soil and existing fills – compaction of deep deposits of sand – vibroflotation – compaction of compressible soils – drainage as a means of stabilization –soil reinforcement– soil nailing.

References:

1. Robin Chowdhury, Phil Flentje, Gautam, “Geotechnical Slope Analysis”, CRC Press, 2009.
2. Mahanti, N.C. Samal, S.K. Datta, P. Nag.N.K., “Diaster Management”, Narosa Publishing House, New Delhi, India, 2006.
3. Lee W. Abramson, Thomas S. Lee, Sunil Sharma, “Slope Stability and Stabilization Methods”, John Wiley & Sons, Inc, 2002.
4. Winterkorn, H.F. and Fang, H.Y., “Foundation Engineering Handbook”, Van Nostrand Reinhold, 1994.
5. Anderson, M.G., and Richards, K.S., “Slope Stability”, John Wiley, 1987.

18CE3080	GEOTECHNICAL EARTHQUAKE ENGINEERING	L 3	T 0	P 0	C 3

Course Objectives

1. To understand the dynamics of earth and its response, effect on earth structure and measures to mitigate the effects.
2. To enable to develop the design ground motion for a site by suitable response analysis

3. To impart knowledge to prepare a hazard and risk map.

Course Outcomes

Student will be able to

1. Apply the principles of earthquake loading.
2. Quantify earthquake intensity and ground motion.
3. Estimate seismic soil design parameters.
4. Analyze and design seismic resistant foundation for buildings.
5. Prepare soil risk and micro zonation maps.
6. Assess the hazard resistance to maintain and modify the soil sample.

Module 1: ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS: Mechanism of earthquakes - causes of earthquake - earthquake fault sources - elastic rebound theory - seismic wave in earthquake shaking - definition of earthquake terms - locating an earthquake - quantification of earthquakes.

Module2: GROUND MOTION CHARACTERISTICS: Strong motion records -characteristics of ground motion - factors influencing ground motion - estimation of frequency content parameters - seismic site investigations - evaluation of dynamic soil properties.

Module 3: GROUND RESPONSE ANALYSIS - LOCAL SITE EFFECTS AND DESIGN GROUND MOTION: Wave propagation analysis - site amplification - ground response analysis - method of analysis - one dimensional analysis - equivalent linear analysis – shear beam analysis - site effects - design ground motion - developing design ground motion - application of software package - codal recommendations

Module 4: LIQUEFACTION AND LATERAL SPREADING: Liquefaction related phenomena - liquefaction susceptibility: historical, geological, compositional and state criteria - evaluation of liquefaction by cyclic stress and cyclic strain approaches - lateral deformation and spreading - criteria for mapping liquefaction hazard zones.

Module 5: SEISMIC STABILITY ANALYSIS: Earthquake resistant design of building foundation - design considerations - geotechnical - architectural - structural - capacity design - seismic analysis. earthquake response of slopes - evaluation of slope stability - pseudostatic analysis - Newmark's study of block analysis - dynamic analysis - earth pressure due to ground shaking valuation - lateral deformation - codal provisions.

Module 6: EARTHQUAKE HAZARD MITIGATION: Seismic risk vulnerability and hazard - risk mapping - scale – changing percept of risk – vulnerability atlas of India - hazard assessment - maintenance and modifications to improve hazard resistance - seismic microzonation – methodology – scale of mapping - different type of foundation and its impact on safety.

References:

1. Krammer S.L., “Geotechnical Earthquake Engineering”, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
2. McGuire, R.K. “Seismic Hazard and Risk Analysis”, Earthquake Engineering Research Institute, 2004.
3. Wai-Fah Chen and Charles Scawthem, “Earthquake Engineering Hand book”, Caspress, 2003.
4. Robert W. Day, “Geotechnical Earthquake Engineering Hand book”, McGraw Hill, 2002.
5. Kameswara Rao, N.S.V., “Dynamics soil tests and applications”, Wheeler Publishing - New Delhi, 2000.

18CE3081	PROFESSIONAL PRACTICES IN DESIGN OF GEOTECHNICAL STRUCTURES (Industry run course)	L 3	T 0	P 0	C 3

Course Objectives

1. To gain knowledge on practical aspects of design relating to substructure elements using software.
2. To impart knowledge on Geotechnical construction practices.
3. To apply knowledge on field execution.

Course Outcomes

Student will be able to

1. Identify the various field practices in Geotechnical engineering.
2. Indicate the various safety and quality control aspects in site.
3. Apply the various design aspects in earthquake resistant structures.
4. Design foundations for special structures using software.
5. Evaluate dynamic properties of soil.
6. Choose the appropriate finite element analysis software applied to Geotechnical Engineering.

Module 1: CONSTRUCTION TECHNIQUES: Geotechnical engineering practices – soil profile – bore log report review and preparation – geotechnical plant and machinery – safety aspects at site.

Module 2: RETAINING STRUCTURES: Design of retaining wall – design of culvert – design of deep excavations – sheet pile – diaphragm walls – shoring system – design of caisson.

Module 3: SUBSTRUCTURES: Design of tower foundation – design of floating foundation – design of pile and pile group – design of under-reamed pile – design of abutment – design of pier – design of mat foundation – design of piled raft foundation.

Module 4: DYNAMIC RESPONSE OF FOUNDATIONS: Soil behaviour – dynamic properties of soil – seismic performance analysis – seismic load in foundation – design procedure for earthquake resistant foundation – soil structure interaction – retrofitting.

Module 5: FINITE ANALYSES AND SOFTWARE APPLICATION: Finite element analysis applied to geotechnical engineering – ANSYS – modelling – applications – PLAXIS.

Module 6: CONSTRUCTION MANAGEMENT: Project planning – construction management – quality control – quality management – Geosynthetics – Geomembrane.

References:

1. George Paaswell, “Retaining Walls: Design and Construction”, Biblibazaar, 2009.
2. Murthy V.N.S, “Advanced Foundation Engineering”, CBS Publishers and Distributors, 2007.
3. Michael John Tomlinson, R.Boorman., “Foundation Design and Construction”, Prentice Hall PTR, 2001.
4. Helmsley, “Design Applications of Raft Foundations”, Thomas Telford, 2000.
5. Davies and Poulos., “Analysis and Design of Pile foundation”, John wiley and sons, 1980.

18CE3082	OFFSHORE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives

1. To impart knowledge on offshore environment.
2. To enlighten knowledge on behavior of soils subjected to repeated loading.
3. To study the numerical modeling of marine foundations.

Course Outcomes

Student will be able to

1. Understand the importance of marine ecosystem and its viable environment.
2. Assess the behavior of soil and select necessary design parameters.
3. Formulate and solve problems of marine soil subjected to repeated loading.

4. Execute investigation program for marine soil deposits.
5. Design suitable marine foundation as per project requirement.
6. Develop numerical model for response of marine foundation for offshore conditions.

Module 1: INTRODUCTION TO OFFSHORE ENGINEERING: Offshore environment – marine ecosystem – types of soil in marine environment – fundamental design of offshore structures.

Module 2: MARINE SOIL DEPOSITS: Offshore structures and foundations – specific problems related to marine soil deposits– physical and engineering properties of marine soils

Module 3: BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING: Effect of wave loading on offshore foundations – behavior of sands and clays under cyclic loading – laboratory experiments including repeated loading– cyclic behavior of soils based on fundamental theory of mechanics– approximate engineering methods which can be used for practical cases

Module 4: SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS: Challenges of site investigation in marine environment – different site investigation techniques – sampling techniques– geophysical methods – recent advancements in site investigation and sampling used for marine soil deposits

Module 5: FOUNDATIONS IN MARINE SOIL DEPOSITS: Different offshore and near shore foundations– gravity platforms– jack-up rigs – pile foundations – cassettes, spudcans

Module 6: NUMERICAL MODELING OF MARINE FOUNDATIONS SUBJECTED TO WAVE LOADING: Numerical modeling of cyclic behavior of soils – empirical models – elastic-plastic models – FEM analysis of marine foundations subjected to wave loading.

References:

1. Mohamed A. El-Reedy., “Offshore Structures: Design, Construction and Maintenance”, Gulf Professional Publishing, 2012.
2. Thomson Dand BeasleyD. J., “Handbook of Marine Geotechnical Engineering”, US Navy, 2012.
3. Reddy D. V. and M. Arockiasamy., “Offshore Structures”, Volume: 1, R.E. Kreiger Pub and Co., 1991.
4. PoulosH. G., “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988.
5. IS:4651 (Part I-1974,Part II -1969,Part III-1974,Part IV-1979)

18CE3083	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

Course Objectives:

1. To demonstrate a critical understanding of key concepts in disaster risk reduction
2. To evaluate disaster risk reduction and humanitarian response policy
3. To impart knowledge on the strengths and weaknesses of disaster management approaches

Course Outcomes:

Student will be able to

1. Identify the man-made and natural disaster
2. Evaluate different disasters and its out breaks
3. Examine the areas prone to disasters
4. Create preparedness risk management
5. Analyses the risks involved during disasters
6. Apply emerging trends in mitigations

Module 1: INTRODUCTION: Disaster - factors and significance - difference between hazard and disaster - natural and manmade disasters – differences: nature - types and magnitude

Module 2: REPERCUSSIONS OF DISASTERS AND HAZARDS: Economic damage - loss of human and animal life - destruction of ecosystem - natural disasters: earthquakes, volcanisms, cyclones, tsunamis,

floods, droughts and famines - landslides and avalanches, man-made disaster: nuclear reactor meltdown, industrial accidents, oil slicks and spills - outbreaks of disease and epidemics - war and conflicts

Module 3: DISASTER PRONE AREAS IN INDIA: Study of seismic zones - areas prone to floods and droughts - landslides and avalanches - areas prone to cyclonic and coastal hazards – tsunami - post-disaster diseases and epidemics

Module 4: DISASTER PREPAREDNESS AND MANAGEMENT: Preparedness: monitoring of phenomena triggering a disaster or hazard - evaluation of risk - application of remote sensing - meteorological data and other agencies - media reports - Governmental and community preparedness.

Module 5: RISK ASSESSMENT: Disaster risk: concept – elements - disaster risk reduction - global and national disaster risk situation - techniques of risk assessment - global cooperation in risk assessment and warning - people's participation in risk assessment - strategies for survival

Module 6: DISASTER MITIGATION: Concept - strategies of disaster mitigation - emerging trends in mitigation - structural mitigation and non-structural mitigation - programs of disaster mitigation in India.

References:

1. Dave R. K., “Disaster Management in India: Challenges and Strategies”, Prowess Publishing, 2018
2. Goel S. L., “Disaster Administration and Management Text and Case Studies”, Deep and Deep Publication Pvt. Ltd., New Delhi, 2007
3. Pardeep Sahni, Alka Dhameja, Uma Medury., “Disaster Mitigation: Experiences and Reflections”, Phi Learning Pvt. Ltd, 2001
4. Larry R. Collins., “Disaster Management and Preparedness”, CRC Press, 2000
5. Brebbia C. A, Alain J. Kassab, E. Div., “Disaster Management and Human Health Risk II: Reducing Risk, Improving Outcomes”, WIT Press, 2011

LIST OF COURSES

Sl. No.	Course Code	Name Of The Course	Credits
1	16CE3021	Geopolymer and Its Application in Civil Engineering	3:0:0
2	16CE3022	Soil Chemistry and Behaviour	3:0:0
3	16CE3023	Advanced Environmental Microbiology	3:0:0
4	16CE3024	Ground Improvement Techniques	3:0:0
5	16CE3025	Soil Structure Interactions	3:0:0
6	16CE3026	Environmental Geotechnology	3:0:0
7	16CE3027	Basic of MR Damper for Civil Engineering Applications	3:0:0
8	16CE3028	Seismic Response Control of Structures	3:0:0
9	17CE1001	Surveying and Levelling	1:0:1
10	17CE1002	Basic Civil Engineering	3:0:0
11	17CE2001	Building Materials and Geology	3:0:0
12	17CE2002	Surveying	3:0:0
13	17CE2003	Strength of Materials – I	3:1:0
14	17CE2004	Mechanics of Fluids	3:1:0
15	17CE2005	Applied Hydraulics and Hydraulic Machinery	3:0:0
16	17CE2006	Strength of Materials - II	3:1:0
17	17CE2007	Soil Mechanics	3:0:0
18	17CE2008	Water Supply and Wastewater Engineering	3:0:0
19	17CE2009	Design of Reinforced Concrete Elements	3:0:0
20	17CE2010	Structural Analysis – I	3:1:0
21	17CE2011	Structural Analysis – II	3:1:0
22	17CE2012	Construction Practices	3:0:0
23	17CE2013	Foundation Engineering	3:0:0
24	17CE2014	Design of Steel Structures	3:0:0
25	17CE2015	Transportation Engineering	3:0:0
27	17CE2016	Concrete Technology	3:0:0
28	17CE2017	Estimation and Costing	3:1:0
29	17CE2018	Strength of Materials Laboratory	0:0:2
30	17CE2019	Computer Aided Building Drawing	0:0:2
31	17CE2020	Civil Engineering Practices Laboratory	0:0:1
32	17CE2021	Fluid Mechanics and Machinery Laboratory	0:0:2
33	17CE2022	Surveying Laboratory	0:0:2
34	17CE2023	Geotechnical Engineering Laboratory	0:0:2
35	17CE2024	Environmental Engineering Laboratory	0:0:2
36	17CE2025	Concrete and Highway Laboratory	0:0:2
37	17CE2026	Computer Application Laboratory	0:0:2
38	17CE2027	Design and Drawing (RCC & Steel)	0:0:2
39	17CE2028	Design and Drawing (Irrigation and Environment)	0:0:2
40	17CE2029	Irrigation Engineering	3:0:0
41	17CE2030	Reinforced Concrete Structures	3:0:0
42	17CE2031	Pre-stressed Concrete	3:0:0
43	17CE2032	Prefabricated Structures	3:0:0
44	17CE2033	Construction Management	3:0:0
45	17CE2034	Structural Dynamics and Earthquake Engineering	3:0:0
46	17CE2035	Building Services	3:0:0
47	17CE2036	Sustainable Building Concepts and Design	3:0:0
48	17CE2037	Intelligent Buildings	3:0:0
49	17CE2038	Smart Materials and Structures	3:0:0
50	17CE2039	Building Acoustics	3:0:0
51	17CE2040	Industrial Waste Treatment and Disposal	3:0:0
52	17CE2041	Municipal Solid Waste Management	3:0:0

53	17CE2042	Environmental and Social Impact Assessment	3:0:0
54	17CE2043	Energy and Environmental Engineering	3:0:0
55	17CE2044	Ecology and Environment	3:0:0
56	17CE2045	Air Pollution Management	3:0:0
57	17CE2046	Global Climate Change and Its Impact	3:0:0
58	17CE2047	Environmental Management	3:0:0
59	17CE2048	Hydraulic Structures	3:0:0
60	17CE2049	Participatory Irrigation Management	3:0:0
61	17CE2050	Remote Sensing and GIS in Civil Engineering	3:0:0
62	17CE2051	Geoinformatics Application for Civil Engineers	3:0:0
63	17CE2052	Advanced Surveying Techniques	3:0:0
64	17CE2053	Digital Cadastre	3:0:0
65	17CE2054	Surface Hydrology	3:0:0
66	17CE2055	Groundwater Engineering	3:0:0
67	17CE2056	Subsurface Investigation and Instrumentation	3:0:0
68	17CE2057	Pavement Design	3:0:0
69	17CE2058	Airport, Harbour and Dock Engineering	3:0:0
70	17CE2059	Transportation Systems Planning	3:0:0
71	17CE2060	Traffic Engineering and Management	3:0:0
72	17CE2061	Intelligent Transportation Systems	3:0:0
73	17CE2062	Fundamentals of Coastal Processes	3:0:0
74	17CE2063	Operations Research Techniques in Civil Engineering	3:0:0
75	17CE2064	Disaster Management and Mitigation	3:0:0
76	17CE2065	Water Resources Systems and Operation	3:0:0
77	17CE2066	Remote Sensing and GIS Laboratory	0:0:2
78	17CE3001	Advanced Concrete Structures	3:0:0
79	17CE3002	Structural Dynamics	3:0:0
80	17CE3003	Applied Elasticity and Plasticity	3:0:0
81	17CE3004	Pre-stressed Concrete Structures	3:0:0
82	17CE3005	Finite Element Analysis of Structures	3:0:0
83	17CE3006	Design of Bridges	3:0:0
84	17CE3007	Advanced Steel Structures	3:0:0
85	17CE3008	Seismic Analysis and Design of Structures	3:0:0
86	17CE3009	Stability of Structures	3:0:0
87	17CE3010	Experimental Techniques and Instrumentation	3:0:0
88	17CE3011	Advanced Structural Engineering Laboratory	0:0:1
89	17CE3012	Computer Aided Design Laboratory	0:0:1
90	17CE3013	Advanced Concrete Technology	3:0:0
91	17CE3014	Analysis and Design of Tall Buildings	3:0:0
92	17CE3015	Off-Shore Structures	3:0:0
93	17CE3016	Geotechnical Earthquake Engineering	3:0:0
94	17CE3017	Structural Optimization	3:0:0
95	17CE3018	Design of Substructures	3:0:0
96	17CE3019	Space Structures	3:0:0
97	17CE3020	Design of Steel Concrete Composite Structures	3:0:0
98	17CE3021	Industrial Structures	3:0:0
99	17CE3022	Nonlinear Analysis of Structures	3:0:0
100	17CE3023	Analysis and Design of Precast Concrete Structures	3:0:0
101	17CE3024	Analysis and Design of Plates and Shells	3:0:0
102	17CE3025	Wind and Cyclone Effects on Structures	3:0:0
103	17CE3026	Energy Efficient Buildings	3:0:0
104	17CE3027	Design and Safety of Structures Under Fire	3:0:0
105	17CE3028	Forensic Engineering	3:0:0

106	17CE3029	Cement and Concrete Chemistry	3:0:0
107	17CE3030	Maintenance and Rehabilitation of Structures	3:0:0
108	17CE3031	Structural Health Monitoring	3:0:0
109	17CE3032	Design of Shells and Spatial Structures	3:0:0
110	17CE3033	Soil Structure Interaction	3:0:0
111	17CE3034	Shallow Foundations	3:0:0
112	17CE3035	Strength and Deformation Characteristics of Soils	3:0:0
113	17CE3036	Experimental Geomechanics	3:0:0
114	17CE3037	Slope Stability and Landslides	3:0:0
115	17CE3038	Theoretical Soil Mechanics	3:0:0
116	17CE3039	Deep Foundations	3:0:0
117	17CE3040	Finite Element Methods for Geotechnical Engineering	3:0:0
118	17CE3041	Soil Dynamics and Machine Foundations	3:0:0
119	17CE3042	Ground Improvement Techniques	3:0:0
120	17CE3043	Pavement Engineering	3:0:0
121	17CE3044	Advanced Geotechnical Engineering Laboratory	0:0:1
122	17CE3045	Advanced Computer Aided Geotechnical Laboratory	0:0:1
123	17CE3046	Earth Retaining Structures	3:0:0
124	17CE3047	Geology in Geotechnical Engineering	3:0:0
125	17CE3048	Reinforced Soil Structures	3:0:0
126	17CE3049	Mechanics of Unsaturated Soils	3:0:0
127	17CE3050	Professional Practices in Design of Geotechnical Structures	3:0:0
128	17CE3051	Rock Mechanics in Engineering Practice	3:0:0
129	17CE3052	Environmental Geotechnology	3:0:0
130	17CE3053	Applied Environmental Chemistry and Microbiology	3:0:0
131	17CE3054	Water and Wastewater Treatment	3:0:0
132	17CE3055	Atmospheric Environmental Pollution and Control	3:0:0
133	17CE3056	Solid and Hazardous Waste Management	3:0:0
134	17CE3057	Environmental Impact Assessment	3:0:0
135	17CE3058	Elements of Hydrology	3:0:0
136	17CE3059	Design of Hydraulic and Conveyance Structures	3:0:0
137	17CE3060	Water Resources Planning and Systems Engineering	3:0:0
138	17CE3061	Principles of Integrated Water Resources Management	3:0:0
139	17CE3062	Hydrology Laboratory	0:0:2
140	17CE3063	Advanced Environmental Engineering Laboratory	0:0:1
141	17CE3064	GIS and Computational Laboratory	0:0:2
142	17CE3065	Remote Sensing and GIS	3:0:0
143	17CE3066	Fundamentals of Matlab Programming	3:0:0
144	17CE3067	Cleaner Production and Sustainable Development	3:0:0
145	17CE3068	Electrochemical Water Processing and Water Treatment	3:0:0
146	17CE3052	Environmental Geotechnology	3:0:0
147	17CE3069	Environmental Policies and Legislation	3:0:0
148	17CE3070	Noise Pollution and Control Techniques	3:0:0
149	17CE3071	Occupational Health and Safety	3:0:0
150	17CE3072	Environmental Nanotechnology	3:0:0
151	17CE3073	Isotope Hydrology	3:0:0
152	17CE3074	Hydro Power Engineering	3:0:0
153	17CE3075	River Mechanics and Sediment Transport	3:0:0
154	17CE3076	Fundamentals of Coastal Engineering	3:0:0
155	17CE3077	Forest, Urban and Agricultural Watershed Management	3:0:0
156	17CE3078	Wetland Hydrology	3:0:0

16CE3021 GEOPOLYMER AND ITS APPLICATION IN CIVIL ENGINEERING

Credits: 3:0:0

Course Objective:

- To impart knowledge on the Chemistry in Geopolymer and its applications in Civil Engineering

Course Outcomes:

- Students are able to understand the Chemistry of Geopolymer and various geotechnical application.

Synthesis of Alumino-silicate mineral geopolymer – Chemistry of geopolymer based binder – properties of geopolymer cement, mortar and cement – flyash based geopolymer for structure application and soil improvement – kaolinite based geopolymer – Application of geopolymer for soil stabilization and slope stability.

References:

1. Joseph Davidovits, “Geopolymer Chemistry and Applications” Geopolymer Institute, France, 4th Edition, 2015
2. Hand Book of Alkali-Activated Cement, mortar and Concrete, Wood Head Publishing, U.K., 2015

16CE3022 SOIL CHEMISTRY AND BEHAVIOUR

Credits: 3:0:0

Course Objective:

- To impart knowledge on the various factors governing the Engineering behavior of soils and the suitability of soils for various Geotechnical Engineering applications.

Course Outcomes:

- Students are able to select suitable soils for various geotechnical applications based on the factors governing the Engineering behavior of soils.

Formation of soils – Genesis of clay minerals – specific surface area – Physical and Physico chemical behavior of soils – effect of ion concentration – dielectric constant – attractive and repulsive forces in clays – swelling and shrinkage behavior of soils – swell potential – soil fabric and measurement – soil compaction – Compressibility, shear strength and permeability behavior of fine and coarse grained soils – liquefaction potential – Conduction in soils – hydraulic, electrical, chemical and thermal flows in soils – Electro-kinetic process – thermo osmosis – electro osmosis.

References:

1. Mitchell, J.K., “Fundamentals of Soil Behaviour”, John Wiley, New York, 1993
2. Yong, R.N. and Warkentin, B.P., “Introduction to Soil Behaviour”, Macmillan, Limited, London, 1979
3. Coduto, D.P., “Geotechnical Engineering – Principles and practices”, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. Perloff, W.H. and Baron, W., “Soil Mechanics”, The Ronald Press Company, 1976.
5. Van Olphen, H., “Clay colloid Chemistry”, John Wiley, 1996
6. Grim, R.E., “Applied Clay Mineralogy”, McGraw Hill, New York, 1966.
7. Lambe, T.W. & Whitman, R.V. “Soil Mechanics”, John Wiley & Sons, New York, 1979.
8. Das, B.M., “Principles of Geotechnical Engineering”, PWS Publishing Comp, Boston, 1998
9. McCarthy D.F., “Essentials of Soil Mechanics & Foundations”, Prentice-Hall, 2002
10. Robert D. Holtz and William D. Kovacs, “An Introduction to Geotechnical Engineering”, Prentice Hall (UK) International, London, 1981.

16CE3023 ADVANCED ENVIRONMENTAL MICROBIOLOGY

Credits: 3:0:0

Course Objective:

- To provide basic knowledge on microbiology and to enable the students to identify and enumerate bacteria from samples

Course Outcomes:

- The candidate will have a basic understanding of microbiology and possess the knowledge to analyse the samples for the presence of various microbes.

Classification of microorganisms - Culture of micro-organisms - media preparation – sterilization - pure culture - maintenance of cultures - Growth curve-factors affecting growth, nutritional requirements of micro-organisms, Micro-organisms in Air, water and soil, Aerobic and anaerobic microbiology - Structure and morphology of bacterial-Gram staining - microscopy - Differential and selective medium - Differentiation of faecal & non-faecal coliforms - tests for the presence of coliform organisms-presumptive - confirmed and completed test - MPN index - use of Millipore filter technique, tests for faecal streptococci and clostridium welchi-their sanitary significance - standards for bacteriological quality - Bioremediation & Biodegradation - Biological process for soil improvement.

References:

1. Pelczar Jr. M.J., Chan, E.C.S, Krieg. R. Noel, and pelczar MernaFoss, “Microbiology”, 5th Edition, Tata Mc Graw-Hill company Ltd, New Delhi, 2006
2. Joanne Willey and Linda Sherwood and hristopher J. Woolverton, Prescott’s “Microbiology”, 10th Tata Edition, Mc Graw-Hill company Ltd, New Delhi, 2006
3. S.C. Bhatia, “Hand Book of Environmental Microbiology”, 3rd Edition, Atlantic Publishers and Distributors, 2008.
4. Ian L. Pepper, Charles P. Gerba, Terry Gentry and Raina M. Maier, “Environmental Microbiology”, 3rd Edition, Academic Press, 2014
5. S.V.S. Rana, “Essentials of Ecology & Environmental Science”, 5th Edition, PHI Learning press, 2013

16CE3024 GROUND IMPROVEMENT TECHNIQUES

Credits: 3:0:0

Course Objectives:

- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

Course Outcomes:

- Based on the knowledge gained student will be in a position to identify and evaluate the deficiencies if any in the deposits of the given project area and capable of providing alternative methods to improve its quality so that the structures built on it will be stable and serve the intended purpose.

Dewatering, vacuum and electro-osmotic methods - Stabilization by thermal and freezing techniques - Compaction and Sand Drains - design, Blasting and dynamic consolidation-Preloading with sand drains - Theories of sand drain - lime piles - Root piles and soil nailing - Design and Applications - Earth reinforcement - basic mechanism of reinforced earth - Synthetic and natural fiber based Geotextiles and their applications - Suspension and solution grouts - injection methods - Stabilization with cement - lime-Stabilization of expansive clays - Recent Development for soil improvement: Application of geopolymer, biological processing of soil improvement.

References:

1. Pappala, A.J. Huang. J, Han, J, and Hoyos, L.R, “Ground Improvement and Geosynthetics”, Geotechnical special publication No. 207, Geo Institute, ASCE,2010
2. Cox, B.R and Griffiths S.C, “Practical Recommendation for Evaluation and mitigation of soil liquefaction” in Arkansas (Project Report), 2010
3. Day, R.W, “Foundation Engineering handbook”, McGraw-Hill Companies, Inc. 2006
4. Rowe, R.K, “Geotechnical and Geoenvironmental Engineering Hand book”, Kluwer Academic Publishers, 2001
5. Das, B.M, “Principles of Foundation Engineering”, Fourth Edition, PWS Publishing, 1999

6. Moseley, M.P, "Ground Treatment", Blackie Academic and Professionals, 1998
7. Koerner, R.M, "Designing with Geosynthetics", Third Edition, Prentice Hall 1997
8. Hehn, R.W, "Practical Guide to Grouting of Underground Structures", ASCE, 1996
9. Jewell, R.A, "Soil Reinforcement with Geotextiles", CIRIA, London, 1996.
10. Koerner, R.M. and Welsh, J.P, "Construction and Geotechnical Engineering using Synthetic Fabrics", John Wiley, 1990
11. Jones, J.E.P, "Earth Reinforcement and Soil Structure", Butterworths, 1985
12. Anantharaman R and Jayaram Paniker C.K, "Text book of Microbiology" 6th Edition 2001, Orient Longman P. Ltd, Hyderabad
13. Murtala Uman, Khairal Annar Kassim, Kenny Tony Punjchiet, "Biological process of soil improvement in Civil Engineering" A review, Journal of Rock Mechanics and Geotechnical Engineering, 2016, pp 767-774.

16CE3025 SOIL STRUCTURE INTERACTION

Credits: 3:0:0

Course Objectives:

- Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.

Course Outcomes:

- At the end of this course, students will have the capacity to idealize soil response in order to analyze and design foundation elements subjected to different loadings.

Foundation interaction problems, soil response models, Elastic-plastic behavior, solution of the elastic line-concentrated and distributed loads on beams-solutions by general method, finite difference and application packages, elastic continuum, Winkler, Two parameters, Thin and thick plates, simple solution, ACI method, Numerical analysis of finite plates, Methods of analysis for settlement of pile, settlement of pile groups, Effect of pile cap, pile raft system, solutions through influence charts and Application packages.

References:

1. Salgado. R, "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2. Murthy, V.N.S, "Advanced Foundation Engineering", CBS Publishers, New Delhi, 2007
3. Saran. S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 2006
4. McCarthy, D.F. "Essentials of Soil Mechanics and Foundations", Basic Geotechnics, Sixth Edition, Prentice Hall, 2002
5. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998
6. ACI 336,"Suggested Analysis and Design Procedures for Combined Footings and Mats", American Concrete Institute, Dehit, 1988
7. Scott, R.F, "Foundation Analysis", Prentice Hall, 1981
8. Poulos, H.G, and Davis, E.H, "Pile Foundation Analysis and Design", John Wiley, 1980
9. Selvadurai, A.P.S, "Elastic Analysis of Soil Foundation Intraction", Elsevier 1979
10. Kurien, N.P, "Design of Foundation Systems, Principles and Practices Narosa Publishing House, New Delhi, 1999.

16CE3026 ENVIRONMENTAL GEOTECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To impart knowledge about soil physics, soil chemistry, hydrogeology, and biological processes along with the principles of soil mechanics.

Course Outcomes:

- Students are able to select appropriate preventive and remedial measures against soil contamination.

Scope of geoenvironmental engineering - multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geoenvironment - Soil-water-contaminant interactions and its implications – Factors affecting retention and transport of contaminants -introduction to geotechnical centrifuge modeling

References:

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
4. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
5. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils", Wiley- Interscience, USA, 1993.
6. Mitchell, J.K., "Fundamentals of Soil Behavior", Wiley, 2005.
7. Hillel D., "Introduction to Environmental Soil Physics", Academic Press, New York, 2003.

16CE3027 BASICS OF MR DAMPER FOR CIVIL ENGINEERING APPLICATIONS

Credit: 3:0:0

Course Objectives:

- To understand the basics of rheology of fluids
- Study the concepts of MR damper

Course Outcomes:

At the end of the course student will be able to

- Choose suitable materials for MR damper
- Analyse the various parameters affecting the Damping force
- Design MR dampers to suite Civil engineering applications

Ferrous alloys and their applications- Rheology – Newtonian and Non-Newtonian flow behaviour - Magnetorheological fluids-Properties of MR fluid affecting the damping force-applications of MR fluid- Modes of operation-Mathematical models for MR dampers- Bio-savart law, Magnetic field intensity, Stokes theorem, Magnetic flux and magnetic flux density, Faraday's law for electromagnetic induction.

References:

1. Siginer. D A, De Kee.D, Chhabra. R.P, "Advances in the flow and rheology of non-newtonian fluids Part-B", Elsevier Publications, 1999.
2. Fridtjov Irgens, "Rheology and non-Newtonian fluids", springer publications, 2013.
3. Janusz Goldasz, Bogdan Sapinski, "Insight into magnetorheological shock absorbers", Springer publications, 2014.
4. Kunquan Lu, Rong Shen, Jixing Liu, "Electrorheological Fluids and Magnetorheological Suspensions (ERMR 2004)", World Scientific publication.2004.
5. John Dixon "The Shock Absorber Handbook", Wiley Publications, 2008

16CE3028 SEISMIC RESPONSE CONTROL OF STRUCTURES

Credit: 3:0:0

Course Objectives:

- To understand the seismic design philosophy
- To study the various control strategies

Course Outcomes:

At the end of the course student will be able to

- Design structures to resist seismic forces
- Adopt suitable vibration control strategy
- Design retrofitting technique for the requirement

Seismic Design philosophy as per codal provisions- Capacity spectrum method- Seismic testing and performance evaluation methods- Vibration control- Passive control strategy- semi-active control strategy- Control algorithm- active control strategy-control algorithms- case studies on existing control systems-retrofitting techniques for seismic damage control - Smart Materials.

References:

1. T.T Soong, M.C Constantinou, Passive and Active Structural Vibration Control in Civil Engineering” “Springer publications, 2014
2. Zhao- Dong Xu, ying-qing Guo, Jun-Tao Zhu, Fei-hong Xu, ”Intelligent Vibration Control in Civil Engineering Structures” Zhejiang university Press, 2016
3. Peter Hagedorn, Gottfried Spelsberg, korpeter, Active and passive Vibration Control of Structures” Springer publication, 2014.
4. Sathish kuma k, Rama Rao, G V, Bharathi Priya, Seismic Response Control and damage mitigation methodologies for buildings and structures” CSIR, Sigma publications, 2014.

17CE1001 SURVEYING AND LEVELLING

Credit: 1:0:1

Course Objectives:

- To give hands-on training on the use of chains and leveling instruments
- To familiarize the students with basic surveying procedures.
- To make the students to leveling concepts

Course Outcomes:

At the end of the course, the student will be able to

- recall the principles of surveying equipments
- select methods to measure distances
- schedule field surveying operations
- examine the implementation of surveying procedures for contour surveying
- appraise the usage of equipments and methods in leveling procedures
- formulate the surveying methods and executions

Unit I - CHAIN SURVEYING: Introduction and Chain Surveying Definition, principle and classification of surveying – conventional signs – equipments used in chain survey – ranging and chaining – setting perpendiculars – offsets – cross staff and optical square – traversing

Unit II - LEVELLING: Levelling - Type of levels and staves – sensitivity of bubble – bench marks – temporary and permanent adjustments – fly, check, profile and block levelling – booking - reduction – arithmetic checks – Precise levelling

Unit III - ERRORS AND MEASUREMENTS: Accuracy and errors - Errors in chaining – corrections due to sag, slope, curvature, temperature, pressure – difficulties and errors in levelling

Unit IV - CONTOURING: Contouring, Areas and Volumes Contouring – characteristics and uses of contours – calculation of areas from field notes and plan – graphical and instrumental methods – enlarging and reducing the size of figures – volume of earth work

Unit V - SURVEY PRACTICES:

1. Measuring the distance between two stations using a chain
2. Overcoming obstacles in chaining and ranging
3. Observations and plotting the salient features in an area by chain survey.
4. Measurement of bearing of survey lines by prismatic compass.
5. Running a closed compass traverse – plotting and adjustments.
6. Plotting the salient features in an area by plane table survey

Text Books:

1. Kanetkar, T.P and Kulkarni, S.V., Surveying and levelling parts 1 and 2, pune Vidyarthi Griha Prakashan, 2010.
2. Bhavikatti SS, “Surveying and leveling”, I.K.International Publishing House Pvt. Ltd. 2008

Reference Books:

1. Rangwala S. C., “Surveying and Levelling”, Charotar Publishing House Pvt. Limited, 2011
2. Basak, N, “Surveying and Levelling”, McGrawHill & Co, 2014

17CE1002 BASIC CIVIL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To give the various aspects construction practices.
- To impart knowledge on the various materials
- To appraise on the scope of infrastructure development

Course Outcomes:

At the end of the course, the student will be able to

- illustrate the fundamental aspects of civil engineering
- plan and set out a building
- demonstrate the uses of various building materials, method of construction
- discuss about various services in a building
- discover the technology of the civil engineering construction
- formulate technology for present and future construction

Unit I - INTRODUCTION: General introduction to Civil Engineering - Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings. Role of civil engineering in infrastructure and natural resources development and conservation – Dependence of other sectors on civil engineering – Socio-economic considerations in civil engineering works – Introduction to environmental impact assessment.

Unit II - PLANNING OF A BUILDING: Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building.

Unit III - MATERIALS: Bricks, cement blocks, Cement, Cement mortar, Steel; Building components – Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting.

Unit IV - MODES OF CONVEYANCE: Roads - classification, alignment of roads, Railways – cross sections, gauges, coning of wheels, Airports – components, markings and aids, Harbours – components, types. (Theory only)

Unit V - CONSTRUCTION PRACTICES IN THE PRESENT SCENARIO: Pre-engineered buildings, fast track construction, Automation in buildings, Green concepts in buildings – Health, safety and environment in construction practices, Intelligent Buildings.

Text Books

1. Bhavikatti SS, “Basics of Civil Engineering”, New Age International (P) Limited Publishers, 2010.
2. Rangwala .S.C, “Engineering Materials”, Charotar Publishing House, Anand, 2012.

References

1. Chudley, R. and Greeno, R., “Building Construction Handbook”, Addison Wesley, Longman Group, England, 1990
2. Gopi, S., “Basic Civil Engineering”, Pearson Publishers, 2009.
3. Kandya, A. A., “Elements of Civil Engineering”, Charotar Publishing house, 2015.

4. Mamlouk, M. S., and Zaniewski, J. P., “Materials for Civil and Construction Engineering”, Pearson Publishers, 2016

17CE2001 BUILDING MATERIALS AND GEOLOGY

Credit: 3:0:0

Course Objectives:

- To acquire knowledge about the formation of rocks and properties of minerals
- To realize the importance of geological conditions for major projects
- To understand the properties of building materials

Course Outcomes

At the end of the course, the student will be able to

- classify the geologic processes related to the formation of rocks
- define the physical and mechanical properties of earth materials
- identify the work of rivers, wind and sea
- carry out geophysical methods of investigations
- select the building materials for construction.
- adopt modern materials in construction

Unit I - GENERAL GEOLOGY AND MINERALOGY: Geology in Civil Engineering – branches of geology – Earth structure and composition – continental drift and plate tectonics - Earth processes – weathering - work of rivers, wind and sea and their Engineering importance – symmetry elements of important crystallographic systems – physical properties of minerals – rock forming minerals – Quartz family, feldspar family, hornblende, calcite, garnet – Properties - behaviour - engineering significance of clay minerals

Unit II - PETROLOGY: Classification of rocks – Igneous, sedimentary and metamorphic rocks - Description, Occurrence and Engineering properties - uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist

Unit III - STRUCTURAL GEOLOGY: Geological maps – Attitude of beds – outcrops - study of structures – folds, faults and joints – their bearing on Engineering investigations – Geological conditions necessary for construction of dams and Tunnels - Geophysical methods – Seismic and electrical methods for subsurface investigations

Unit IV - BUILDING MATERIALS: Stones - characteristics of stones – material property – Bricks – brick manufacture – classification - Properties of clay bricks - material test – Timber - Classification and identification of timber - Defects in timber, seasoning and preservation of timber - Cement and Concrete – raw material – manufacture methods – types and properties of cement - Steel– alloy steels – plain and deformed bars –Aluminium – Glass.

Unit V- MODERN MATERIALS: Glass – Ceramics – Sealants for joints – Rubber – Plastics - Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geomembranes and Geotextiles for earth reinforcement - colour coated sheets, insulated wall panels

Text Books:

1. Parbin Singh, “Engineering and general Geology”, Katson publication House, 2010.
2. Varghese P.C., “Building materials”, Prentice Hall, 2005.

Reference Books:

1. Gokhale K.V.G.K. “Principles of Engineering Geology”, BS Publications, 2010
2. Bell F G., “Fundamentals of Engineering Geology”, Butterworth-Heinemann, 2007
3. Chenna Kesavulu., “Textbook of Engineering Geology” 2nd Edition, Macmillan Publishers India Ltd. 2009
4. Rangwala, S.C., “Engineering Materials”, Charotar Publishing House, Anand, 2008.
5. Surendra Singh, “Building Materials”, Vikas Publishing Company, New Delhi, 1996.

17CE2002 SURVEYING

Credits: 3:0:0

Course Objectives:

- Introduce the principle of surveying methods
- Teach different methods of surveying
- Learn the surveying applications in Civil Engineering

Course Outcomes:

At the end of the course, the student will be able to

- recall the principles of surveying equipments
- select methods to measure angles and distances
- schedule field surveying operations
- examine the implementation of surveying procedures for setting out curves
- appraise the usage of equipments and methods in triangulation survey
- formulate the surveying methods and executions

Unit I - INTRODUCTION AND LEVELLING: Surveying- basic concepts- ranging – chain surveying - compass surveying- principles and practices – levelling-Instruments – bench marks - fly, check, profile and block levelling -Temporary and permanent adjustments – Booking – Reduction- arithmetic checks – longitudinal and cross sectioning – Curvature and Refraction correction – Reciprocal levelling – Contouring-characteristics and uses

Unit II - THEODOLITE SURVEYING: Theodolite–Principle and practices –Types- Temporary and permanent adjustments- Horizontal and vertical angles – repetition and reiteration methods – Traversing - Closing error and distribution-Bowditch's and Transit rule – Omitted measurements -Heights and distances-Single plane-Double plane method

Unit III - TACHEOMETRIC SURVEYING: Tacheometric surveying - Principle of stadia method – Distance and elevation formulae for staff held vertical – Instrumental constants - Anallactic lens -Tangential method- Subtense bar.

Unit IV - CURVES: Curve Surveying: Types of curves - Elements of simple curves – Setting out simple curves by linear and angular methods – Introduction to transition curve: requirements and functions.

Unit V - TRIANGULATION AND MODERN INSTRUMENTS: Classification of triangulation systems - Intervisibility and height of stations - Signals and towers – Base line corrections: temperature, pull, sag and slope - Satellite stations: reduction to centre.Introduction to total station- Basic Principle – Classifications - Sources of Error, Infrared and Laser Total Station instruments- EDM, and Aerial photographic survey

Text Books:

1. Basak, N., “Surveying and Levelling”, McGrawHill & Co., New Delhi 2015.
2. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2016

Reference Books:

1. Arthur Bannister, Stanley Raymond, Raymond Baker, “Surveying”, Pearson, 2009.
2. Duggal, S.K., “Surveying”, Volume I and 2, McGraw Hill & Co., Third Edition, 2009

17CE2003 STRENGTH OF MATERIALS – I

Credits: 3:1:0

Course Objectives:

- To learn fundamental concepts of stress, strain and deformation of solids with applications to bars, beams and trusses.
- To know the mechanism of load transfer in beams, the induced stress resultants and deformations.
- To understand the effect of torsion on shafts and springs.

Course Outcomes:

At the end of the course, the student will be able to

- define the fundamental concepts of stresses and strains in one dimensional and two dimensional states
- sketch shear force and bending moment diagram for determinate beams
- interpret the stresses acting on plain trusses
- calculate deflection for determinate beams under standard loading condition

- evaluate the power required for the shaft
- predict springs for its maximum energy storage capacities

Unit I - STRESS, STRAIN AND DEFORMATION OF SOLIDS: Rigid and deformable bodies – Stability, strength and stiffness - Axial and Shear Stresses – Deformation of simple and compound bars- Stress strain behavior of ductile and brittle material in uniaxial state of stress – Biaxial state of stress- Thermal stresses – Elastic Constants and its relations - Principal planes and principal stresses and its determination using Mohr's circle.

Unit II - ANALYSIS OF PLANE TRUSSES: Stability and equilibrium of plane frames – Types of frames- Assumptions-Types of Trusses – Analysis of forces in truss members – Method of joints – Method of tension coefficient – Method of sections

Unit III - BENDING OF BEAMS: Beams – Types and transverse loading on beams – Shear force and bending moment in beams – Cantilever beams – Simply supported beams and over-hanging beams - Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Leaf springs – Flitched beams – Shear stress distribution.

Unit IV - TORSION: Theory of simple torsion - Stresses and deformation in circular and hollow shafts – Stepped shafts – Shafts fixed at both ends – Stresses and deflection in helical springs- introduction to torsion of rectangular sections-warping

Unit V - DEFLECTION OF BEAMS: Double Integration method – Macaulay's method – Area moment method – Conjugate beam method for computation of slopes and deflections in determinate beams- deflection due to shear.

Text Books

1. Bansal R.K “Strength of Materials”, Laxmi Publications, 2004.
2. Rajput.R.K. “Strength of Materials”, S.Chand & Company Ltd., New Delhi 2014.

Reference Books

1. Egor.P.Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi 2001
2. Vazirani.V.N, Ratwani.M.M, Duggal .S.K “Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1”, Khanna Publishers, New Delhi 2014.
3. Timoshenko.S.P. and Young .D.H., “Elements of Strength of Materials”, V Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 2002.
4. Beer. F.P. & Johnston.E.R.“Mechanics of Materials”, Tata McGraw Hill, New Delhi 2010.
5. Subramaniam.R., “Strength of Materials”, Oxford university Press, 2005
6. Prakash Rao.D, “Strength of Materials”, University Press, 2002

17CE2004 MECHANICS OF FLUIDS

Credits: 3:1:0

Course Objectives:

- Introduction of fundamental concepts of fluid statics, kinematics and dynamics
- Application of the concepts of flow measurements and analysis of flow through pipes
- To introduce the concepts of boundary layer theory and flow around submerged objects

Course Outcomes:

At the end of the course, the student will be able to

- recall the behaviour of fluids under static condition, measure pressure changes and estimate total pressure on plane surfaces
- explain the flow pattern and the transport of mass, momentum and energy
- demonstrate flow measurement methods
- differentiate laminar and turbulent flows
- select method to design pipe flows including losses
- formulate and solve boundary layer problems

Unit I - INTRODUCTION: Fluid Properties – Newton's law of Viscosity – Classification of Fluids Fluid Statics Pressure – Pascal's law – Atmospheric, Absolute, Gauge and Vacuum pressures – Pressure measurement - Hydrostatics: Forces on plane and curved surfaces-Total pressure and Centre of pressure – Buoyancy and Metacentric height (Theory only)

Unit II - FLUID KINEMATICS: Types of flow – Stream line – Path line – Streak line – Stream tube – Control volume – Continuity equation – one dimensional and three dimensional flow – velocity potential and stream function free – and forced vortex flow Equations of Motion Euler's equation in one dimensional form – Bernoulli's equation

Unit III - FLOW MEASUREMENTS: Venturimeter – Orifice meter – Pitot tube – Mouthpiece and Orifice – Weirs and Notches – Rectangle, Triangular, Broad crested, Narrow Crested Laminar and Turbulent flows: Definition – Reynold's Experiment – Reynold's Number – Hagen Poiseuille equation for a circular pipe Turbulent flow Definition – Darcy Weisbach's equation – Moody's diagram – Friction factor for Laminar and Turbulent flow – for smooth and rough pipes

Unit IV - FLOW THROUGH PIPES: Loss of energy in pipes – Hydraulic Gradient, Energy Gradient – Major energy loss – Minor energy losses – Pipes in series and parallel –Equivalent pipe – Power transmission through pipes – Syphon – Water hammer (Definition)

Unit V - BOUNDARY LAYER FLOW: Boundary layer and its definition - Displacement thickness - Momentum thickness - Energy thickness - Laminar and turbulent boundary layers – Forces on submerged bodies.

Text Books

1. Modi, P.N. & Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 2007.
2. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 2008.

Reference Books

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2005.
2. Som S.R. & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2012.
3. Subramanya, K., "Fluid Mechanics and Hydraulic Machines", McGraw Hill India Pvt. Ltd., New Delhi, 2011
4. Yunus A.Cengel., "Fluid Mechanics", Tata McGraw Hill India Pvt. Ltd., 2010.

17CE2005 APPLIED HYDRAULICS AND HYDRAULIC MACHINERY

Credits: 3:0:0

Course Objectives:

- To learn the fundamentals on flow in open channels
- To introduce the concepts of boundary layer theory and flow around submerged objects
- To impart the knowledge on pumps and turbines

Course Outcomes:

At the end of the course, the student will be able to

- define the uniform flow conditions for channels
- recognize the non - uniform flow conditions for channels
- demonstrate the application of hydraulic jumps
- relate the physical parameters using dimensional analysis
- experiment on the impact of forces exerted by the jet on inclined, curved and stationary bodies
- investigate the selection and operation turbines and pumps

Unit I - UNIFORM FLOW: Definition and differences between pipe flow and open channel flow - Types of Flow, Properties of open channel - Fundamental equations - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force - Critical depth and velocity.

Unit II - NON UNIFORM FLOW: Gradually Varied Flow: Dynamic equations of gradually varied flow - Water surface flow profile classifications: Hydraulic Slope and Hydraulic Curve - Hydraulic Slope and Hydraulic Curve. Rapidly Varied Flow: Application of the energy equation for RVF - Critical depth and velocity - Critical, Sub-critical and Super-critical flow - Application of the momentum equation for RVF - Hydraulic jumps - Energy dissipation.

Unit III - DIMENSIONAL ANALYSIS AND SIMILITUDE: Fundamental and secondary dimensions – Dimensional Homogeneity – Rayleigh and Buckingham Pi methods – Similitude – Significance of Dimensionless Numbers – Classification of hydraulic models – Scale effect

Unit IV - TURBINES: Impact of Jet on vanes, Turbines - Layout and Components of Hydro-electric project - Reaction turbines - Francis turbine - Kaplan turbines - Draft tube - Performance of turbine, Headlosses and efficiency, Specific speed, Runway speed

Unit V - PUMPS: Centrifugal pumps - Minimum speed to start the pump - Reciprocating pumps - Classification and Working principle of reciprocating pumps - Comparison between centrifugal and reciprocating pumps.

Text Books

1. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S. Chand and Co., New Delhi, 2006.
2. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, Edition 9. 2011.

Reference Books

1. Modi, P.N. & Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 19th Edition, 2011
2. Jagadeesh Lal J, "Hydraulic Machines Including Fluidics", Metropolitan Book Co.Pvt Ltd.-New Delhi, 2016
3. Som, S.R. & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 3rd Edition, 2014
4. Hubert Chanson, "Hydraulics of Open Channel flow", Butterworth-Heineman Ltd., 2nd Edition, 2004.

17CE2006 STRENGTH OF MATERIALS - II

Credits: 3:1:0

Course Objectives:

- To learn the computation of deflection of beams and trusses using energy principles and to know the concept of analysis of indeterminate beams.
- To estimate the load carrying capacity of columns and analysis of three dimensional state of stress.
- To understand the concept of theories of failure of materials, unsymmetrical bending, shear center and fracture of materials.

Course Outcomes:

At the end of the course, the student will be able to

- find the slope and deflections of beams by energy principles
- sketch shear force and bending moment diagram for indeterminate beams
- calculate the crippling load of a column under different end conditions
- categorize failure of material
- evaluate thin, thick and compound cylinders
- explain the concepts of stress in three dimension

Unit I - ENERGY PRINCIPLES: Strain energy and strain energy density – Strain energy in axial force - Shear, flexure and torsion – Castigliano's and Engesser's theorems – Principle of virtual work – Application of energy theorems for computing deflections in beams – Maxwell's reciprocal theorem.

Unit II - INDETERMINATE BEAMS; Propped Cantilever and Fixed Beams – Fixed end moments reactions, slope and deflection for standard cases of loading — Continuous beams – support reactions and moments – Theorem of three moments – Shear Force and Bending Moment Diagrams.

Unit III - COLUMNS: Behaviour of short and long columns - Euler's theory of long columns – Critical loads for prismatic columns with different end conditions - Rankine-Gordon Formula - Eccentrically loaded long columns - Eccentrically loaded short columns - middle third rule – Core of section.

Unit IV - STATE OF STRESS IN THREE DIMENSIONS: Determination of principal stresses and principal planes – Volumetric strain – Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories – Application in analysis of stress, load carrying capacity and design of members. Interaction problems - Interaction curves.

Unit V - ADVANCED TOPICS: Unsymmetrical bending of beams - symmetrical and unsymmetrical sections, shear centre – stresses on curved beams for simple solid sections – Winkler Bach Formula –Thin cylinders- Thick cylinders – Compound cylinders - residual stresses, stress concentration, fatigue - torsion of thin walled sections

Text Books

1. Bansal R.K “Strength of Materials”, Laxmi Publications, 2004.
2. Rajput.R.K. “Strength of Materials”, S.Chand & Company Ltd., New Delhi 2014.

Reference Books

1. Egor.P.Popov, “Engineering Mechanics of Solids”, Prentice Hall of India, New Delhi 2001
2. Vazirani.V.N, Ratwani.M.M, Duggal .S.K, “Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1”, Khanna Publishers, New Delhi 2014.
3. Timoshenko.S.P. and Young .D.H., “Elements of Strength of Materials”, V Edition, Affiliated East-West Press Pvt. Ltd., New Delhi, 2002.
4. Beer. F.P. & Johnston.E.R., “Mechanics of Materials”, Tata McGraw Hill, New Delhi 2010.
5. Subramaniam.R., “Strength of Materials”, Oxford university Press, 2005
6. Prakash Rao.D, “Strength of Materials”, University Press, 2002

17CE2007 SOIL MECHANICS

Credits: 3:0:0

Course Objectives:

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.
- To familiarize the students on compaction, stress transformation, consolidation and shear strength of soils.
- To impart knowledge of design of both finite and infinite slopes.

Course Outcomes:

At the end of the course students will be able to

- examine three phase system in soil properties estimated using three phase system
- evaluate the index and engineering properties of soil
- predict the flow through soil
- estimate the magnitude of settlement due to consolidation process
- determine shear strength parameters and stress changes in soil
- assess both physical and engineering behaviour with stability analysis of slopes

Unit I - SOIL CLASSIFICATION AND COMPACTION: Soil description – Soil structure – Phase relation – Index properties – Particle size distribution – Atterberg’s limits – Indices - BIS classification – Compaction of soils – Laboratory tests – Field Compaction methods – Factors influencing compaction of soils

Unit II - EFFECTIVE STRESS AND PERMEABILITY: Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Two dimension flow – Darcy’s law – Permeability - Laboratory methods - Constant head - falling head methods – Stratified Strata - Factors influencing permeability of soils – Seepage - Laplace’s equation – Quick sand – Liquefaction - Flow nets.

Unit III - STRESS DISTRIBUTION AND SETTLEMENT: Stress distribution in homogeneous and isotropic medium – Boussinesq theory – Point load, Line load and udl – Westergaard’s solution - Use of New marks influence chart – Components of settlement — Immediate and consolidation settlement – Terzaghi’s one dimensional consolidation theory – Computation of rate of settlement. - $\sqrt{t}$ and $\log t$ methods – e - $\log p$ relationship.

Unit IV - SHEAR STRENGTH: Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters

Unit V - SLOPE STABILITY: Stability Analysis - Infinite slopes and finite slopes – Total stress analysis - Friction circle method – Use of stability number – Method of slices – Fellenious and Bishop’s method –Stability number - Slope protection measures.

Text Books

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 2011.
2. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers Distribution Ltd., New Delhi, 2015

Reference Books

1. McCarthy, D.F., “Essentials of Soil Mechanics and Foundations”. Prentice-Hall, 2006.

2. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
4. Gopal Ranjan and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age Ltd., International Publisher New Delhi (India) 2006.
5. Karl Terzaghi, “Soil Mechanics in Engineering Practice”, Read Books, 2010.

17CE2008 WATER SUPPLY AND WASTEWATER ENGINEERING

Credits: 3:0:0

Course Objectives:

- To learn the fundamentals on water supply and distribution
- To introduce the concepts of wastewater treatment and disposal
- To design water and wastewater treatment units.

Course Outcomes:

At the end of the course, the student will be able to

- select appropriate sources for water supply
- learn the characterization and testing of water and wastewater
- estimate the quantity and demand of water
- calculate the quantity of flow of wastewater
- design water and wastewater treatment units
- make use of available standards

Unit I - SOURCES, QUALITY AND DEMAND OF WATER: Sources – Types of demand - Population forecast - Computation of quantity – Design period – Physical Chemical and Biological characteristics - Tests – Water quality standards.

Unit II - TREATMENT OF WATER: Layout of water treatment plant – Theory and design principles of water treatment units – Sedimentation, Coagulation and flocculation, Filtration, Disinfection.

Unit III - CONVEYANCE AND DISTRIBUTION OF WATER: Types of pipes - Pipe joints – Laying and testing – Distribution – Methods, Systems and Layouts – Pipe appurtenances.

Unit IV - WASTEWATER ESTIMATION AND CHARACTERISTICS: Collection systems – Estimation of quantity – Sewer: section, materials, joints and hydraulics – Laying and testing of sewer – Appurtenances - Physical Chemical and Biological characteristics

Unit V - WASTEWATER TREATMENT AND DISPOSAL:

Layout of wastewater treatment plant – Theory and design principles of wastewater treatment units – Preliminary, primary, secondary and tertiary treatment methods - Disposal methods and standards

Text Books

1. S.K Garg, “Environmental Engineering (I & II)”, 28th edition, Khanna Publication, 2010.
2. B.C.Punmia, “Water Supply Engineering”, Laxmi Publications, 2012

Reference Books

1. Metcalf and Eddy, Inc., “Wastewater Engineering – Treatment, Disposal and Reuse”, 3rd Edition, McGraw Hill Book Co, N.Y. 1985
2. Raju, B.S.N., “Water Supply and Wastewater Engineering”, Tata McGraw-Hill Co., New Delhi, 1995.
3. Steel.E.W.and McGhee, T.J., “Water Supply and Sewerage”, 5th Edition, McGraw Hill International Editions, New York, 1988

17CE2009 DESIGN OF REINFORCED CONCRETE ELEMENTS

Credits: 3:0:0

Course Objectives:

- To understand the design philosophies of RCC elements
- To design the structural elements as per IS 456:2000
- To detail the reinforcement as per the design

Course Outcomes

At the end of the course, the student will be able to

- examine the design philosophies for rcc elements
- demonstrate the behaviour of elements for load calculations
- illustrate the lsm for estimating stress resultants
- select sections based on stress resultants
- design the reinforcement for the structural elements
- estimate the safety of the designed sections
- develop suitable detailing diagrams

Unit I - DESIGN PHILOSOPHY: Design Concept of Working stress method, ultimate load method and limit state method – Design codes and specification – Limit state of collapse & serviceability, partial safety factors for material & loading. Stress-strain characteristics of concrete & reinforcing steel, Type of section-under reinforced, over reinforced & balance section- Design of sections for flexure using working stress method.

Unit II - LIMIT STATE DESIGN OF SLABS: Analysis and design of one way, two way and continuous slabs and cantilever slabs subjected to various boundary conditions

Unit III - LIMIT STATE DESIGN OF BEAMS: Analysis and design of singly, doubly reinforced rectangular and flanged beams – Design for bond & anchorage, deflection and torsion.

Unit IV - LIMIT STATE DESIGN OF COLUMNS: Introduction to types of columns – Braced and unbraced columns -Design of short column - axially loaded, uniaxial bending, biaxial bending, long column.

Unit V - LIMIT STATE DESIGN OF FOOTING: Design of wall footing – Design of axially and eccentrically loaded rectangular and sloped footings – Design of combined rectangular footing for two columns only.

Text Books

1. Unnikrishna Pillai and Devdass Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd., 2003
2. Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi, 2007

Reference Books

1. Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, 2002
2. Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., 2006
3. Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi 2005
4. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
5. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.

17CE2010 STRUCTURAL ANALYSIS I

Credit: 3:1:0

Course Objectives:

- To understand the methodology of analysis
- To know the different techniques available for the analysis of structures
- To identify the best suitable method of analysis

Course Outcomes:

At the end of the course, the student will be able to

- choose strain energy methods for solving various structural elements
- distinguish determinate and indeterminate structures for determining moments
- identify the method of solving determinate and indeterminate structures

- compare the force method and deflection method
- analyze the moving loads using influence diagram
- predict failure of structure using plastic hinge analysis

Unit I - STRAIN ENERGY METHOD: Static indeterminacy - Strain energy method - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures - temperature effect - bending moment and shear force diagram.

Unit II - SLOPE DEFLECTION METHOD: Kinematic indeterminacy - Slope deflection method - analysis of continuous beams and portals - bending moment and shear force diagram.

Unit III - MOMENT DISTRIBUTION METHOD: Moment distribution method - analysis of continuous beams and portals - Sway and non sway analysis - bending moment and shear force diagram

Unit IV - INFLUENCE LINES: Influence line - influence lines for bending moment and shear force - Maxwell's reciprocal theorem - Muller Breaslau's - principle, determinate and indeterminate beams

Unit V - PLASTIC ANALYSIS: Statically indeterminate structures - Beams in pure bending - Plastic moment of resistance - Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - Static and kinematic methods - Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

Text Books

1. Vazirani & Ratwani, Analysis of Structures, Vol. 1 & II, Khanna publishers, 2003.
2. Bhavikatti, S., "Structural Analysis", Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2011

Reference Books

1. Vaidyanathan, R. and Perumal, P., "Structural Analysis", Vol.1 & 2, Laxmi Publications, New Delhi, 2014
2. S.Ramamrutham, "Theory of structures", Dhanpat Rai publications, 2004
3. C.S.Reddy, "Structural Analysis", Tata McGraw Hill, 2002
4. L.S.Negi, "Structural Analysis", Tata McGraw Hill Co., 2003
5. Rajasekharan & Sankarasubramaiaam, "Computational Structural Mechanics", Prentice-Hall of India. 2000

17CE2011 STRUCTURAL ANALYSIS II

Credit: 3:1:0

Course Objectives:

- To develop analytic and critical skills through mathematical and visual study of structures
- To differentiate between rigid and deformable structures.
- To understand the principle of force and displacement methods

Course Outcomes:

At the end of the course, the student will be able to

- recall the fundamental concepts of structural analysis
- choose structural matrices method for analyse the structure
- analyse typical structures such as three hinged and two hinged arches
- analyze of cables and suspension bridges
- execute analysis of trusses, continuous beams and rigid frames using matrix force method
- determine responses of the structures

Unit I - ARCHES: Three hinged arch - Two hinged arch - parabolic and semi-circular arches - Concentrated loads - Uniform loads - Temperature effects - Determination of Reaction, Normal Thrust, Radial shear and Bending Moment - Influence line for Stress Resultants in two hinged and three hinged arches - load position for maximum values.

Unit II - SUSPENSION CABLES AND BRIDGES: Cables and suspension bridges with three hinged stiffening girders

Unit III - SPACE FRAMES: Three Dimensional Frames (Determinate) Analysis of pin jointed Space frames - forces in various members - Analysis of Rigid jointed space frames - Determination of stress resultants - Application to Simple problems -Use of Analysis Software for application to space trusses.

Unit IV - CHARACTERISTICS OF FLEXIBILITY AND STIFFNESS MATRICES -FLEXIBILITY METHOD: Definition - Application of Principle of Superposition - Properties - Application to Two Degree of Freedom systems - Structure and element co-ordinates - Transformation of force and displacement - Structure flexibility in terms of element flexibility - Structure stiffness in terms of element stiffness. Forces not acting at co-

ordinates - Formulation of Structure Flexibility matrix - Determination of Displacements - Application to determinate and indeterminate trusses, beams, frames - Effect of Temperature, lack of fit

Unit V - STIFFNESS METHOD: Forces not acting at co-ordinates _ Formulation of Structure Stiffness matrix - Determination of Displacements - Application to determinate and indeterminate trusses, beams, frames - Effect of Temperature, lack of fit - Static Condensation Technique. - Use of analysis software for application to the analysis of plane trusses and frames.

Text Books

1. Reddy C S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Co., 2010.
2. Rajasekaran,S., Sankarasubramanian,G., “Computational Structural Mechanics”, Prentice Hall of India, 2004

Reference Books

1. Mukhopadhyay M, “Matrix Finite Element Computer and Structural Analysis”, Oxford & IBH, 2002.
2. McGuire W and Gallagher R H, “Matrix Structural Analysis”, John Wiley & Sons, 2014.
3. Devdas Menon, “Advanced Structural Analysis”, Alpha Science Publications 2009
4. Igor A. Karnovsky and Olga I. Lebed, “Advanced Methods of Structural Analysis”, springer, 2010

17CE2012 CONSTRUCTION PRACTICES

Credit: 3: 0: 0

Course Objectives:

- Acquire knowledge about site planning and construction of foundations
- Adopt various methods of constructions and service requirements
- Selection and usage of equipments for construction

Course Outcomes:

At the end of the course, the student will be able to

- identify suitable materials required for construction
- explain construction methodology for different types of construction
- demonstrate the temporary construction methods
- categorize the service requirements for the construction
- examine the distress in the construction
- adapt the safety in the construction site.

Unit I - FIELD PRACTICES: Building Planning - Foundations – Shallow and Deep Foundations – setting out - Stone masonry – Brick masonry – Composite masonry – Plastering and Pointing - Flooring - Roofs and roof covering - Damp proofing – Termite proofing

Unit II - CONSTRUCTION METHODS: Construction sequence - Reinforced Concrete framed structures - Construction of R.C.C. slabs, Beams and Columns – Construction methods: Pre-cast and cast-in-situ concrete, steel – load bearing structures – underwater construction

Unit III - FORMWORK AND SCAFFOLDING: Formwork – Centering and Shuttering – Sheet piles – Slip and moving forms — Joints in Concrete — Shoring – Scaffolding– Underpinning

Unit IV - CONSTRUCTION EQUIPMENT: Selection of equipment for earthwork, concreting, material handling and erection of structures – Dewatering and pumping equipments- RMC–transit mixers - placement techniques - pumping of concrete

Unit V - CONSTRUCTION SAFETY: Quality and Safety Concerns in Construction - Accidents and their Causes – Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment – safety design

Text Books

1. Varghese, P. C., “Building Constructions”, Prentice Hall, New Delhi 2007.
2. Bhavikatti S, “Building Constructions”, Prentice Hall, New Delhi 2007.

Reference Books

1. Arora, S. P. and Bindra S. P., “Building Construction”, Dhanpat Rai and Sons, New Delhi, 1997.
2. Punmia, B. C., “Building Construction”, Laxmi Publications (P) Ltd., New Delhi, 1993.
3. Peurifoy, R. L., “Form work for Concrete Structures”, McGraw Hill Book Co., 1999.

- Richard J. Coble, Jimmie Hinze and Theo C. Haupt, "Construction Safety and Health Management", Prentice Hall Inc., 2001

17CE2013 FOUNDATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- To impart knowledge on site investigation programme.
- To select geotechnical design parameters and type of foundations.
- To familiarize the geotechnical design of different type of foundations and retaining walls.

Course Outcomes:

At the end of the course, the student will be able to

- interpret soil investigations
- examine the bearing capacity of soils and foundation settlements
- identify the suitable foundation for construction
- design the foundation system for shallow depth
- analyses earth retaining structures for different soil mediums
- estimate pile and pile group capacity

Unit I - SITE INVESTIGATION AND SELECTION OF FOUNDATION: Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Bore log report - Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Selection of foundation based on soil condition

Unit II - BEARING CAPACITY: Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits from plate load test – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements – ground improvement techniques

Unit III - SHALLOW FOUNDATION: Isolated footing - Combined footing - Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations – Structural design of isolated and combined footing - Floating foundation.

Unit IV - PILE FOUNDATION: Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae - Engineering news and Hiley's – Capacity from insitu tests -SPT and SCPT – Negative skin friction – Uplift capacity- Group capacity by different methods - Feld's rule, Converse – Labarra formula and block failure criterion – Settlement of pile groups – Interpretation of pile load test -Under reamed piles

Unit V - RETAINING WALLS: Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provision.

TextBooks

1. Arora, K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.
2. Varghese, P.C., "Foundation Engineering", Prentice Hall of India Private Limited, NewDelhi, 2005.

Reference Books

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors Ltd., New Delhi, 2015.
2. GopalRanjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International (P) Ltd, New Delhi, 2006.
3. Das, B.M. "Principles of Foundation Engineering" (Eighth edition), Thompson Asia Pvt. Ltd., Singapore, 2013.

4. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
5. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt.Ltd. New Delhi, 2005.
6. Venkatramaiah, C., "Geotechnical Engineering", New Age International Publishers, New Delhi, 2007.
7. Karl Terzaghi, "Soil Mechanics in Engineering Practice", Read Books, 2010.

17CE2014 DESIGN OF STEEL STRUCTURES

Credits: 3:0:0

Course Objectives:

- Acquire knowledge on limit state design of steel structural elements
- Ability to explain and design bolted and welded connection
- Design the structural systems such as roof trusses, gantry girders as per provisions of current code (IS 800 2007) of practice.

Course Outcomes:

At the end of the course the students will be able to

- classify different types of steel connections
- recommend suitable type of connection
- assess the strength of steel connections
- explain the behaviour of steel structural elements
- design steel structural elements
- differentiate the types of roof trusses.

Unit I - INTRODUCTION TO STEEL CONNECTIONS: Properties of structural steel – Classification of steel sections – Limit State Design Concepts – Loads and load combination – Connections - welding, bolting – Design of bolted and welded joints – Eccentric connections - Efficiency of joints.

Unit II - DESIGN OF TENSION MEMBERS: Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of Connections in tension members – Lug angles – Design of tension splice – Concept of shear lag.

Unit III - DESIGN OF COMPRESSION MEMBERS: Types of compression members – Theory of columns – Compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of laced and battened type columns – Design of column bases – Gusseted base.

Unit IV - DESIGN OF BEAMS: Design of laterally supported and unsupported beams – Built up beams – Beams subjected to Uniaxial and biaxial bending – Design of welded plate girders - Intermediate and bearing stiffeners

Unit V - DESIGN OF ROOF TRUSSES: Roof trusses – Types - Loading - Roof and side coverings – Design of purlin and elements of truss; end bearing –Design of gantry girder.

TextBooks

1. L.S Jayagopal & D.Tensing, "Design of Steel Structures" Vikas Publications , 2015
2. Duggal. S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2014

Reference Books

1. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013
2. Shiyekar. M.R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
3. Bhavikatti.S.S, "Design of Steel Structures by Limit State Method as per IS:800–2007", IK International Publishing House Pvt. Ltd., 2014
4. Shah.V.L. and Veena Gore, "Limit State Design of Steel Structures", IS 800–2007 Structures Publications, 2009.
5. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
6. IS 800 :2007, General Construction in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007

17CE2015 TRANSPORTATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- To understand the importance of transportation and characteristics of different modes of transportation
- To study about the geometric design of highways
- To impart knowledge in planning, geometric design, construction, operation and maintenance of Highways, Railways, Airports and Harbours

Course Outcomes:

At the end of the course, the student will be able to

- understand the concepts of highway planning, design and project formulation
- carry out surveys involved in planning and highway alignment
- design cross section elements, sight distance, horizontal and vertical alignment
- describe different types of highway pavements
- recognize the importance of different elements of permanent way in railways
- generalize the constituents and basic design concepts of airports and harbours

Unit I - HIGHWAY DEVELOPMENT AND PLANNING: Different modes of transportation – characteristics - historical Development of road construction- Highway Development in India –Classification of roads-Road patterns- Planning Surveys – Highway planning in India- Highway alignment - Engineering Surveys for Highway Locations – Highway project – Built operate and transfer (BOT)

Unit II - GEOMETRIC DESIGN OF HIGHWAYS: Highway cross sectional elements- Sight Distance – Design of horizontal alignment - Super elevation- Extra-widening of Pavements on horizontal curves- Transition Curves- Set-back Distance- Design of Vertical alignment – Gradients- summit and Valley Curves

Unit III - HIGHWAY MAINTENANCE AND DRAINAGE: Pavement Failures –Flexible and Rigid Pavement – Maintenance of Highways –Pavement Evaluation -Importance of highway drainage - Surface Drainage- Subsurface drainage - Road construction in water logged areas– maintenance of various roads - Road side development and arboriculture - Problems on Hill Roads

Unit IV - RAILWAY ENGINEERING: Railway Transportation and its development – Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Subgrade and Embankment – Track Alignment – Survey for track alignment – Points and crossing – Track Junctions – Station and Yards – Signalling & control System

Unit V - AIRPORTS AND HARBOURS: Airport Planning-Airport Components –Apron, Terminal Building, Passenger facilities & Services, Hangers, Runway, Parking Area - Airport Obstructions- Runway Orientation – Wind rose Diagram – Runway design- Harbours – History of water transportation – Modern trends in water transportation- components of harbour –Requirements of Harbour- Classification of harbours – Site Selection and Planning of harbours - ports and docks – Navigational Aids

Text Books

1. Khanna .S.K, Justo .C.E.G, “Highway Engineering,” Nemchand & Bros, 2001.
2. Partha Chakroborty and Animesh Das, “Principles of Transportation Engineering”, Prentice Hall of India, New Delhi, 2003.

Reference Books

1. Kadiyali.L.R. “Principles and Practice of Highway Engineering”, Khanna Technical Publications, 8th edition Delhi, 2013.
2. Rangwala, “Railway Engineering”, Charotar Publishing House, 2013.
3. Mundrey J.S. “A course in Railway Track Engineering”. Tata McGraw Hill, 2007.
4. Rangwala, “Airport Engineering”, Charotar Publishing House, 2013.
5. Rangwala, “Harbor Engineering”, Charotar Publishing House, 2013.
6. Oza.H.P. and Oza.G.H. “A course in Docks & Harbour Engineering”. Charotar Publishing Co., 2013
7. Saxena Subhash C and Satyapal Arora, “A Course in Railway Engineering”, Dhanpat Rai and Sons, Delhi, 2003
8. Satish Chandra and Agarwal M.M, “Railway Engineering”, 2nd Edition, Oxford University Press, New Delhi, 2013.
9. Khanna .S. K, Arora .M, G Jain .S.S, “Airport Planning and Design” Nemchand and Bros, Roorkee, 2005.
10. Bindra .S.P. A “Course in Docks and Harbors Engineering”, Dhanpat Rai and Sons, New Delhi, 2001.

17CE2016 CONCRETE TECHNOLOGY

Credit: 3:0:0

Course Objectives:

- To acquire knowledge on constituents of concrete materials
- To study the properties of fresh and hardened concrete
- To design the concrete mixes

Course Outcomes:

At the end of the course, the student will be able to

- identify the functional role of ingredients of concrete
- predict the properties of fresh and hardened concrete
- illustrate the durability of concrete
- demonstrate techniques of non destructive testing of concrete structures
- appraise innovative materials for use in concrete
- design a concrete mix based on various parameters

Unit I - CONCRETE MATERIALS: Cement: Composition and properties of Portland cement - tests on material properties - cement types - composition - properties - uses under different constructional and weather conditions - IS code specifications - Water: Requirements of water for concrete making - IS Code specifications - Aggregates: Classification - Mechanical Properties - deleterious substances in aggregates - Bulking of sand - Alkali Aggregate reaction - Grading requirements - IS Code specifications - Admixtures: Admixtures and Construction chemicals

Unit II - FRESH CONCRETE AND HARDENING OF CONCRETE: Fresh Concrete: Workability - Factors affecting workability - Tests for workability - Segregation - Bleeding - Process of manufacture of concrete - creep and shrinkage - Maturity of concrete - Micro cracking - autogeneous healing - Evolution of heat and expansion - effect due to chemical, temperature - Hardened Concrete: Strength Test: Compression test – Split Tension test - Flexure Test - Test for Bond strength– Determination of modulus of elasticity - IS Code provisions - Accelerated strength tests - non-destructive strength evaluation -In site strength determination - Factors affecting strength test results – concrete quality check.

Unit III - DURABILITY : Strength and durability relationship –Impact of W/C ratio on strength and durability - Permeability – Chloride penetrability – impact strength-Acid attack: mineral and organic acids – corrosion of steel- Thermal expansion and shrinkage – Freezing and Thawing – Carbonation attack - Sulphate attack - Fire resistance - Resistance to Abrasion, erosion and Cavitation - Acoustic properties - creep of concrete - factors influences it - Marine atmosphere - Methods to improve durability

Unit IV - MIX DESIGN: Concept - basic consideration- mix design methods - BIS method, American concrete institute method, and British codal method of mix design - mix design for concrete with flyash

Unit V - SPECIAL CONCRETES: Light weight concrete- Aerated concrete – no fines concrete – high density concrete – Sulphur infiltrated concrete – fiber reinforced concrete – prepacked concrete – shotcrete – vacuum concrete – ferrocement – self compacting concrete – bacterial concrete – Geo polymer concrete - behavior of concrete with rice husk, nano materials like silicafume

Text Books

1. A.R. Santhakumar, “Concrete Technology” Oxford University press, Jai Singh road, Delhi, 2006
2. Shetty, M.S., “Concrete Technology”, S.Chand & Co., New Delhi, 2005

Reference Books

1. Gambhir, M.L., “Concrete Technology”, Tata Mc Graw Hill Publishing Company limited, New Delhi, 2004
2. Neville, A.M, “Properties of Concrete”, Longman Scientific & Technical, England, 1995
3. Neville, A.M., “Concrete Technology”, Longman Scientific & Technical, 1990.

17CE2017 ESTIMATION AND COSTING

Credits: 3:0:0

Course Objectives:

- To understand the types of estimates
- To identify the methods used for different structural components
- To understand rate analysis and process of preparation of bills

Course Outcomes:

At the end of the course, the student will be able to

- list the detailed specification for different types of structures
- explain valuation reports and cost quality control
- plan the rate analysis of civil engineering works
- determine the rates of various items of civil works
- justify estimated cost of civil construction projects
- evaluate the actual value of any property

Unit I - INTRODUCTION TO ESTIMATES AND SPECIFICATIONS: General introduction to Quantity surveying–purpose of estimates - Types of estimates - various items to be included in estimates - Principles in selecting units of measurement for items, various units and modes of measurement for different trades - I.S. 1200, Specifications – purpose and basic principles of general and detailed specifications: detailed specifications for various items of work.

Unit II - ANALYSIS OF RATES: Rate analysis & preparation of bills – Data analysis of rates for various items of works – abstract estimates for Building projects

Unit III - QUANTITY ESTIMATION FOR BUILDING AND SANITARY: Estimation of building – Method of estimate, estimate of walls, Estimate of masonry platform - estimate of single room building with verandah - estimate of two roomed building - Sanitary - Estimation of a septic tank and soak pit

Unit IV - QUANTITY ESTIMATION FOR RCC WORKS AND STRUCTURES AND ROADS: Estimate of R.C.C and Steel works - RCC Slab – RCC beam – RCC column with foundation, RCC framed building. Road- RCC slab culvert Detailed estimate for WBM, Bituminous road.

Unit V - VALUATION: Valuation- rent fixation, Gross income, Net income, Depreciation, different methods of calculating depreciation–straight line method, declining balance method, sinking fund method, plinth area required for residential building

Text Books

1. Dutta.B.N, “Estimating and Costing in Civil Engineering Theory and Practice,” 2002.
2. Birdie.G.S, “A Text Book on Estimating and Costing”, DhanpatRai and Sons, New Delhi, 2000.

Reference Books

1. Jogleka.P.T, “Practical Information for Quantity Surveyors”, Institution of Surveyors, 1978.
2. Rangwala.S.C, “Elements of Estimating and Costing”, Charotar Publishing House, Anand, 1987.
3. Rangwala .S.C, “Valuation of Real Properties”,Charotar Publishing House, Anand, 1984.
4. Jagannathan.G, “Getting More at Less Cost”,-The Value Engineering Way, Tata McGraw Hill, New Delhi, 1992.

17CE2018 STRENGTH OF MATERIALS LABORATORY

Credits: 0: 0: 2

Course Objectives:

- To apply the theory of mechanics of solids on real specimens
- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally

Course Outcomes

At the end of the course, the student will be able to

- demonstrate the application of theories
- evaluate the quality of the materials
- identify the behavior of structural materials.
- categorise the material based on their property
- examine the material behaviour
- suggest the quality materials for constructions

List of experiments:

1. Tension test on mild steel rod
2. Double shear test on metal
3. Brinell Hardness Tests

4. Rockwell Hardness Tests
5. Charpy Impact test
6. Izod Impact test
7. Test on Helical Springs open coiled
8. Test on Helical Springs closed coiled
9. Static bending test on wood
10. Deflection Test on Cantilever Beam
11. Torsion test on mild steel rod
12. Compressive strength of Burnt clay
13. Deflection Test – Carriage Spring
14. Torsion test on Mild steel Rod
15. Study on Fatigue test
16. Study on cold Bend Test on Steel

Reference Books:

1. Jindal, U.C, “Strength of Materials”, Asian Books Pvt. Ltd, 2007.

17CE2019 COMPUTER AIDED BUILDING DRAWING LAB

Credit: 0:0:2

Course Objectives:

- To adopt the principles of building planning by laws in drawing
- To draft the plan, elevation and section of various structures
- Create architectural drawings using modern softwares.

Course Outcomes

At the end of the course, the student will be able to

- define the principles of civil engineering drawing and planning
- perform computer aided drafting of building components and systems
- develop plan, elevation section and site plan of various types of buildings
- build architectural plan and elevation using appropriate software.
- detail interior design in various building drawings
- explain the landscape drawing for various buildings

List of experiments:

1. Introduction to planning and drafting softwares
2. Building Cross section
3. Plan, elevation and section of residential building
4. Plan, elevation and section of school building
5. Plan, elevation and section of auditorium building
6. Plan, elevation and section of hostel building
7. Plan, elevation and section of hospital building
8. Architectural drawing of residential building
9. Architectural drawing of commercial building
10. Architectural drawing of industrial building
11. Architectural drawing of Stadium
12. Architectural drawing of nuclear plant

Reference Books

1. Balagopal Prabhu, T. S., “Building Drawing and Detailing”, Spades Publishing, KDFA Building, Calicut, 2012.
2. Sikka V.B, “A Textbook of Basic Drawing for Architects and Civil Engineers”, S.K. Kataria & Sons; 2015 edition
3. AUTO CAD Tutorials and Manual- Autodesk Work Book on AUTO CAD Level I and II CAD/CAM centre, Coimbatore.
4. Gurucharan Singh, “Civil Engineering Drawing”, Standard Publications; New Delhi, 2009.

5. IS: 962 – 1967, Code of Practice for Architectural and Building Drawing, Bureau of Indian Standards, New Delhi
6. IS: 4021 – 1983, Specification for Timber Door, Window and Ventilator Frames, Bureau of Indian Standards, New Delhi
7. IS: 1003 – 1977, Part I, II Specification for Timber Panelled and Glazed Shutters, Bureau of Indian Standards, New Delhi

17CE2020 CIVIL ENGINEERING PRACTICES LABORATORY

Credit: 0:0:1

Course Objectives:

- Introduce the application of civil engineering theory in to practices.
- Analyze and design bar bending schedule and welding joints.
- Impart knowledge on using modern equipment in civil engineering

Course Outcomes:

At the end of the course, the student will be able to

- list electrical and plumbing work for buildings and factories
- outline the foundation marking using modern survey equipment
- select appropriate flooring for building work
- explain the bar bending schedule to supervisors
- measure the strength of welding joints
- construct a brick masonry wall

List of experiments:

1. Foundation Marking Using Total Station
2. Practices in Brick Masonry Construction
3. Practices in Brickwork Plastering
4. Welding Practices in Civil Engineering
5. Preparation of Bar bending Schedule
6. Engineering Practices in Plumbing Services
7. Engineering Practices in Electrical Services

Reference Books

1. Saravanapandian M, Pranitha S, Jeyapoovan T., “Engineering Practices Laboratory Manual”, VRB Publishers Private Ltd 2009
2. Jeyachandran.K, Natarajan.S and Balasubramanian.S. “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
3. Bawa.H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad.A and Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.

17CE2021 FLUID MECHANICS AND MACHINERY LABORATORY

Credit: 0:0:2

Course Objectives:

- To give hands on training on principle and working of different flow measuring instruments
- To impart knowledge on working of different types of turbines.
- To demonstrate energy losses in pipe connections

Course Outcomes:

At the end of the course, the student will be able to

- recall the principles of instruments used in flow related measurements
- describe the flow measurement methods
- demonstrate energy losses in pipe connections
- appraise the flow measurement techniques
- experiment and select turbines and pumps
- investigate the operation of turbines and pumps

EXPERIMENTS:**Fluid Mechanics**

1. Determination of Darcy's Friction Factor.
2. Calibration of Flow Meters.
3. Flow over weirs / Notches.
4. Flow through Mouth piece / orifice.
5. Determination of Minor Losses in pipes
6. Determination of Manning's Co-efficient of Roughness.
7. Calibration of pressure Gauges.
8. Impact of jet on vanes.
9. Reynolds' Experiment.

Fluid Machinery

1. Performance of Centrifugal Pump
2. Performance of Submersible Pump
3. Performance of Reciprocating pump
4. Performance of Gear Oil pump
5. Performance of Jet pump
6. Performance of Vertical Turbine pump
7. Load Test on Pelton Wheel.
8. Load Test on Francis Turbine
9. Load Test on Kaplan Turbine

Reference Books

1. Modi, P.N. & Seth, S.M., "Hydraulics and Fluid Mechanics Including Hydraulics Machines", Standard Book House, New Delhi, 10th Edition, 2002
2. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 2008.
3. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2010

17CE2022 SURVEYING LAB**Credits: 0:0:2****Course Objectives:**

- To train the students to acquire skill in operation of various survey instruments
- To give hands on training on the use of conventional and modern tools of surveying
- To enhance the knowledge of the students to carryout and interpret the field surveying procedures

Course Outcomes:

At the end of the course, the student will be able to

- memorize the procedures of usage of surveying instruments
- identify the method for a typical survey
- demonstrate the appropriate methods of surveying
- organize the field operations during surveying
- judge the mistakes during surveying execution
- construct layouts and diagrams as per the field data

EXPERIMENTS:

1. Use of Dumpy level - fly levelling
2. Use of Dumpy level – reciprocal levelling
3. Measurement of horizontal angles by the method of repetition
4. Measurement of horizontal angle by the method of reiteration
5. Single plane method
6. Double plane method
7. Stadia tacheometry and determination of constants of a theodolite
8. Tangential tacheometry
9. Setting out a simple circular curve by ordinates from long chord
10. Setting out a circular curve by Rankine's method of tangential angles
11. Measurement of area using Total station

12. Measurement of volume using Total station

Reference Books:

1. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Part 1 & 2, Pune, Vidyarthi Griha Prakashan, 2011.
2. Basak, N., “Surveying and Levelling”, McGrawHill& Co., 2015.

17CE2023 GEOTECHNICAL ENGINEERING LABORATORY

Credits: 0:0:2

Course Objectives:

- To provide the hands on training in determination of Engineering and index properties of soils, applied in field problems.
- To provide the knowledge on the use of experimental results pertaining to foundation problems
- To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test and unconfined compressive test

Course Outcomes:

At the end of the course, the student will able to

- determine the index properties of soil
- determine the insitu density and compaction characteristics of soil
- determine the engineering properties of soil
- calculate the shear strength parameters of the soil
- analyse the settlement of the saturated soil
- determine the optimum moisture content and dry density of the soil

LIST OF EXPERIMENTS

1. Determination of moisture content using i) Oven drying method and ii) Infrared moisture balance iii) Pycnometer
2. Determination of moisture content and specific gravity of soil
3. Determination of relative density of soil
4. Grain size distribution using Sieve Analysis
5. Grain size distribution using Hydrometer Analysis
6. Standard Proctor compaction test
7. Determination of field density using i) Sand replacement method and ii) core cutter method
8. Determination of Liquid limit & Plastic limit
9. Determination of Shrinkage limit
10. Permeability test using i) Constant head method and ii) Variable head method
11. Direct shear test
12. California bearing ratio test
13. Unconfined Compression test
14. Consolidation Test
15. Triaxial Compression test

Reference Books:

1. Saibaba Reddy, E. Ramasastri, K. “Measurement of Engineering Properties of Soils”, New age International (P) limited publishers, New Delhi, 2008
2. Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.
3. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
4. G.Venkatappa Rao and Goutham .K. Potable, “Geosynthetics Testing – A laboratory Mannual”, Sai Master Geoenvironmental Services Pvt. Ltd., 1st Edition 2008.

17CE2024 ENVIRONMENTAL ENGINEERING LABORATORY

Credits: 0: 0: 2

Course Objectives:

- To give hands on training on water quality analysis
- To carry out the quantitative estimation of water quality parameters.
- To interpret the quality of water and wastewater

Course Outcomes

After completion of the course the student will have:

- recall the principles of environmental experiments related to water quality
- select appropriate method to quantify a water quality parameter
- demonstrate the experiments related to bacteriological contamination
- experiment on air quality parameters appraise statistical analysis and interpret laboratory results
- construct reports on water quality tests and parameters

EXPERIMENTS:

1. (a) Determination of Color.
(b) Determination of Taste and Temperature
2. Determination of (a) Total Suspended and Dissolved Solids.
(b) Organic and Inorganic Solids.
3. (a) Determination of pH and Electrical Conductivity.
(b) Determination of Turbidity.
4. (a) Determination of Acidity.
(b) Determination of Alkalinity.
5. Determination of Hardness
6. (a) Determination of Chlorides.
(b) Determination of Sulphates.
7. (a) Determination of Dissolved Oxygen.
(b) Determination of Residual Chlorine.
8. (a) Determination of Optimum Coagulant Dose.
(b) Determination of MPN Index of water.
9. (a) Ambient Air Quality Monitoring.
(b) Determination of Ambient Noise.

Reference Books:

1. B.Kotaiah & N.Kumara Swamy, "Environmental engineering laboratory manual", Choraotar Publishing House.
2. Standard Methods for Examination of Water and Wastewater 22nd Ed by APHA

17CE2025 CONCRETE AND HIGHWAY LABORATORY

Credits: 0:0:2

Course Objectives

- Hands on training in testing of concrete materials
- Methods of mix Design
- Examine the highway material properties.

Course Outcomes

At the end of the course, the student will be able to

- identify the field condition of materials through experimentation
- evaluate the quality of concrete and the materials used in the construction
- design the concrete mix for the field condition
- identify the materials for highway
- determine the bitumen property
- compile the melting point of Bitumen

LIST OF EXPERIMENTS:

CONCRETE LAB:

Tests on cement:

1. Specific gravity
2. Fineness
3. Consistency
4. Initial and final setting time
5. Soundness Test
6. Compressive strength of cement mortar

Tests on fine aggregate:

1. Tests on particle size distribution and fineness modulus
2. Specific gravity
3. Bulking of sand

Tests on coarse aggregate:

1. Tests on particle size distribution and fineness modulus
2. Specific gravity

Concrete mix design:

1. IS method for different mixes

Test on fresh concrete:

1. Slump test
2. Compaction factor test

Tests on hardened concrete:

1. Compression test on cubes and cylinder
2. Modulus of rupture test
3. Split tensile strength test
4. Determination of modulus of elasticity

HIGHWAY LAB:

Tests on highway material

1. Flakiness index
2. Elongation index
3. Crushing test

Test on aggregate

1. Impact strength test
2. Attrition test
3. Abrasion resistance test using Deval's abrasion and Los Angeles Abrasion test.

Test on bitumen

1. Marshall stability test on asphalt

Ductility test for bitumen/tar

1. Penetration of bitumen

Softening point

1. Determination of softening point
2. Flash and fire point of bitumen

Reference Books:

1. Shetty, M. S., "Concrete Technology", S. Chand and Co., New Delhi, 1998.
2. Khanna, S. K., and Justo, C.E.G., "Highway Engineering", Nem Chand and Bros., 2005.
3. Gambhir, M.L., "Concrete Technology – Theory and Practice", Tata McGraw Hill Publishing Ltd, New Delhi, 2011.
4. IS 2386 – 1963 Part I, III, "Methods of test for aggregate for concrete", Bureau of Indian Standards, New Delhi.
5. IS 516 – 1959, "Method of test for strength of concrete", Bureau of Indian Standards, New Delhi.
6. IS 10262-2009, "IS standard for recommended guidelines for concrete mix design", Bureau of Indian Standards, New Delhi..

17CE2026 COMPUTER APPLICATION LABORATORY

Credits: 0:0:2

Course Objectives:

- To adopt the concepts of spread sheet development for civil engineering applications
- To make the students to analyse and design structural elements using STAAD Pro
- To give hands on training on finite element analysis software.
- To introduce the concepts of project management using Primavera

Course Outcomes

At the end of the course, the student will be able to

- model 2d and 3d building frames using staad
- analyse concrete and steel building frames using software's
- design different structural elements using software's
- evaluate the structural behaviour of building components
- develop the design for the building components
- formulate the construction resource planning

LIST OF EXPERIMENTS:

Structural analysis and design using STAAD pro:

1. Analysis of plane beams
2. Analysis of 2D and 3D Rigid jointed frames using
3. Analysis and design of steel Truss
4. Analysis and design of multi storied buildings for dead and live loads.
5. Analysis and design of multi storied steel frames subjected to lateral loading.

Structural analysis using ANSYS:

1. Analysis of simply supported, cantilever and continuous beams
2. Analysis of plane frames subjected to different types of loads.

Development and implementation of programmes for the following using excel spread sheet:

1. Designing elementary profile of gravity dam.
2. Design of Staircase and retaining wall.
3. Design of one-way and two-way slab.
4. Design of septic tank.
5. Design of water tanks.

Computer application in construction management using primavera (demonstration only):

1. Planning – Scheduling and Resource Analysis

Reference Books

1. Sham Tickoo, "Learning Bentley Staad.Pro V8i for Structural Analysis", Dreamtech Press; 2015
2. Shah, V.L., "Computer aided design in reinforced concrete", Structures publication, Pune, 2009.
3. Sarma T S, "STAAD Pro V8i for Beginners: With Indian Examples", Notion Press; 2014.
4. "Project planning and Management" – Primavera Reference Guide.
5. STAAD Pro 2007 V8i Analysis Reference Manual
6. Divya Zindani, Apurba Kumar Roy, Kaushik Kumar, "Working with ANSYS A Tutorial Approach", I K International Publishing House, 2016.
7. Saeed Moaveni, "Finite Element Analysis Theory and Application with ANSYS", Pearson India; 2008
8. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.
9. IS 456- 2000, Code of practice for plain and reinforced concrete , Bureau of Indian Standards, New Delhi.

17CE2027 DESIGN AND DRAWING (RCC & STEEL)

Credits: 0:0:2

Course Objectives

- To design and detail RCC structures.
- To design and detail steel structures.
- To prepare detailing in appropriate professional formats.

Course Outcomes:

At the end of the course student will be able to

- recall the design procedures of various structures
- estimate the various loads on the structures
- choose the appropriate dimensions and sections
- design the reinforcement for the resultant moments
- prepare the detailing diagram in software
- interpret the detailing diagrams

LIST OF EXPERIMENTS:

Design of Reinforced Concrete structures

1. Building Floor System design
2. Column and Footing design
3. Dog legged Staircase design
4. Cantilever Retaining wall design
5. Slab Bridge design
6. Circular Water tank design

Design of Steel Structures

1. Tension member design
2. Slab base column and foundation design
3. Gusseted base column and foundation design
4. Welded Plate Girder design
5. Gantry Girder design
6. Roof Truss connection design

Reference Books

1. KrishnaRaju N., “Structural Design and Drawing”, University Press, 2005.
2. Ramamurtham and Narayanan, “Reinforced concrete structures”, Dhanpat Rai publishers, 2009.
3. Ramchandra, “Limit State Design”, Standard Book House, Delhi-6, 2005.
4. Ramchandra, “Design of Steel Structures”, Standard Book House, Delhi-6, 2004.
5. Sinha.S.N, “Reinforced Concrete Design”, Tata McGraw Hill publishing company Ltd., 2005.
6. Krishna Raju, N and Pranesh, R.N., “Reinforced Concrete Design – IS 456 – 2000 Principles and Practice”, New Age International Publishers, New Delhi, 2003.
1. Duggal .S.K, “Design of steel structures”, Tata Mcgraw –Hill Publishing company Ltd, 2009.

17CE2028 DESIGN AND DRAWING (IRRIGATION AND ENVIRONMENT)

Credit: 0:0:2

Course Objectives:

- To design and draw the components of irrigation structures
- To analyse, design and draw various water treatment units
- To maintain and operate irrigation and environmental structures

Course Outcomes:

At the end of the course, the student will be able to

- define the basic concepts in the design of structures
- select the methods for design of various structures
- demonstrate the procedure for designing the structural components
- organise the design to develop the system
- judge the operation of the system
- construct the irrigation and treatment structures

LIST OF EXPERIMENTS:

Part : A IRRIGATION WORKS

Design of the following irrigation works are to be worked out and detailed drawings are to be drawn:

1. Earthen Dams - Sections of different types of earth dams, plan showing drainage systems.
2. Tank sluice - wing type
3. Tank surplus weir.
4. Canal Regulator (Head regulator)
5. Canal drop.

6. Syphon aqueducts

Part: B ENVIRONMENTAL ENGINEERING WORKS

Design of the following Environmental Engineering works are to be worked out and detailed drawings are to be drawn.

1. General layout of water supply scheme.
2. Mixing basin, flocculation and sedimentation tanks.
3. Slow and rapid filters - service and clear water reservoirs.
4. General layout for drainage scheme.
5. Manholes, pumping station, septic tank with dispersion trenches and imhoff tank.
6. Primary and secondary settling tanks - trickling filter and storm water separator.

Reference Books

1. Krishnamoorthy, P., Structural. Design Drawing, CBS Publishers 2001
2. Satyanarayanamurthy, C., Design of Minor Irrigation and Canal Structures, Wiley Eastern Limited, June 1994.
3. Ellis, W.M., "College of Engineering Manual: Irrigation", The Textile Institute Publishers, 1955.
4. Gharpure, V.N., "A Text Book of water supply Engineering", Allied Publishers limited. 2006

17CE2029 IRRIGATION ENGINEERING

Credit: 3:0:0

Course Objectives:

- To impart knowledge about surface and ground water irrigation methods
- To acquire ideas about different types of irrigation structures
- To understand the operation of irrigation water management structures

Course Outcomes:

At the end of the course, the student will be able to

- state the concepts of duty, crop and crop seasons
- classify the irrigation methods
- demonstrate the irrigation methods
- examine irrigation management techniques
- appraise and design of impounding structures and cross drainage works
- construct the irrigation projects

Unit I - INTRODUCTION: Irrigation – Need and mode of irrigation – Merits and demerits of irrigation – Crop and crop seasons – consumptive use of water – Duty – Factors affecting duty – Irrigation efficiencies – Planning and Development of irrigation projects.

Unit II - IRRIGATION METHODS: Canal irrigation – Lift irrigation – Tank irrigation – Flooding methods – Merits and demerits – Sprinkler irrigation – Drip irrigation

Unit III - DIVERSION AND IMPOUNDING STRUCTURES: Weirs – elementary profile of a weir – weirs on pervious foundations - Types of impounding structures - Percolation ponds – Tanks, Sluices and Weirs – Gravity dams – Earth dams – Arch dams – Spillways – Factors affecting location and type of dams – Forces on a dam – Hydraulic design of dams.

Unit IV - CANAL IRRIGATION: Alignment of canals – Classification of canals – Canal drops – Hydraulic design of drops – Cross drainage works – Hydraulic design of cross drainage works – Canal Head works – Canal regulators – Aqueducts - River Training works.

Unit V - IRRIGATION WATER MANAGEMENT: Need for optimization of water use – Minimizing irrigation water losses – water pricing - On farm development works - Participatory irrigation management – Water users associations – Changing paradigms in water management – Performance evaluation.

Text Books

1. Punima B.C. & Pande B.B .Lal, "Irrigation and Water Power Engineering", Laxmi Publishing, New Delhi 2007
2. Santhosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2016.

Reference Books

1. Dilip Kumar Majumdar, "Irrigation Water Management (Principles & Practices)", Prentice Hall of India (P), Ltd, 2000
2. Basak, N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co. New Delhi, 1999.
3. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000

17CE2030 REINFORCED CONCRETE STRUCTURES

Credits: 3:0:0

Course Objectives

- To study the design of Staircase, retaining walls and water tanks
- To study the design of bridges
- To study the design of miscellaneous structures

Course Outcomes:

At the end of the course student will be able to

- identify the behaviour of various structures
- predict the typical failure modes of structures
- estimate the loads on the structures
- apply the principles, procedures and indian code requirements for the analysis and design
- design & detail rc structures
- develop the reinforcement detailing diagrams as per standard formats

Unit I - STAIRCASE: Definition of technical terms, Requirements of good stair, Types of Stairs, Geometrical design of RCC Stair stair, Dog legged staircase, Open newel staircase.(Plan and sectional elevation).

Unit II - RETAINING WALLS: Types, behaviour and application of retaining wall, stability criteria, design & detailing of cantilever & counterfort type retaining wall for various ground conditions - Concepts of shear key.

Unit III - WATER TANKS: Design of circular tanks- flexible and rigid base, rectangular water tanks- tanks resting on ground, underground and overhead tanks - Classification of water tank and method of analysis, permissible stresses, codal provisions, Design of circular and rectangular under-ground water tanks using IS code method.

Unit IV - BRIDGES: Introduction to Bridges- Classification of bridges- bridge deck system- IRC Loading class- Design Consideration-Slab Spanning in one direction-Slab Spanning in two direction- Pigeaud's Chart- T-Beam deck slab - Courbons Method.

Unit V - MISCELLANEOUS STRUCTURES: Introduction – Design of Corbel-Modes of failure of Corbel-IS code recommendations, Design of deep beams - Design aspects in deep beam-IS code recommendations, - domes types - grid floor and flat slab.

Text Books

1. Punmia B.C Ashok, Kumar Jain, "Limit state design of Reinforced Concrete", LaxmiPublications, New Delhi, 2007
2. S. S Bhavikatti, "Advance RCC Design (RCC Vol.II)", New Age International Publishers, 2016

Reference Books

1. Sinha. S.N. "Reinforced Concrete Design", Tata McGraw Hill, 2002
2. Krishna Raju. N, "Design of Reinforced Concrete Structures", CBS Publishers and Distributors, Delhi 2005
3. IS 456-2000, "Indian Standard Code of practice for Plain and Reinforced concrete Structures", Bureau of Indian Standards, New Delhi.
4. SP 16-1980, "Design Aids for Reinforced Concrete", Bureau of Indian Standards, New Delhi.
5. IS 3370 (Part I) - 1975 - Code of Practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi.
6. IRC 6-2000 – Standard specification and code of practice for road bridges
7. IRC 21 -2000 – Standard specification and code of practice for road bridges
8. IS 3370 (Part I) - 1975 - Code of Practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi.
9. IRC 6-2000 – Standard specification and code of practice for road bridges
10. IRC 21 -2000 – Standard specification and code of practice for road bridges

17CE2031 PRE-STRESSED CONCRETE

Credits: 3:0:0

Course Objectives:

- Acquire knowledge on various prestressing methods, types and advantages of prestressing techniques
- Design of prestressed concrete structures subjected to flexure
- Evaluation and estimation of losses of prestressing

Course Outcomes:

At the end of the course, the student will be able to

- identify the suitable prestressing techniques
- classify the different types of losses in prestressing
- explain the behaviour of prestressed concrete elements
- analyse the continuous beams in prestressed concrete
- design prestressed concrete structural elements
- evaluate the strength and deflection of prestressed concrete elements

Unit I - INTRODUCTION – THEORY AND BEHAVIOUR : Basic concepts – Advantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections – Losses of prestress – Estimation of crack width.

Unit II - DESIGN FOR FLEXURE: Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on I.S. 1343 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

Unit III - DESIGN OF ANCHORAGE ZONE : Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyons' method and IS1343 code – design of anchorage zone reinforcement – Spalling tension - Check for transfer bond length in pre-tensioned beams.

Unit IV - COMPOSITE BEAMS AND CONTINUOUS BEAMS: Analysis and design of composite beams – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design

Unit V - MISCELLANEOUS STRUCTURES: Design of tension and compression members – Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing - merits and demerits of partial prestressing

Text Books

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2014.

Reference Books

1. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2012
3. Lin T.Y. and Ned.H. Burns, "Design of Prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4. IS1343:1980, "Code of Practice for Prestressed Concrete", Bureau of Indian Standards, New Delhi 2012

17CE2032 PREFABRICATED STRUCTURES

Credit: 3:0:0

Course Objectives:

- Acquire knowledge on industrialized construction methods.
- Design of prefabricated elements
- Explain and Recommend suitable types of joint for prefabricated structural connections.

Course Outcomes

At the end of the course, the student will be able to

- identify the suitable prefabrication building system

- classify the different types of precast construction
- explain the behaviour of prefabricated structures
- examine the behaviour of precast structural connections
- recommend suitable types of joints for prefabricated structures
- design for precast structure against progressive collapse

Unit I - INTRODUCTION: Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection.

Unit II - PREFABRICATED COMPONENTS: Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Unit III - DESIGN PRINCIPLES: Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

Unit IV - JOINT IN STRUCTURAL MEMBERS: Joints for different structural connections – Dimensions and detailing – Design of expansion joints

Unit V - DESIGN FOR ABNORMAL LOADS: Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

Text Books

1. Kim S Elliott, Colin Jolly, “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013
2. Kim S. Elliott, “Precast Concrete Structures”, Second Edition, CRC Press, 2016

Reference Books

1. IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice
2. Code of Practice for “Precast concrete construction”, PCI Design hand book, 2003
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc., 1994
4. CBRI, Building materials and components, India, 1990
5. Koncz T., “Manual of precast concrete construction”, Vol. I, II and III, Bauverlag, GMBH, 1997
6. Structural design manual, “Precast concrete connection details”, Society for the studies in the use of precast concrete, Netherland BetorVerlag, 2009

17CE2033 CONSTRUCTION MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To introduce the concepts of management, resources and construction planning
- To establish the labour laws, principle of accounting
- To adapt fundamentals and concepts of computer applications in construction management

Course Outcomes:

At the end of the course, the student will be able to

- choose the resources and labours in construction
- assess the construction projects
- evaluate the contracts and tenders
- examine the construction schedule
- execute the work as per schedule
- integrate computer application in construction projects

Unit I - PRINCIPLES OF MANAGEMENT: Principles of Management Definition - Importance - Functions of management – construction sector in India - Govt., Quasi Govt. Departments - Private contractors, and contracting firms – Organisation - Basic Economic concepts - Economic decisions, fixed, variable costs -Break Even Analysis - probabilistic estimates – project feasibility reports.

Unit II - PLANNING FOR CONSTRUCTION: Planning for construction projects – Objectives, principles, advantages, limitations, stages – Construction Planning: Collection of field data - preliminary estimates - approval and sanction of estimates - Budget provision - Construction stages - Resource Planning: Planning for materials, machines and men -organisation - resource allocation - construction contracts and specification – Tenders and

agreement – Construction financing and control - Labour And Labour Welfare: Relationship between management and labour – Labour problems - labour legislation - minimum wages act - settlement of disputes - industrial psychology.

Unit III - SCHEDULING: Definition, uses, advantages, classification, methods –line of balance technique – project management through network – events, activities, dummies- network types - Fulkerson's rule – Program Evaluation and Review Technique(PERT)- time estimate, slack, critical path, probability of completion of project – Critical path method(CPM) – time estimate, float, criticality, critical activity- difference between PERT/CPM – precedence networks – decision network -Resource Oriented Scheduling - Scheduling with Resource Constraints and Precedences - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Durations

Unit IV - EXECUTION OF WORK: Departmental Works: Procedure - departmental labour - quality control, inspection and duties of personnel - safety requirements - Departmental procedure and accounting -Accounts and Stores: Measurements of work - recording - checking - types of bills - mode of payment - budget estimate - revised estimates - completion reports and certificates - claims and transfer classifications of transactions - ledger accounts - Imprest Account - Cash book. Suspense classification - stores - maintenance and inspection- inventories – Accounting of surplus and of shortage of stores - procedures adopted in P.W.D. and C.P.W.D

Unit V - ECONOMICS OF PROJECT MANAGEMENT: valuation engineering - Introduction to Computer Application in Construction Management Planning – Scheduling and Resource Analysis - Recording and Operations – Project Accounting, Costing and Finance – artificial intelligence in construction industry

Text Books:

1. Seetharaman,S., “Construction Engineering and Management”, Umesh Publications, 2007.
2. Sengupta,B., and Guha,H., “Construction Management and Planning”, Tata McGraw-Hill Book cc, 2000.

Reference Books:

1. Rana,V.K., “Construction Management Practice”, Tata McGraw-Hill publishing CO, 2000
2. Chitkara,K.K., “Construction Project Management”, Tata McGraw-Hill publishing COM, 2000.
3. Calin M. Popescu, Chotchai Charoenngam, “Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications”, Wiley, New York, 1995.
4. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000.
5. Moder, J., C. Phillips and E. Davis, “Project Management with CPM, PERT and Precedence Diagramming”, Van Nostrand Reinhold Company, Third Edition, 1983.
6. Willis, E. M., “Scheduling Construction Projects”, John Wiley & Sons, 1986.
7. Halpin, D. W., “Financial and Cost Concepts for Construction Management”, John Wiley & Sons, New York, 1985.

17CE2034 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

Credits: 3:0:0

Course Objectives:

- To understand the principles of dynamics of structures
- To study the behaviour of structures subjected to seismic forces
- To analyse and detail structures as per codal provisions

Course Outcomes:

At the end of the course, the student will be able to

- identify the dynamic properties of structures
- estimate the forces on the structures
- assess the response on the structures
- detail the reinforcement for shear resistance
- evaluate the failure of structures
- incorporate suitable remedial measures

Unit I - SINGLE DEGREE OF FREEDOM SYSTEM: Definition of degree of freedom – Idealization of structure as SDOF system – Formulation of equation of motion for various SDOF system – D’Alemberts Principles – Effect of damping – Free and forced vibration of damped and undamped structures – Response to harmonic forces and periodic forces.

Unit II - MULTI DEGREE OF FREEDOM SYSTEM: Formulation of equation of motion for multidegree of freedom (MDOF) system – Evaluation of natural frequencies and modes – Eigen values and Eigen vectors – Response to free and forced vibration of undamped and damped MDOF systems.

Unit III - INTRODUCTION TO EARTHQUAKE ENGINEERING: Elements of Engineering seismology – Definitions, Introduction to seismic hazard, Earthquake phenomenon – Seismotectonics – Seismic instrumentation – Characteristics of strong earthquake motion – Estimation of earthquake parameters.

Unit IV - EARTHQUAKE EFFECTS ON STRUCTURES: Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading – Evaluation of Earthquake forces – IS Code 1893: 2002 – Response Spectra – Lessons learnt from past earthquakes.

Unit V - CONCEPTS OF EARTHQUAKE RESISTANT DESIGN: Causes of damage – Planning considerations/Architectural concept (IS 4326–1993) – Guidelines for Earthquake resistant design – Earthquake resistant design of masonry buildings 67 – Design consideration – Guidelines – Earthquake resistant design of R.C.C. buildings – Lateral load analysis – Design and detailing (IS 13920:1993)

Text Books:

1. Damodarasamy S.R, Kavitha.S, “Structural Dynamics and Asiesmic design” , Phi Learning Private Ltd., 2013.
2. Duggal S.K., “Earthquake Resistant Design of Structures”, OUP India Private Ltd.2013.

Reference Books:

1. Mario Paz, “Structural Dynamics – Theory and Computations”, Third Edition, CBS publishers, 2004
2. Jai Krishna, Chandrasekaran. A.R., and Brijesh Chandra, “Elements of Earthquake Engineering”, South Asia Publishers, 2009
3. Minoru Wakabayashi, ‘Design of Earthquake Resistant Buildings”, McGraw – Hill Book Company, 2006
4. Humar.J.L, “Dynamics of Structures”, Prentice Hall Inc., 2012.
5. Anil K Chopra, “Dynamics of structures – Theory and applications to Earthquake Engineering”, Prentice Hall Inc., 2001.
6. Moorthy.C.V.R., “Earthquake Tips”, BMTPC, NICEE, IIT Kanpur, 2005

17CE2035 BUILDING SERVICES

Credits: 3:0:0

Course Objectives

- To understand the need for essential services in buildings- Mechanical, electrical and plumbing services
- To gain knowledge about safety provisions in buildings
- To pioneer the concepts of sustainable and intelligent buildings

Course Outcomes

At the end of the course, the student will be able to

- synchronize the construction activities with installation of building services
- select the suitable electrical as well as mechanical services for particular requirements of buildings
- apply various types of fire services as per requirements of building based on NBC regulations
- plan for rain water harvesting systems for buildings
- provide acoustic and sound insulation to buildings
- understand and apply green and intelligent building technology

Unit I - INTRODUCTION TO BUILDING SERVICES: Objective and uses of services, applications of services for different types buildings, classification of building services, lighting and ventilation-definition, types, factors for designing lighting and ventilation systems for different buildings. Air conditioning- definition, principle and types of air conditioners - Electrical services in the building- distribution of power, earthing, types of wiring and insulations - Plumbing system for building - internal water supply, sanitary plumbing in buildings, arrangement of sewerage systems in housing, septic tank and soak pits.

Unit II - FIRE PROTECTION, ACOUSTIC AND SOUND INSULATIONS: Causes of fire and effects of fire-General Requirements of Fire Resisting building as per IS and NBC 2005 ,Characteristics of fire resisting materials - Fire Fighting Installations, fire safety measures- NBC provisions . Introduction to building acoustics-requirement of good acoustics, Factors to be followed for noise control in different types of buildings

Unit III - MUNICIPAL BYE LAWS AND REGULATIONS: Definition, role of building bye laws in planned

development, objectives of bye laws, Classification of buildings as per NBC, Basic and important terms- Plinth area, carpet area, super built up area, FAR, etc. Open space requirements, minimum dimensions required for various rooms, Building bye laws for various building components.

Unit III - PROVISIONS FOR BARRIER FREE LIVING: Introduction to barrier free planning and designing, Special features for elderly and physically challenged people in buildings. Vertical transport in buildings - Lifts and Escalators - Uses of different types of elevators and escalators

Unit IV - MISCELLANEOUS SERVICES: Need and novelty of Rain Water Harvesting Systems (RWHS) - Types of rain water harvesting systems - Components of RWH systems. Lightning protection systems for building- role of LPS, components. Physical security systems - Access control systems – types - CCTV's- types, choice of selection - Structural health monitoring: definition, importance, components, case study.

Unit V - SUSTAINABLE AND INTELLIGENT BUILDINGS: Concept of green buildings, components of green building and energy efficiency - LEED rating, Green building rating systems in India- GRIHA, IGBC, BEE. Intelligent buildings - Building automation - Smart buildings - Building services in high rise buildings - Smart materials and systems for artificial intelligence, Case studies on Green and Intelligent buildings.

Text Books

1. David V. Chadderton, "Building Services Engineering", Routledge; 6th edition, 2013
2. Bajwa G. S., "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003.

Reference Books:

1. National Building Code of India – 2005, Bureau of Indian Standards, BIS, New Delhi
 2. Jain V.K, "Fire Safety in Buildings", new age publishers- 2010
 3. R. Udaykumar "A text book on Building Services", Eswar press- 2007
 4. Subhash M Patil, "Building Services: Environmental & Electro Mechanical Services", Sm Patil- 2014.
 5. Gupta R S, "A Handbook of Fire Technology", Universities Press, 2010
- Government of India, "Model Building Bye-Laws", Young Global Publications; 2016

17CE2036 SUSTAINABLE BUILDING CONCEPTS AND DESIGN

Credits: 3:0:0

Course Objectives:

- To introduce the concept of sustainable development and principles of environmental management
- To develop an understanding in long-term mitigation to promote eco-sustainable developments
- To emphasize the integrative approaches for cleaner production, Life Cycle Assessment (LCA) and sustainable management.

Course Outcomes

At the end of the course, the student will be able to

- sketch the philosophy and art of environmental management systems
- paraphrase the life cycle assessments
- illustrate policy options for addressing the political and economic sources
- discriminate the environmental pollution problems and their sustainable solutions
- recommend systems for comforts in buildings
- adapt the principles for sustainable practices

Unit I - SUSTAINABILITY: Introduction, Need and concept of sustainability- Sustainable development - Nexus between Technology and Sustainable development - Sustainable wastewater treatment - Zero waste concept - 3 R concept - Resource degradation - Climate change - Carbon credits and carbon trading - carbon foot print.

Unit II - ENVIRONMENTAL IMPLICATIONS OF BUILDINGS: Carbon emissions- Building materials: sources, methods of production and environmental Implications - Transportation Energy for Building Materials - Maintenance Energy for Buildings.

Unit III - ENERGY OF BUILDINGS: Framed Construction - Masonry Construction - Resources for Building Materials - Alternative concepts - Recycling of Industrial and Buildings Wastes - Biomass Resources for buildings.

Unit IV - COMFORTS IN BUILDING: Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques - concepts of Solar Passive Cooling and Heating of Buildings.

Energy efficient and environment friendly building - Psychometrics – passive heating and cooling systems - Energy Analysis – Active HVAC systems - Preliminary Investigation – Goals and policies – Energy audit – Types of Energy audit – Analysis of results – Energy flow diagram – Energy consumption / Unit Production - Energy efficient design strategies – Contextual factors – Longevity and process Assessment – Advanced building Technologies – Smart buildings

Unit V - GREEN COMPOSITES FOR BUILDINGS: Concepts of Green Composites - Water Utilisation in Buildings - Low Energy Approaches to Water Management - Management of Solid Wastes - Management of Sullage Water and Sewage – Vertical farming - Urban Environment and Green Buildings - Green Cover and Built Environment.

Text Books

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. “Alternative Building Materials and Technologies”, New Age International, 2007.
2. Osman Attmann, “Green Architecture advanced technologies and Materials”, McGraw Hill, 2010.

Reference Books

1. Moore F., “Environmental Control system”, Mc Graw Hill, Inc. 1994.
2. T. A. Markus and E. N. “Morris Buildings Climate and Energy”, Pitman, London, 1980.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
4. T N Seshadri; Mela Ram Sharma; Sharafat Ali, “Climatological and Solar Data for India”, CBRI and Sarita Prakashan, 1969

17CE2037 INTELLIGENT BUILDINGS

Credits: 3:0:0

Course Objectives

- To provide knowledge on the underlying concepts of intelligent buildings
- To provide the working principles of building automation systems, office automation systems, and communication systems
- To get an exposure to air conditioning and fire safety arrangement in Intelligent buildings

Course Outcomes:

At the end of the course, the student will be able to

- identify benefits, impacts and driving forces of intelligent buildings, and its subsystems
- describe the principles of construct automated buildings
- illustrate design philosophy of building automation systems
- analyze the intelligent building design concepts
- design hvac, lighting and fire safety systems for intelligent buildings
- adapt sensors, actuators and controllers for the design of thermal comfort control and building automation

Unit I - INTRODUCTION: Introduction to Intelligent buildings - Basic concepts - Building automation system - Cost analysis of intelligent buildings – Introduction to smart materials- Intelligent Building Management System.

Unit II - HEATING VENTILATION AND AIR CONDITIONING: Introduction - Human comfort - Comfort air-conditioning – Classification - Air conditioning systems - Electrical installations and illumination - Introduction, terminologies in electrical power engineering - Electrical power transmission to buildings - Electrical power quality in buildings - Lighting systems in buildings – correlating the systems

Unit III - FIRE PROTECTION SYSTEMS: Introduction - Type of fire service installations - Automatic fire alarm detection – Sprinklers - Hose reels hydrants - Foam systems -Microprocessor based alarm.

Unit IV - SECURITY AND SAFETY SYSTEMS: Introduction - Designing a security system - Intrusion sensors and space sensors – access control and intrusion detection systems- Closed circuit television system –selection of camera- Central alarm systems – Health monitoring systems.

Unit V - BUILDING ELECTRONICS: Introduction - Microprocessor based control - Programmable logic controller – Communication principles - Telephone systems - Communal aerial broadcasting - Satellite communication - Fiber optic system

Text Books

1. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.
2. Derek Clements, Croome Routledge, “Intelligent Buildings: An Introduction”, 2013

Reference Books

1. Derek Clements Croome, "Intelligent Building Design, Management and Operations", Thomas Telford Publishing, London, 2004.
2. Albert Ting – pat SowaiLok Chan, "Intelligent Building Systems", Kluwer Academic Publisher, U.S.A, 1999.
3. Ehrlich, C., "Intelligent Building Dictionary: Terminology for Smart, Integrated, Green Building Design, Construction, and Management" San Francisco, Calif: Hands-on-Guide, 2007.
4. Michael Wigginton, Jude Harris, "Intelligent Skins", Architectural Press, Burlington, 2003.

17CE2038 SMART MATERIALS AND STRUCTURES

Credit: 3:0:0

Course Objectives:

- To familiarize with the structure and physical properties of smart materials
- To focus on the stability properties and degradation processes
- To acquire knowledge on various smart sensors

Course Outcomes

At the end of the course, the student will be able to

- understand the behaviour of smart materials
- select the smart materials for smart structures
- know the properties of piezo electric sensors
- measure the strain using strain gauges
- design the smart structures using smart materials
- apply the smart materials in structural applications

Unit I - OVERVIEW OF SMART MATERIALS: Introduction to smart materials - Piezoelectricity - Piezoceramic Materials - Single crystals vs Polycrystalline systems - Piezoelectric Polymers - Principles of Magnetostriction - Magnetostriction and Magneto-resistance Effect - Electro-active Materials - Electronic Materials - Electro-active Polymers - Ionic Polymer Matrix Composite - Shape Memory Effect - Shape Memory Alloys - Polymers, Shape Memory Actuators - Active Vibration Control - Active Shape Control - Passive Vibration Control - Hybrid Vibration Control Electro-rheological Fluids - Magneto Rheological Fluids.

Unit II - HIGH-BAND WIDTH, LOW STRAIN SMART SENSORS: Piezoelectric Strain Sensors - In-plane and Out-of Plane Sensing - Shear Sensing - Accelerometers - Effect of Electrode Pattern - Active Fibre Sensing - Magnetostrictive Sensing - Magnetic Delay Line Sensing - Application of Smart Sensors for Structural Health Monitoring - System Identification using Smart Sensors - Fiber Optics - Fiber characteristics - Fiber optic strain sensors

Unit III - VIBRATION ABSORBERS AND STRAIN GAUGES: Parallel damped vibration absorber - Gyroscopic vibration absorber - Active vibration, absorber - Applications - Vibration Characteristics of mistuned systems - strain Measuring Techniques using Electrical strain gauges - Types - Resistance - Capacitance - Inductance - Wheatstone bridges - Pressure transducers - Load cells - Temperature Compensation - Strain Rosettes.

Unit IV - ADVANCES IN SMART STRUCTURES & MATERIALS: Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials, Autophagous Materials, Self Healing Polymers, Intelligent System Design, Emergent System Design

Unit V - APPLICATIONS IN CIVIL ENGINEERING: Application of Shape Memory - Alloys in Bridges - Concept of smart bridges - Application of ER fluids - Application of MR dampers in different structures - Application of MR dampers in bridges and high rise structures - Structural health monitoring - Application of optical fibres - Concept of smart concrete.

Text Books

1. Srinivasan, A.V., and Michael McFarland. D., "Smart Structures - Analysis and Design", Cambridge University Press, 2001.
2. Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996.

Reference Books

1. Gandhi, M.V and Thompson, B.S., "Smart Materials and Structures", Chapman and Hall, 1992.
2. Inman D.J. and Farrar C.R., "Damage Prognosis", John Wiley and Sons, 2005.

3. Gaudenzi, P., “Smart Structures”, Wiley, 2009 (c) Cady, W. G., Piezoelectricity, Dover Publication, 2009

17CE2039 BUILDING ACOUSTICS

Credits: 3:0:0

Course Objectives:

- To learn the fundamentals of building acoustics
- To incorporate acoustic design in planning and design of buildings
- To know about the Environmental and Architectural aspects of Acoustics

Course Outcomes:

At the end of the course, the student will be able to

- enumerate the principle of acoustic design
- compare materials for design of sound fields in rooms
- illustrate outdoor and indoor noises for various type of buildings
- analyze speech privacy between in buildings
- evaluate parameters to isolate buildings from highway noise pollution
- design building for environmental and architectural acoustics of buildings

Unit I - INTRODUCTION: Acoustics Engineering - Requirements for good acoustics - General principles of acoustic design - Fundamentals: Noise, Frequency, Sound, Band, Wavelength, Decibel, Reverberation Time

Unit II - SOUND ABSORBERS AND ROOM ACOUSTICS: Sound Absorbers: Introduction - Main categories of absorber, Porous materials - Sound Transmission, Characterization and properties of single walls and floors - Room Acoustics: Introduction - Modeling of sound fields in rooms, Room acoustics parameters

Unit III - PLANNING AND DESIGN: Planning and design against outdoor and indoor noise, Residential, Office, Hospital, Hotels and hostels, laboratories and test house, miscellaneous building.

Unit IV - ENVIRONMENTAL ACOUSTICS: Weighted sound levels speech interference – highway noise – noise induced hearing loss noise and architectural design specification and measurement of some isolation design of portions.

Unit V - ARCHITECTURAL ACOUSTICS: Building skin envelope, Inter-space noise control, Interior space acoustics, Mechanical equipment noise - Sound in enclosure – A simple model for the growth of sound in a room – reverberation time - Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design.

Text Books

1. National Building Code-Part VIII Building Services- Section 4, Acoustics, Sound Insulation and Noise Control- Bureau of Indian Standards, New Delhi, 2005
2. M.David Egan, “Architectural Acoustics”, J.Ross Publishing, India, 2008

Reference Books

1. Heinrich Kuttruff, “Acoustics an Introduction”, Taylor and Francis published, NewYork, 2007
2. Marshall Long, “Architectural Acoustics”, Academic Press, December 2005.
3. Marc Asselineau, “Building Acoustics”, CRC Press, Taylor and Francis group, New York London, 2015
4. William Cavanaugh and Joseph.A Wilkes, “Architectural Acoustics Principles and Practice”, John Wiley and Sons, New York, 1999.
5. IS: 2526 – 1963 (reaffirmed 1996) Code of Practice for Acoustical Design of Auditoriums and Conference Hall- Ninth reprint December 1998 (incorporating Amendment No: 1) New Delhi

17CE2040 INDUSTRIAL WASTE TREATMENT AND DISPOSAL

Credits: 3:0:0

Course Objectives:

- To know the sources, characteristics of various industrial waste, effects, and fundamental methods in Industrial waste treatment
- To impart knowledge about disposal of effluents and the standards for disposal
- To impart knowledge on strategies for pollution prevention and control.

Course Outcomes

At the end of the course, the student will be able to

- have an insight into the pollution from major industries including the sources and characteristics of pollutants.
- discuss about the wastewater characteristics
- design facilities for the processing and reclamation of industrial wastewater.
- plan and minimization of industrial waste.
- gain knowledge in waste management
- acquire skills to undertake major project related to industrial treatment

Unit I - INTRODUCTION: Industrial scenario in India – Industrial activity and environment- Sources and characteristics of various industrial process and waste – Population equivalent – Effects of industrial waste on streams, sewer, land, sewage treatment plants and on human health – Environmental legislations and standards related to prevention and control of industrial pollution and hazardous waste – Toxicity of industrial effluents and Bioassay tests.

Unit II - CLEANER PRODUCTION: Waste management approach – Waste audit – Volume reduction – Strength reduction – Material and process modification – Recycle, reuse and byproduct recovery – Waste Minimization- Cost benefit analysis – Pay back period – Implementing and promoting Pollution Prevention Programs in Industries.

Unit III - INDUSTRIAL WASTEWATER TREATMENT: Flow and load equalization – Neutralization- Removal of suspended, floating and dissolved organic solids – Removal of fats, oil and grease- Removal of inorganic constituents – Precipitation, Nitrogen and phosphorous removal, Adsorption, Ion exchange, Eletrodialysis- Removal of Organic constituents- Biological treatment process, Chemical oxidation processes-Advanced oxidation processes.

Unit IV - POLLUTION FROM MAJOR INDUSTRIES: Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for selected industries such as – Textiles, Tanneries, Pharmaceuticals – Pulp and paper – Diary- Sugar – Distilleries- Steel plants – Oil Refining – Fertilizer- Thermal power plants – Wastewater reclamation and reuse concepts.

Unit V - EFFLUENT STANDARDS AND LEGISLATIONS: Environmental Impact Assessment (EIA) - Environmental Auditing, ISO-14000 - Polluter Pays Principle - Environmental Protection Act - Air Act - Water Act - Wetland Regulatory Notification and Coastal Zone Regulation.

Text Books

1. Rao, M.N. and Dutta, “Waste Water Treatment”, Oxford and IBH Publishing Ltd., Calcutta, 2012.
2. Eckenfelder, W.W., “Industrial Water Pollution Control”, McGraw Hill Book Co., New Delhi, 1999.

Reference Books

1. Shen T.T., “Industrial Pollution Prevention”, Springer, 1999.
2. Stephenson R.L and .Blackburn J.B, Jr., “Industrial Wastewater Systems Hand book”, Lewis Publisher, New York, 1998
3. Freeman H.M., “Industrial Pollution Prevention Hand Book”, McGraw Hill Inc., New Delhi, 1995.
4. Bishop P.L., “Pollution Prevention: Fundamental & Practice”, McGraw Hill, 2000.
5. Pandey, “Environmental Management” Vikas Publications, 2010.
6. “Industrial Wastewater Management, Treatment and Disposal”, WEF Manual of practice - FD3, McGraw Hill, 2008.

17CE2041 MUNICIPAL SOLID WASTE MANAGEMENT

Credits: 3:0:0

Course Objectives

- To impart knowledge and skills with different aspects of the types, sources, generation, storage, collection, transport, processing and disposal of solid waste.
- To impart knowledge on various recycling options available for the solid waste.
- To educate the engineering principles, design criteria, methods and equipments available to manage the solid waste.

Course Outcomes:

At the end of the course, the student will be able to

- analyze the nature and characteristics of municipal solid wastes
- sort out the functional elements for solid waste management
- apply the techniques and methods used in transformation, conservation and recovery of materials from solid waste
- identify and design waste containment systems
- gain knowledge in regulatory requirements regarding municipal solid waste management
- apply the basic scientific principles for solving practical waste management challenges

Unit I - SOURCES AND TYPES: Types and Sources of municipal solid waste – Need for solid and hazardous waste management- characteristics – methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects-Elements of integrated waste management and roles of stakeholders – Social and financial aspects- Municipal solid waste (M&H Rules)- Public awareness; Role of NGO's

Unit II - WASTE CHARACTERISATION AND SOURCE REDUCTION: Waste generation rates and variation – Factors affecting generation- Composition, physical, chemical and biological properties of solid wastes – Hazardous characteristics – TCLP tests – Waste sampling and characterization plan - Source reduction of wastes – Waste exchange – Reduction, recycling and reuse.

Unit III - ONSITE STORAGE AND PROCESSING: Handling and segregation of wastes at source -Onsite storage methods- Analysis of collection systems- Need for transfer and transport- Public health and economic aspects of open storage- Compatibility, storage, labeling and handling of hazardous wastes – waste segregation and storage-case studies under Indian conditions- Hazardous waste manifests and transport.

Unit IV - OFF-SITE PROCESSING: Objectives of waste processing – Physical processing techniques and equipments – Chemical conversion technologies– Resource recovery from solid waste composting and biomethanation – Methods and controls of Composting -Solidification and stabilization of hazardous wastes – Case studies under Indian conditions-Treatment of biomedical wastes.

Unit V - DISPOSAL: Land disposal of solid waste; Sanitary landfills- site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor– Dumpsite Rehabilitation.

Text Books

1. Bhide A.D. and Sundaresan, B.B, “Solid Waste Management Collection”, Processing and Disposal, 2001
2. Paul T Willams, “Waste Treatment and Disposal”, John Wiley and Sons, 2000

Reference Books

1. Tchobanoglous.G. Theisen, H. M., and Eliassen, R. “Solid. Wastes: Engineering Principles and Management Issues”. New York: McGraw Hill, 1977.
2. Manual on “Municipal Solid Waste Management”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
3. Vesilind, P.A. and Rimer, A.E., “Unit Operations in Resource Recovery Engineering”,Prentice Hall, Inc., 1981
4. Manser A.G.R. and Keeling A.A, “Practical Handbook of Processing and Recycling of Municipal solid Wastes”, Lewis Publishers, CRC Press, 1996
5. George Tchobanoglous and FrankKreith, Handbook of “Solid waste Management”, McGraw Hill, New York, 2002

17CE2042 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Credits: 3:0:0

Course Objectives:

- To expose the students to the need, methodology, documentation and usefulness of environmental and social impact assessment
- To develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Course Outcomes

At the end of the course, the student will be able to

- understand the importance of impact assessment

- outline the impacts and risks caused by development activities
- list process and different stages of analysis
- classify methodologies of assessment
- compose detailed report of impact assessment
- explore the legal requirements of environmental and risk assessment for the projects

Unit I - INTRODUCTION: EIA in Project Cycle. Legal and Regulatory aspects in India – Types and limitations of EIA – EIA process- screening – scoping – setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

Unit II - IMPACT IDENTIFICATION AND PREDICTION: Matrices – Networks – Checklists – Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological – Cumulative.

Unit III - SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION: Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials

Unit IV - ENVIRONMENTAL MANAGEMENT PLAN: EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

Unit V - ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT:

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Text Books

1. Lawrence, D.P., “Environmental Impact Assessment – Practical solutions to recurrent problems”, Wiley-Interscience, New Jersey. 2003
2. Canter, L.W., “Environmental Impact Assessment”, McGraw Hill, New York, 1996

Reference Books

1. World Bank –Source book on EIA 4. Cutter, S.L., “Environmental Risk and Hazards”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, “Risk Assessment and Management Hand book”, McGraw Hill Inc., New York, 1996.
3. K. V. Raghavan and A. A. Khan, “Methodologies in Hazard Identification and Risk Assessment”, Manual by CLRI, 1990.
4. Sam Mannan, “Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control”, 4th Edition, Butterworth Heineman, 2012.

17CE2043 ENERGY AND ENVIRONMENTAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To provide an idea of the challenges in the field of energy engineering,
- To provide a perspective on energy technology, systems dimensions of the energy problem, Historical perspective on energy technology and system development.
- To provide an idea about pollution arising due to energy generation and their control methods

Course Outcomes

At the end of the course, the student will be able to

- understand about different energy resources
- apply technology for energy generation
- know about the pollution resulted from the energy generation
- solve the pollution issues by using engineering technology

- know about global standard and issues regarding energy
- can know about law and regulations of the country

Unit I - INTRODUCTION: energy past, present and future, definition, origin, forms of energy, energy supply and demand, energy and the environment classification of energy resources and their availability,

Unit II - RENEWABLE ENERGY SOURCES: Wind energy- wind rose, wind power, wind turbine, design considerations, Hydro energy: hydroelectric energy, tidal energy, power generation, Geothermal energy: resources, heat pumps, Solar energy: the sun, electric power generation, solar thermal power stations, OTEC, solar ponds, photo voltaic cells

Unit III - NONRENEWABLE ENERGY SOURCES: Thermal energy: heat and temperature thermo dynamics, thermal devices,, Biomass energy: photo synthesis, power generation by biomass, Fossil fuels; petroleum, coal Nuclear energy: fission and fusion ,

Unit IV - ENVIRONMENTAL IMPACTS: open access and tragedy of commons, efficiency standards, pollution, safety standards, benefits of environmental protection, cost- benefit analysis, economic impacts, environmental legislation and global issues

Unit V - ENERGY SCENARIO IN INDIA: Availability of conventional and nonconventional energy resources and future energy demand; Indian reserves and resources of natural oil and gas, coal and nuclear minerals; potential of hydroelectric power, solar energy, thermal, nuclear, wind, tidal wave and biomass based power in India; Introduction to hydrogen energy and fuel cells.

Text Books

1. Reza Toossi, “Energy and the Environment: Sources, Technologies, and Impacts”, VerVe Publishers. Inc.2005
2. Wen-Pei Sung, Jimmy C.M. Kao, Ram Chen, “Frontiers of Energy and Environmental engineering”, CRC Press, 2012

Reference Books

1. Chuck Lancaster , “Energy and Environmental Engineering”, Callisto Reference, 2015
2. Smriti Srivastava, “Energy Environment Ecology and Society”, S.K. Kataria & Sons, 2011
3. Barrow, C. J, “Environmental Management and Development”, Taylor and Francis Group, London, New York. 2005
4. Chremisinoff, N.P, “Environmental management systems handbook for refineries”, Gulf Publishing Company, Houston, Texas. 2006

17CE2044 ECOLOGY AND ENVIRONMENT

Credits: 3:0:0

Course Objectives:

- To Impart basic knowledge about the environment and its allied problem
- To apply knowledge in Economic development without destroying the environment
- To have knowledge on renewable energy and non-renewable energy sources

Course Outcomes:

At the end of the course, the student will be able to

- understand the processes, chains and systems of ecology and environment
- impart knowledge on climate changes occurring on earth
- classify pollutions and their causes
- evaluate effects of pollution on human and species
- learn about the solution and legislations for maintaining environment
- apply knowledge for the solutions of environmental pollution problems

Unit I - ECOLOGY: Introduction – definition - environment and its components -functions of an Ecosystem - types

Unit II - BIODIVERSITY: Indian Biodiversity - Animal diversity and Plant diversity in India - endangered and vulnerable flora and fauna - Protected area network, Conservation efforts,

Unit III - CLIMATE CHANGE: introduction, global warming, acid rains, ozone layer depletion and heat island effects, Impact of climate change- India, Mitigation strategies,

Unit IV - ENVIRONMENTAL POLLUTION: air pollution, water pollution, soil pollution, noise pollution, thermal pollution, nuclear pollution and light pollution, causes, effects and measures against pollutions.

Unit V - LEGISLATION: Climate change organizations - Acts and policies - Institutions and measures - Environmental organizations - International environmental conventions - Environmental issues and Health effects

Text Books

1. Majid Husain, "Environment and Ecology: Biodiversity, Climate Change and Disaster Management", access publishing, 2014
2. P.D.Sharma, "Ecology and environment", Rastogi Publications, 2011

Reference Books

1. Singh, J.S., Singh S.P. and Gupta S.R.. "Ecology, Environment and Resource Conservation", Anamaya Publishers, New Delhi. 2006
2. Singh K.P. and. Singh J.S. "Tropical Ecosystems: Ecology and Management", Wiley Eastern Limited, Lucknow, India, 1992.
3. Anuj Kumar Purwar, "Environment and Ecology", I K International Publishing House Pvt. Ltd; First Edition, 2012
4. Townsend, C.R., Begon, M. and Harper, J.L. "Essentials of Ecology", Blackwell Publishing, Oxford, 2003

17CE2045 AIR POLLUTION MANAGEMENT

Credit: 3:0:0

Course Objectives:

- To impart knowledge on the causes and effects of air pollution.
- To evaluate behavior of air pollutants.
- To apply appropriate control measures of air pollution.

Course Outcomes

At the end of the course, the student will be able to

- understand causes of air pollution
- analyze different types of air pollutants
- impart knowledge on different atmospheric components
- evaluate air pollutant behaviour in the atmosphere
- choose appropriate control technology for air pollution
- develop air pollution reduction techniques

Unit I - POLLUTION SOURCES AND EMISSION INVENTORIES: Anthropogenic and natural sources. Particulates, Carbon monoxide, sulphur oxide, Nitrogen oxide, Hydrocarbons, Oxidants, Emission factors. Sampling train – stack sampling – Phytomonitoring of air quality.

Unit II - EFFECTS OF AIR POLLUTANTS: Effects of different air pollutants on human beings, animals, plants and materials.

Unit III - PLUME DISPERSION AND PLUME RISE: wind roses, mixing depths, inversions, plume behaviour. The Gaussian Model , Diffusion coefficients, Box model, Inversion effects.

Unit IV - AIR POLLUTION CONTROL: Zoning – Town planning – Control of particulate matter – Settling chambers, cyclons, bag –filter, electrostatic precipitators – Removal of gaseous matter – SO₂, NO_x, VOCs and CO.

Unit V - AIR POLLUTION AND LEGISLATION: Legislation – Air Act, 1981, and Environment (Protection) Act, 1986.

Text Books

1. Rao M N and Rao HVN, "Air pollution", TMH Publications, 2007
2. Garg S K, "Sewage Disposal & Air Pollution Engineering", Khanna Publications, 2011

Reference Books

1. Thod Godesh, "Air Quality, Lewis India Edition, 2013.
2. Peavy S.W., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", McGraw Hill, New Delhi, 1985.
3. Mark Z. Jacobson, "Atmospheric Pollution: History, Science, and Regulation", Cambridge University Press, Cambridge, 2002.
4. Daniel Vallero, "Fundamentals of Air Pollution", 4th Edition, Academic Press, Burlington, 2008.

5. ISO 14001/14004: “Environmental management systems – Requirements and Guidelines”, International Organisation for Standardisation, 2004
6. ISO 19011: 2002, “Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002.

17CE2046 GLOBAL CLIMATE CHANGE AND ITS IMPACT

Credit: 3:0:0

Course Objectives:

- To impart knowledge on global climate
- To understand the principle of global climate changes
- To choose appropriate climate model for impact control measures

Course Outcomes

At the end of the course, the student will be able to

- understand the fundamentals of climate science
- provide knowledge on climate and weather
- expose elements and process related to climate change
- evaluate impacts of global climate change
- develop climate mitigation and adaption models
- apply the knowledge in global climate change and its control measures

Unit I - INTRODUCTION: Ancient Earth - Climate and Chemical Histories, Paleo-indicators of climate, Global energy balance, Concern about Climate Change, Climate Change and Sustainable development.

Unit II - CLIMATE AND WEATHER: Factors affecting global, regional and local climates - Tropical, Monsoon, Polar, Desert, Mid-latitude climates and their role in global climate change - Antarctica, Greenland and the North Pole case studies.

Unit III - ELEMENTS AND PROCESSES RELATED TO CLIMATE CHANGE: Structure and driving forces of the earth. Earth's carbon reservoirs- marine and terrestrial carbon cycles - The Atmosphere - Radiation budget, Circulation, Stability, Chemistry of Atmosphere - Global wind systems, weather maps - Importance of water, Global Ocean Circulation - Industrialization and urbanization - Greenhouse gases, lifestyle changes.

Unit IV - IMPACTS OF GLOBAL CLIMATE CHANGE: The Greenhouse effect – Ecosystems and species interactions, global warming, sea level rise, ozone problem, El Nino and southern oscillation, storms, thunderstorms, tornadoes, changes in agricultural production, droughts, spread of epidemics, wildfires and other extreme weather events - Nuclear winter.

Unit V - CLIMATE CHANGE MITIGATION / ADAPTATION: Climate change and the political realm. Mission of the Intergovernmental Panel on Climate Change - International agreements and protocols - Future use of energy and fossil fuels - Role of Governments, industries, and individuals - Concept of CDM and carbon finance

Text Books

1. Lee, R. Kump, Kasting, F. James and Robert, C. Crane, “The Earth System”, 2nd Edition, Prentice Hall, 2004.
2. Houghton, J.T., “Climate Change 2001: The Scientific Basis”, Cambridge University Press, Cambridge, U.K., 2001.

Reference Books

1. Ruddiman, W.F., “Earth's Climate: Past and Future”, W.H. Freeman and Company, 2001
2. Henson R., “The Rough Guide to Climate Change”, 3rd edition, Rough Guides Ltd., London, 2011
3. IPCC. 2007. “Climate Change- Intergovernmental Panel on Climate Change” (IPCC)'s Fourth Assessment Report, Cambridge University Press, Cambridge, U.K. 2007
4. Maslin, Mark, “Climate Change: A Very Short Introduction”, 3rd Edition. Oxford UP, 2014.

17CE2047 ENVIRONMENTAL MANAGEMENT

Credit: 3:0:0

Course Objectives:

- To impart knowledge on Environmental Management
- To understand different environmental standards
- To develop skills on pollution prevention

Course Outcomes

At the end of the course student will be able to

- understand different environmental standards
- appreciate the elements of Corporate Environmental Management systems complying to international environmental management system standards
- lead pollution prevention assessment team and implement waste minimization options
- develop, Implement, maintain and Audit Environmental Management systems for Organizations
- impart knowledge in environmental management audit
- evaluate and success environmental management system for different industries

Unit I - ENVIRONMENTAL MANAGEMENT STANDARDS: Unique Characteristics of Environmental Problems - Classification of Environmental Impact Reduction Efforts – Evolution of Environmental Stewardship – Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources - Environmental quality objectives – Rationale of Environmental standards.

Unit II - PREVENTIVE ENVIRONMENTAL MANAGEMENT : Pollution control Vs Pollution Prevention - Opportunities and Barriers – Four Stages and nine approaches of Pollution Prevention - Getting Analysis of Process Steps – Material balance – Preventive Environmental Management over Product cycle.

Unit III - ENVIRONMENTAL MANAGEMENT SYSTEM : EMAS, ISO 14000 - EMS as per ISO 14001– environmental policy– legal and other requirements- environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control –monitoring and measurement – management review.

Unit IV - ENVIRONMENTAL AUDIT: Roles and qualifications of auditors - Environmental performance indicators and their evaluation –Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement - Due diligence audit

Unit V - APPLICATIONS: Applications of EMS - Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper – Electroplating - Tanning industry – Dairy – Cement - Chemical industries, etc

Text Books

1. Mike Russo., “Environmental Management: Readings and Cases”, 2nd Edition, Sage Publications, 2008.
2. Canter, W Larry., “Environmental Impact Assessment”, McGraw-Hill Inc., 1996

Reference Books

1. Christopher Sheldon and Mark Yoxon, “Installing Environmental management Systems – a step by step guide”, Earthscan Publications Ltd, London, 1999.
2. ISO 14001/14004: “Environmental management systems – Requirements and Guidelines”, International Organisation for Standardisation, 2004
3. ISO 19011: 2002, “Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002.
4. Jain, R.K., Urban, L.V., Stacey, G.S. and Balbach, H.E., “Environmental Assessment”, McGraw-Hill, 1993.
5. Rau, J.G and Wooten, D.C., “Environmental Impact Analysis Handbook”, McGraw-Hill, 1980.
6. Jain, R.K., Urban, L.V., Stacey, G.S. and Balbach, H.E., “Environmental Assessment”, McGraw-Hill, 1993.
7. UNEP/IED Technical Report Serial No.2., “Environmental Auditing”, 1990

17CE2048 HYDRAULIC STRUCTURES

Credit: 3:0:0

Course Objectives:

- To integrate the hydraulics and water resources background in the design of hydraulic structures
- To solve multi-variable hydraulic design problems in an open-ended solution space.
- To develop understanding of the basic principles and concepts of analysis and design of hydraulic structures.

Course Outcomes:

At the end of the course, the student will be able to

- recall the concepts of storage structures
- describe the forces acting on the dams
- operate the system component in the dam site
- distinguish the functions of the components of dams
- appraise the execution the water resource projects
- investigate the construction of dams and structures

Unit I - MULTIPLE-STEP DESIGN: Internal stresses in gravity dams - stress distribution around openings - stress distribution around a circular hole in an infinite plate due to a normal stress on the plate - stress distribution around a horse shoe shaped gallery using phillips and zanger's tables - design of reinforcement around galleries in dams

Unit II - DAMS: Arch Dams: Economic central angle of an arch dam - constant radius method - constant angle method- variable radius and variable angle design of arch dams -trial load method of analysis of arch dams - Earth Dams: Seepage analysis - stability analysis of infinite slopes with and without seepage - stability analysis of finite slopes – friction circle method - method of slices - ordinary method of slices - simplified Bishop method of slices - spencer's method.

Unit III - SPILLWAYS: Design of reinforcement in the crest region of an ogee spillway - hydraulic design of chute spillways - morning glory spillways - side channel spillways. Intake structures - Trash Racks.

Unit IV - WATER CONDUCTOR SYSTEM: Economic analysis for determination of sizes of water conductors - analysis and design of lined pressure tunnels - water hammer analysis - analysis and design of surge tanks of various types - design of anchor blocks for penstocks - design of penstock junctions – design of scroll cases and draft tubes.

Unit V - GATES AND VALVES

Vertical lift gates - tainter gates - cylindrical gates - butterfly valves - Howell – Bunger valves - needle valves - flow induced forces on vertical lift gates - flow induced vibration of vertical lift gates - Layout of Power Houses.

Text Books

1. S K Garg, "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 2014
2. Vischer, D.L and Hager, W. H. "Dam Hydraulics", John Wiley & Sons, New York, 1998.

Reference Books

1. Yanmaz A. M. "Applied Water Resources Engineering", METU press, 2001.
2. Roberson, J.A., Cassidy, J.J. and Chaudhry, M.N. "Hydraulic Engineering", John Wiley & Sons, New York, 1998.
3. Mays, L.W. "Hydraulic Design Handbook", McGraw-Hill Professional; 1st edition, 1999.

17CE2049 PARTICIPATORY WATER MANAGEMENT

Credit: 3:0:0

Course Objectives

- To introduce the students to the concept of farmer involvement in water management.
- To highlight the value of participatory approach for better performance of the irrigation systems
- To provide other facilities to the water users through organized associations.

Course Outcomes

At the end of the course, the student will be able to

- recall the concepts of system approach
- discuss the application of socio-economical concepts in the operation of water resources system

- solve water resource problems using linear and dynamic programming techniques
- organize the concepts of integrated planning in water resources projects
- appraise the pros and cons in the execution of water resources projects
- formulate the problems and solve using Simulation techniques

Unit I - FUNDAMENTALS OF SOCIOLOGY: Sociology as a science: basic concept – Perspectives of sociology – Social system – Early sociological thought

Unit II - CONCEPT OF PARTICIPATION: Introduction – Dublin statement – Irrigation as a socio-technical process – System management by agencies and users – Farmers organization and participation: need, and contribution to irrigation management (greater productivity, improved water distribution, conflict management, greater resources mobilization and sustained system performance).

Unit III - WATER USER ASSOCIATION: Kinds of participation – Activities in irrigation management – Water users Association – Types and levels of operation and organization in irrigation systems – User roles in irrigation management – Role of community organizers – The context of participation: factors in the environment - Organizational structure for watershed management - Role of SHGs and NGOs- Participatory planning and implementation of watershed projects

Unit IV - SUPPORTING FARMERS ORGANIZATION AND PARTICIPATION: Policy consideration – Support – Experimentation, phasing and flexibility – Bottom-up approach – Existing organizations – Ownership – Non-political associations – Bureaucratic reorientation – Compatibility of objectives – Choices in organizational design – Scope of activity – Size and structure – Membership and decision making – Leadership and responsibilities – Legal basis – Development strategy – Channels for implementation.

Unit V - IMPROVING AGENCY RELATION WITH FARMERS: Agency incentives – Technical cooperation – Special roles and style of agency – Agency organization – Irrigation management transfer

Text Books

1. S.S. Kalamkar & A Narayanamoorthy, “Participatory Irrigation Management: Evolution, Perception and Impact”, Gyan Publishing House 2011
2. David Groenfeldt & Mark Svendsen, “Case Studies in Participatory Irrigation Management”, world bank publication, 2000

Reference Books

1. Abraham Mark, “Social Research Methods”, Prentice. Hall Inc. Eaglewood Cliffs, N.J. 1993.
2. Chambers R., “Managing Canal Irrigation”, Oxford IBM Publishing Co., New Delhi. 1988.

17CE2050 REMOTE SENSING AND GIS IN CIVIL ENGINEERING

Credit: 3:0:0

Course Objectives:

- To introduce the basic concepts and principles of various components of remote sensing.
- To understand the satellite image analysis and interpretation
- To provide an exposure to GIS and its practical applications in civil engineering.

Course Outcomes

At the end of the course, the student will be able to

- recall the principles of remote sensing and gis
- describe the analysis methods RS and GIS data
- interpret the data for modeling applications
- distinguish sensors and satellites datas for specific applications
- appraise the usage of data models
- formulate methods to solve issues related to environment using RS and GIS techniques

Unit I - EMR AND ITS INTERACTION WITH ATMOSPHERE & EARTH MATERIAL: Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein’s Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

Unit II - PLATFORMS AND SENSORS: Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Pay load description of important Earth Resources and Meteorological satellites – Airborne and spaceborne TIR and microwave sensors.

Unit III - IMAGE INTERPRETATION AND ANALYSIS : Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised.

Unit IV - GEOGRAPHIC INFORMATION SYSTEM: Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems (DBMS)

Unit V - DATA ENTRY, STORAGE AND ANALYSIS: Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

Text Books:

1. Lillesand T.M., Kiefer, R.W. and J.W.Chipman. “Remote Sensing and Image Interpretation” 5th Edition, John Willey and Sons Asia Pvt. Ltd., New Delhi, 2004.
2. Anji Reddy, M. “Textbook of Remote Sensing and Geographical Information System” 2nd edition. BS Publications, Hyderabad, 2001.

Reference Books:

1. Lo.C.P.and A.K.W.Yeung, “Concepts and Techniques of Geographic Information Systems”, Prentice Hall of India Pvt. Ltd., New Delhi, 2002
2. Peter A. Burrough, Rachael A. McDonnell, “Principles of GIS”, Oxford University Press, 2000
3. Ian Heywood “An Introduction to GIS”, Pearson Education Asia, 2000

17CE2051 GEOINFORMATICS APPLICATIONS FOR CIVIL ENGINEERS

Credits: 3:0:0

Course Objectives:

- To introduce the applications of geoinformatics technique for resources Management
- To impart knowledge about measurement of structural changes
- To provide an exposure to applications of geoinformatics in infrastructure management

Course Outcomes:

At the end of the course, the student will be able to

- repeat different surveying procedures which includes total station, gps, topographic and bathymetric surveys
- identify deformation in structural aspects
- execute the applications of remote sensing techniques
- organize intelligent transportation systems
- appraise the application of modeling tools for water resources planning and management
- formulate and solve civil engineering problems using geoinformatic applications

Unit I - LAND RESOURCE MANAGEMENT: Total Station and GPS Surveys – Topographic and Bathymetric Surveys – Cadastral Information – Soil and Land Use Surveys - Land Information System (LIS) – Real Estate Information System

Unit II - STRUCTURAL STUDIES: Deformation studies of deflection - Dam deformation - structural movement - Pavement yield - shifting sand-bank and shoreline – Landslide Risk Analysis

Unit III - SOIL CONSERVATION AND MANAGEMENT: Soil survey interpretation and mapping - impact of agricultural and industrial activity on soil properties - soil erosion - factors influencing soil erosion - soil contamination using Hyper spectral Remote Sensing - mining pollution- EMR responses with contaminated soil - modeling soil characteristics using satellite data - soil degradation assessment using Remote Sensing and GIS - Land reclamation studies

Unit IV - URBAN AND TRANSPORTATION MANAGEMENT: Monitoring Urban Growth through Remote Sensing - Geo-demographic Analysis – Property Market Analysis Urban Renewal - traffic analysis - accident analysis - site suitability analysis for transport infrastructure –transportation databases: creation and maintenance - Vehicle routing – Highway maintenance system – Intelligent Transportation System

Unit V - WATER RESOURCES PLANNING AND MANAGEMENT: Location of storage/diversion works – capacity curve generation – sediment yield - modelling of catchments – Delineation of watershed - Watershed modelling for sustainable development - Rainfall – Runoff modelling –LiDAR Mapping for Urban area –Water quality mapping and monitoring – Flood Risk Zoning - Flood damage assessment – Flood Modelling - Assessment of droughts and mitigation

Text Books:

1. Basudeb Bhatta, “Remote Sensing and GIS”, 2nd edition, Oxford University Press 2011.
2. C.P.Lo.Albert K.W.Yeung, “Concepts and Techniques of Geographic Information Systems”, 2nd edition, PHI Learning Private Limited, Delhi, 2014.

Reference Books:

1. Andrew N. Rencz, “Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring”, John Wiley & Sons Inc, April 2004
2. Rashed, Tarek; Jürgens, Carsten (Eds.), “Remote Sensing of Urban and Suburban Areas”, Springer, 1st Edition. 2010.
3. Harvey J. Miller, Shih-Lung Shaw, “Geographic Information Systems for Transportation – Principles and Applications”, Oxford University Press, 2001.
4. Gert A. Schultz Edwin T. Engman, “Remote Sensing in hydrology and Water Management”, Springer - verlag Berlin Heidelberg, Germany, 2000.

17CE2052 ADVANCED SURVEYING TECHNIQUE

Credit: 3:0:0

Course Objectives:

- To introduce advanced surveying techniques
- To give an understanding of linear and angular measurements
- To explain surveying methods and procedures

Course Outcomes

At the end of the course, the student will be able to

- recall the principles of surveying &levelling
- describe the preparation of contour and topographic maps
- implement surveying effectively to minimize the errors
- distinguish the astronomical objects
- appraise the appropriate usage of instruments for measurements
- develop methods to solve problems using photogrammetric methods

Unit I - GPS – PRINCIPLES: EDM – Principle, sources and error, GPS – Principles, Errors, Differential GPS, Instruments and Setting out of tunnel, bridge.

Unit II - MAP PROJECTION: Fundamental properties of Map projection – Classification of Map projection-Principles of selecting map projection - Surveying and map projection.

Unit III - BASICS OF PHOTOGRAMMETRY: Principles of photography – instruments – photographic measurements – vertical photographs – stereoscopic viewing and parallax - Photomaps & Mosaics – Tilted photographs – Oblique and panoramic photographs – Terrestrial photogrammetry – around controls – photographic interpretations.

Unit IV - ASTRONOMICAL SURVEYING: Field Astronomy - measurement of time - determination of Azimuth - Latitude and longitude.

Unit V - MISCELLANEOUS RECONNAISSANCE: Route surveys for highways, railways and waterways – Hydrographic survey: Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge – Mine surveying Equipment – Weisbach triangle – Tunnel alignment and setting out.

Text Books

1. Bannister, A., Raymond, S., Baker, R., “Surveying”, Pearson Education, 2006
2. Punmia P.C., “Surveying” volume 3, Lakmi publications, 2004

Reference Books

1. Chandra, A.M., “Higher Surveying”, New Age International Publishers, 2002

2. Wolf, P.R., “Elements of Photogrammetry”, Mc.Graw – Hill International Book Company, 1998

17CE2053 DIGITAL CADASTRE

Credit: 3:0:0

Course Objectives:

- To introduce the students to the cadastral survey methods and its application
- To develop an understanding about inventory of land areas, land use and determine land tax
- To familiarize about land rights

Course Outcomes

At the end of the course, the student will be able to

- define the principles of cadastral system, records and taxation
- classify the various methods used for cadastral surveying,
- interpret from cadastral maps and maintain cadastral records
- distinguish within the photogrammetric methods
- support the systematically recording of land rights
- develop the digital cadaster and land information system

Unit I - INTRODUCTION: History of cadastral survey - Types of survey - Tax - Real Property – Legal cadastre - Graphical and Numerical Cadastre, Legal Characteristics of Records, Torrens System

Unit II - METHODS OF SURVEYING: Cadastral Survey Methods - Steps in survey of a village - Instruments used for cadastral survey & mapping - Orthogonal, Polar survey methods - Boundary survey - Rectangulation - Calculation of area of Land- GPS and Total Station in Cadastral survey.

Unit III - MAINTENANCE AND MEASUREMENTS: Cadastral survey maintenance - Resurveys - Measurement of sub-division - Measurement of obstructed lines - Survey of urban areas - Control requirement for Urban survey use of Satellite Imagery in boundary fixing.

Unit IV - PHOTOGRAMMETRIC METHODS: Photogrammetry for cadastral surveying and mapping - Orthophoto map – Quality control measures - Organisation of cadastral offices – international scenario

Unit V - MAPPING PROCEDURES AND LIS: projection for cadastral maps – Conventional symbols -map - reproduction processes - Automated cadastral map, Management of Digital Cadastral - Creation of Land Information System - Integrating LIS – Land administration

Text Books:

1. James, M. Anderson and Edward N. Mikhail, “Introduction to Surveying”, McGraw Hill Book Co, 1985
2. Kazi Humayun Kabir, “An Investigation into Geospatial Tools for a Multipurpose Cadastre”, Laambart Academic Publishing, 2011

Reference Books:

1. Alias Abdul Rahman, Siyka Zlatanova, Volker Coors, “Innovations in 3D geo information systems”, 2006
2. Kahmen&Faig, “Surveying”, Walter de Gruyter, Berlin, 1993.
3. Peter F. Dall, John D. McLaughlin, “Land information management”, Oxford Press.1988

17CE2054 SURFACE HYDROLOGY

Credit: 3:0:0

Course Objectives:

- To understand the main processes involved in water flow above the surface
- To learn the various measurement techniques
- To execute the models for runoff estimation.

Course Outcomes

At the end of the course, the student will be able to

- recall the system concepts, water budget equation and hydrologic cycle
- describe energy, momentum and continuity principles
- solve the problems related to atmospheric hydrology
- distinguish the modeling tools to optimize hydrographs
- appraise the application of statistical tools to manage hydrology related problems

- investigate channel flow and catchment storage problems

Unit I - INTRODUCTION: Hydrologic cycle, water budget equation, world water quantities, residence time, systems concept, transfer function operators, hydrologic model classification

Hydrologic processes: Reynold's Transport Theorem - continuity equation - momentum equation - energy equation - discrete time continuity.

Unit II - ATMOSPHERIC HYDROLOGY: Atmospheric circulation - water vapor - formation of rainfall - types and forms of precipitation - precipitable water - monsoon characteristics in India - rainfall measurement - density and adequacy of rain gauges; Thunderstorm Cell model - IDF relationships - spatial averaging methods of rainfall - Factors affecting evaporation - estimation and measurement of evaporation - energy balance method, aerodynamic method - Priestly-Taylor method and pan evaporation.

Unit III - SURFACE WATER: Catchment storage concept, Hortonian and saturation overland flow - streamflow hydrographs - base-flow separation. Phi-index - ERH & DRH - algorithm for abstraction using Green-Ampt equation - SCS method - overland and channel flow modeling - time area concepts and stream networks.

Unit IV - UNIT HYDROGRAPH: General hydrologic system model - response functions of a linear hydrologic systems and their inter-relationships - convolution equation; definition and limitations of a UH - UH derivation from single and complex storms - UH optimization using regression - matrix and LP methods - Synthetic unit hydrograph, S-Curve, IUH.

Unit V - HYDROLOGIC STATISTICS: Probability concepts - random variables - laws of probability - PDFs & CDFs; Normal and Binomial distributions - Statistical parameters: expected value - variance, skewness, and peakedness - Fitting of a probability distribution, methods of moments and maximum likelihood: Testing the goodness of fit - Chi-square test - Frequency analysis: return period - probability plotting - Extreme value distributions - frequency factors - Log-Pearson distribution - confidence limits.

Text Books:

1. Ven T. Chow, David R. Maidment, and Larry W Mays, "Applied Hydrology", McGraw Hill International Editions, 2013
2. K. Subramanya "Engineering Hydrology", Tata McGraw Hill Publishing Company, New Delhi, 2013

Reference Books:

1. Larry W. Mays, "Ground and surface water hydrology", John Wiley & Sons Inc, 2011
2. SK Garg, "Hydrology and Water Resources Engineering", Khanna Publisher, New Delhi, 2005

17CE2055 GROUNDWATER ENGINEERING

Credit: 3:0:0

Course Objectives:

- To introduce the principles of Groundwater governing Equations
- To identify the characteristics of different aquifers
- To understand the techniques of development and management of groundwater.

Course Outcomes

At the end of the course, the student will be able to

- recall the aquifer properties and its dynamics
- identify the practical problems of groundwater aquifers
- solve the problems related to well hydraulics
- organize the mathematical modelling to solve problems in groundwater management
- select methods to solve groundwater quality issues
- investigate the groundwater conservation & artificial recharge techniques

Unit I - HYDROGEOLOGICAL PARAMETERS: Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.

Unit II - WELL HYDRAULICS: Objectives of Groundwater hydraulics – Darcy’s Law - Groundwater equation – steady state flow - Dupuit Forchheimer assumption - Unsteady state flow - Theis method - Jacob method - Slug tests - Image well theory – Partial penetrations of wells.

Unit III - GROUNDWATER MANAGEMENT: Need for Management Model – Database for groundwater management – groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery.

Unit IV - GROUNDWATER QUALITY: Ground water chemistry - Origin, movement and quality - Water quality standards – Health and aesthetic aspects of water quality - Saline intrusion – Environmental concern and Regulatory requirements

Unit V - GROUNDWATER CONSERVATION: Artificial recharge techniques – Remediation of Saline intrusion– Ground water management studies – Protection zone delineation - Contamination source inventory - remediation schemes - Ground water Pollution and legislation.

Text Books

1. Raghunath H.M., “Ground Water Hydrology”, New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., “Ground Water Hydrology”, John Wiley and Sons, New York, 2000.

Reference Books

1. Fitts R Charles, “Groundwater Science”, Elsevier, Academic Press, 2002.
2. Ramakrishnan S, “Ground Water”, K.J. Graph arts, Chennai, 1998.

17CE2056 SUBSURFACE INVESTIGATION AND INSTRUMENTATION

Credits: 3:0:0

Course Objectives:

- To understand the importance of site investigation and planning of sub soil investigation.
- Interpretation of investigated data to design suitable foundation system.
- Importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design suitable foundation system.

Course Outcomes:

At the end of the course, the student will able to

- understand the procedure, applicability and limitations of various methods of geotechnical investigation as well as the field tests to be conducted
- plan and execute the sub soil investigation programme
- determine the basic properties of disturbed and undisturbed soil samples
- demonstrate the basic properties of the soil
- interpret the investigated data and design suitable foundation system
- select suitable soils for various geotechnical applications based on the factors governing the Engineering behaviour of soils.

Unit I - PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS: Scope and objectives, planning an exploration program - methods of exploration - exploration for preliminary and detailed design, spacing and depth of bores, data presentation - Geophysical exploration and interpretation, seismic and electrical methods, cross bore hole, single bore hole – up hole - down hole methods.

Unit II - EXPLORATION TECHNIQUES: Methods of boring and drilling - non-displacement and displacement methods - drilling in difficult subsoil conditions - limitations of various drilling techniques - stabilization of boreholes - bore logs.

Unit III - SOIL SAMPLING: Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques - offshore sampling - shallow penetration samplers - preservation and handling of samples.

Unit IV - FIELD TESTING IN SOIL EXPLORATION: Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressure meter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test - Procedure, limitations, correction and data interpretation of all methods

Unit V - INSTRUMENTATION: Instrumentation in soil engineering, strain gauges - resistance and inductance type - load cells - earth pressure cells - settlement and heave gauges - pore pressure measurements - slope indicators - sensing units, case studies.

Text Books

1. Hunt R.E., "Geotechnical Engineering Investigation Manual", McGraw Hill, 2005.
2. Alam Singh and Chowdhary, G.R., "Soil Engineering in Theory and Practice Volume-2, Geotechnical testing and instrumentation", CBS Publishers and Distributors, New Delhi, 2009.

Reference Books:

1. Winterkorn, H.F. and Fang, H.Y., "Foundation Engineering Hand Book", a Nostrand Reinhold 2013.
2. Nair, R.J. and Wood, P.M., "Pressuremeter Testing Methods and Interpretation", Butter-worths, 1987.
3. Dunnicliff J and Green, G.E., "Geotechnical Instrumentation for Monitoring Field Performance", John Wiley, 1993.
4. Hanna, T.H., "Field Instrumentation in Geotechnical Engineering", Trans Tech., 1985.
5. Day, R.N., "Geotechnical and Foundation Engineering", Design and Construction, McGraw-Hill, 1999.
6. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, The McGraw-Hill companies, Inc., New York, 1995.

17CE2057 PAVEMENT DESIGN

Credit: 3:0:0

Course Objectives:

- To gain knowledge on various IRC guidelines for designing rigid and flexible pavements.
- To assess quality and serviceability conditions of roads.
- To relate the performance evaluation and maintenance of pavements

Course Outcomes:

At the end of the course, the student will be able to

- identify the different pavement materials for flexible and rigid pavements
- infer pavement construction procedures and its equipment's
- analyse and design flexible and rigid pavements based on IRC guidelines
- practice the pavement evaluation and overlay design
- understand the methods of pavement stabilization
- experiment the field control stabilisation on roads

Unit I - PAVEMENT MATERIALS: Basic road construction materials such as soils, aggregates, bitumen and Portland cement - types, sources, functions, requirements, properties, tests and specifications for use in various layers of road. Properties of subgrade layers in flexible/rigid pavement construction,

Unit II - TYPES OF PAVEMENT: Types and component parts of pavements – Flexible, Rigid, Semi-rigid & Composite - Functions & desirable characteristics of pavements – Comparison of Rigid & Flexible Pavements - Highway and airport pavements - Factors affecting design and performance of pavements

Unit III - DESIGN OF FLEXIBLE PAVEMENT: Stresses and strains in flexible pavements: Boussinesq's equations - Burmister's two layer and three layer theories, Wheel load stresses, various factors in traffic wheel loads, Equivalent single wheel load of multiple wheels. Repeated loads and EWL factors – Flexible pavement design methods for highways - Empirical, semi empirical and theoretical approaches in IRC method of pavement design – Ministry of Road Transport and Highways (MORT) specifications

Unit IV - DESIGN OF RIGID PAVEMENT: Stresses in rigid pavements - Westergaard's equations for calculation of stresses in rigid pavement - rigid pavement analysis, EWL - factors influencing design of rigid pavements – Design procedure as per IRC guidelines – Design of Joints

Unit V - PERFORMANCE EVALUATION & MAINTENANCE AND STABILIZATION OF PAVEMENTS: Pavement Evaluation – causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Ravelling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements – Pavement Serviceability index – Pavement maintenance (IRC Recommendations only) - Design of overlays - Stabilization of Pavements - Choice of stabilizers – Testing and field control Stabilisation for rural roads in India – use of Geosynthetics in roads.

Text Books

1. Yang H Huang, "Pavement Analysis and Design", Pearson, Paperback, 2008
2. Khanna, S.K., Justo C.E.G. and Veeraragavan. A., "Highway Engineering", Nem Chand and Brothers, 10th Edition, Roorkee, 2014.

Reference Books

1. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000.
2. IRC-37-001, "The Indian roads Congress, Guidelines for the Design of Flexible Pavements", New Delhi, 2001
3. IRC 58-1998, "The Indian Road Congress, Guideline for the Design of Rigid Pavements for Highways", New Delhi, 1991
4. Rajib B.Mallick, Tahar El-Korchi, "Pavement Engineering: Principles and Practice", 2nd Edition, CRC Press, 2013.
5. Wright P.H. "Highway Engineers", John Wiley and Sons, Inc., New York, 1996.
6. Kadiyali, L.R. "Principles and Practice of Highway Engineering", Khanna tech. Publications, New Delhi, 1989.

17CE2058 AIRPORT, HARBOUR AND DOCK ENGINEERING

Credit: 3:0:0

Course Objectives:

- To understand about the Railway planning, construction and maintenance
- To learn about the aircraft characteristics, planning and components of airport.
- To study about the types and components of docks and harbours.

Course Outcomes:

At the end of the course, the student will be able to

- develop and design the elements of permanent way
- generalize the concepts of signalling & interlocking in railways
- understand the concepts of air transport growth and planning
- design the runway, taxiway, and airfield pavements as per guidelines
- recognize the importance of water transport with proper planning and designing of harbour and docks
- construct the layout and facilities of Harbour and Docks

Unit I - RAILWAY PLANNING: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way: Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys - conventional and modern methods – Soil suitability analysis – Geometric design of railways – gradient - super elevation - widening of gauge on curves- Points and Crossings - Signalling & Interlocking

Unit II - RAILWAY CONSTRUCTION AND MAINTENANCE: Earthwork – Stabilization of track on poor soil – Tunnelling Methods, drainage and ventilation – Calculation of Materials required for track laying – Construction and maintenance of tracks –Modern methods of construction & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.

Unit III - AIRPORT PLANNING: Air transport characteristics-airport classification-airport planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Case studies, parking and circulation area.

Unit IV - AIRPORT DESIGN: Runway Design- Orientation, Wind Rose Diagram – Runway length – Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings and lighting.

Unit V - HARBOUR ENGINEERING: Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works

Text Books

1. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee, 2012.
2. K.P.Subramanian, "Railways, Airports and Harbour Engineering", SCITECH Publications (India) Pvt Ltd, 2016

Reference Books

1. Rangwala, "Airport Engineering", Charotar Publishing House, 2013.
2. Rangwala, "Harbor Engineering", Charotar Publishing House, 2013.
3. Oza.H.P. and Oza.G.H. "A course in Docks & Harbour Engineering". Charotar Publishing Co., 2013
4. Srinivasan R. Harbour, "Dock and Tunnel Engineering", 26th Edition 2013
5. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 2013

17CE2059 TRANSPORTATION SYSTEMS PLANNING

Credit: 3:0:0

Course Objectives:

- To know about the process and concepts of transportation planning
- To impart knowledge in the rudiments and advancements in Transportation Planning and Travel Demand Forecasting
- To identify the suitable Landuse and public transportation system for developing countries

Course Outcomes:

At the end of the course, the student will be able to

- relate the principles of the transportation planning process and demand estimation
- analyse the trip production and trip attraction models
- practice the growth factor, gravity and opportunity models
- infer the mode choice behaviour and mode split models
- evaluate the shortest path models for route assignment
- recognize the Land use and public transportation system

Unit I - URBANISATION PROCESS: Urban Transportation System Planning - Goals and objectives - Hierarchical levels of transportation System planning - Forecast - Implementation – Constraints - UTP survey - Urban growth mechanism – Urban morphology - Urbanisation & travel demand - Urban development planning policy – NUTP - Urban transport projects - Urban transport problems in India

Unit II - TRAVEL DEMAND ESTIMATE: Urban travel patterns - Study area delineation- Zoning - Planning surveys - Urban activity system- Sustainable urban transport - Systems approach - Trip based and activity based approach - Four stage travel demand modelling - Data needs and outputs - Quick response techniques - Survey designs.

Unit III - TRIP GENERATION & TRIP DISTRIBUTION: Productions & Attractions - Influential factors –Trip rate analysis-Category analysis- Simple & Multiple linear regression models – FHWA method -Interchange matrix – Growth factor methods – Synthetic methods – Calibration of Gravity model

Unit IV - MODAL SPLIT & TRIP ASSIGNMENT: Influential factors – FHWA Procedure – Diversion curves & surfaces- Discrete choice models, Concept, Types, BL,MNL & HL models - Trip Assignment procedure – Diversion curves- BPR model - All or Nothing assignment - Multipath assignment - Capacity restraint assignment – User equilibrium and system equilibrium approach - Stochastic assignment approach

Unit V - LAND USE TRANSPORT SYSTEM & PUBLIC TRANSPORTATION: Urban system components - Urban spatial structure – Accessibility - Location theory - Land use models - Land use transport models, Lowry & Garin – Lowry models. Urban growth and public transport needs - Transit mode classifications - Transit characteristics - Fleet size and capacity estimation - Multiple regression models - Category analysis - Trip production models - Trip distribution models - Linear programming approach. Modal split models - Behavioural models - Probabilistic models - Utility functions - logit models - Two stage model

Text Books

1. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning", 3rd Edition, Prentice Hall of India, New Delhi, 2008
2. Konstadinos G. Goulias "Transportation Systems Planning: Methods and Applications" CRC Press, Taylors and Frances Group, 2008.

Reference Books

1. John D.Edwards (Edr.), "Transportation Planning Hand Book", 2nd Edition, Institute of Transportation Engineers, Prentice Hall Inc.,, Washington DC, USA, 1999
2. Ennio Cascetta "Transportation Systems Analysis: Models and Applications" 2nd Edition, Springer New York.

3. John Khisty C, Kent Lall B, “Transportation Engineering – An Introduction”, 3rd Edition, Prentice Hall of India, New Delhi, 2002
4. Chennai Metropolitan Development authority (CMDA), Chennai Metropolitan Area – Second Master Plan, Chennai, 2006
5. Chennai Metropolitan Development authority (CMDA) Chennai Comprehensive Transportation study 2008

17CE2060 TRAFFIC ENGINEERING AND MANAGEMENT

Credit: 3:0:0

Course Objectives:

- To illustrate the fundamentals of traffic engineering
- To identify the different theories of traffic flow
- To impart the importance of traffic safety and management

Course Outcomes

At the end of the course, the student will be able to

- impart the fundamental of traffic engineering
- carry out different traffic studies
- design channels, intersections, signals, roundabouts and parking arrangements
- express the application of traffic flow theory
- enhance safety and environment in all design aspects
- develop Traffic management Systems

Unit I - FUNDAMENTALS OF TRAFFIC ENGINEERING: Scope of Traffic Engineering - Elements of Traffic Engineering - road user, vehicle and road way. Road Characteristics – Road user characteristics – PIEV theory – Vehicle characteristics - IRC standards - Design speed, volume – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India –

Unit II - TRAFFIC SURVEYS AND LEVEL OF SERVICE: TRAFFIC SURVEYS – Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting - Level of service – Concept, applications and significance - Highway capacity - Capacity of urban and rural roads - PCU concept and its limitations – Road user facilities - Parking facilities - Cycle tracks and cycle ways - Pedestrian facilities – Traffic Flow theory

Unit III - TRAFFIC DESIGN AND VISUAL AIDS: Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated - Design of signal setting - phase diagrams - timing diagram – Signal co-ordination – Roundabouts - Grade separated intersections - Geometric elements for divided and access controlled highways and expressways

Unit IV - TRAFFIC SAFETY AND ENVIRONMENT: Road furniture - Street lighting -Traffic signs including Variable Message Sign and road markings – Significant roles of traffic control personnel – Networking pedestrian facilities & cycle tracks - Traffic regulation and control Traffic Safety – Principles and Practices – Road Safety Audit – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport

Unit V - TRAFFIC MANAGEMENT: Area Traffic Management System – Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education – Car pooling

Text Books

1. Kadiyali.L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 2013
2. Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan Press Ltd.1996

Reference Books

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, “Principles of Highway Engineering and Traffic Analysis”, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, “Principles of Traffic and Highway Engineering”, CENGAGE Learning, New Delhi, 2010

3. SP:43-1994, IRC Specification, “Guidelines on Low-cost Traffic Management Techniques” for Urban Areas, 1994
4. John E Tyworth, “Traffic Management Planning, Operations and control”, Addison Wesley Publishing Company, 1996
5. Hobbs.F.D. “Traffic Planning and Engineering”, University of Birmingham, Peragamon Press Ltd, 2005
6. Taylor MAP and Young W, “Traffic Analysis – New Technology and New Solutions”, Hargreen Publishing Company, 1998.
7. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.

17CE2061 INTELLIGENT TRANSPORTATION SYSTEMS

Credit: 3:0:0

Course Objectives:

- To learn the fundamentals of ITS.
- To study the ITS functional areas
- To employ the ITS implementation in developing countries

Course Outcomes:

At the end of the course, the student will be able to

- understand the concept of its, with particular emphasis on advanced traffic management and traveller information issues
- explain the human factor issues for its
- generalize the sensor and communication technologies
- apply the various its methodologies
- define the significance of its under indian conditions
- describe the elements of Vehicle Location, Route Navigation and Guidance concepts

Unit I - INTRODUCTION: ITS Objectives - Historical Background - Benefits of ITS - Architecture – ITS Architecture Framework –Dynamic Message Sign - ITS Data collection techniques – Detectors - Automatic Vehicle Location (AVL) - Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS) - Video data collection.

Unit II - TELECOMMUNICATIONS IN ITS: Importance of telecommunications in the ITS system, Information Management - Traffic Management Centres (TMC) - Vehicle – Road side communication – Vehicle Positioning System ITS functional areas – Advanced Traffic Management Systems (ATMS)

Unit III - ADVANCED TRAVELLER INFORMATION SYSTEMS (ATIS): Commercial Vehicle Operations (CVO) - Advanced Vehicle Control Systems (AVCS) - Advanced Public Transportation Systems (APTS) - Advanced Rural Transportation Systems (ARTS)

Unit IV - ITS USER NEEDS AND SERVICES: Travel and Traffic management - Public Transportation Management - Electronic Payment - Commercial Vehicle Operations - Emergency Management - Advanced Vehicle safety systems - Information Management - Incident Management

Unit V - AUTOMATED HIGHWAY SYSTEMS: Vehicles in Platoons – Integration of Automated Highway Systems - ITS Programs in the World – Overview of ITS implementations in developed countries -ITS in developing countries – Case studies

Text Books

1. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
2. Kan Paul Chen, “ITS Hand Book 2000: Recommendations for World Road Association”, (PIARC) John Miles, 2000

Reference Books

1. Henry F.Korth, and Abraham Siberschatz, “Data Base System Concepts”, McGraw Hill, 1992.
2. Turban E., “Decision Support and Export Systems Management Support Systems”, Maxwell Macmillan, 1998
3. Sitausu S. Mittra, “Decision Support Systems – Tools and Techniques”, John Wiley, New York, 1986.
4. Cycle W. Halsapple and Andrew B.Winston, “Decision Support Systems – Theory and Application”, Springer Verlag, New York, 1987

5. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

17CE2062 FUNDAMENTALS OF COASTAL PROCESSES

Credit: 3:0:0

Course Objectives:

- To introduce Coastal Processes
- To relate it to the principles and practice of coastal engineering
- To design for coastal erosion and adopt principles of harbours and breakwaters

Course Outcomes

At the end of the course, the student will be able to

- adapt the fundamentals of the hydraulic processes in coastal zone
- identify sedimentary processes that shape the active coastal zone
- analyse problems related to coastal protection
- design solutions to coastal erosion
- illustrate the design principles of harbours and breakwaters
- apply knowledge on the beach nourishment and other coastal protection measures

Unit I - WAVE HYDRODYNAMICS: Water waves - impact on the coasts and coastal erosion processes. Linear long waves - theory and approximations. Sine waves - application, flow field, pressure field, flow velocity. Wave statistics - random waves, expected maximum wave heights, wave groups.

Unit II - WAVE MEASUREMENT: Offshore wave measurements - design conditions, tides, how these affect design Outside the surf zone - breakwaters and harbours, types, typical designs, key constraints. Inside the surf zone - wave setup, surf beat, long-shore currents, Influence in coastal management and planning

Unit III - WAVE RUN UP: Beach face process - wave run-up - tsunami run-up - Impact of these processes in terms of coastal inundation and coastal safety

Unit IV - COASTAL PROTECTION: Beach groundwater - coastal aquifers, dispersion of pollutants, vegetation - Surf safety - rip currents - Beach profiles and erosion cycles - differences between short and long term erosion, protection against the different modes

Unit V - COASTAL MODELLING AND ANALYSIS: Coastal sediment transport - sediment budgets, how to analyse, coastal cells Long-shore and cross-shore transport principles - key drivers, influence of man-made and natural structures, mitigation measures. Coastal area modelling - present state-of-the-art in hydrodynamic models and morphology

Text Books

1. Sundar, V, "Ocean Wave Mechanics: Applications in Marine Structures" Wiley, 2015
2. Chakrabarti, S.K, "Hydrodynamics of Offshore Structures" Springer-Verlag, 1987

Reference Books

1. Peter Nielsen, "Coastal and Estuarine Processes" World Scientific Publishing Company, 2009
2. Hermans, A.J, "Water Waves and Ship Hydrodynamics", Springer Netherlands, 2011
3. Svendsen, Ib A, "Introduction to Nearshore Hydrodynamics", World Scientific Publishing Company, 2006
4. Horikawa, K., "Coastal Engineering", University of Tokyo Press, 1978

17CE2063 OPERATIONS RESEARCH TECHNIQUES IN CIVIL ENGINEERING

Credit 3:0:0

Course Objectives

- To introduce students to quantitative methods and techniques for effective optimization
- To formulate mathematical modeling and application
- To learn various techniques that are used in solving Civil Engineering Problems

Course Outcomes

At the end of the course, the student will be able to

- identify the characteristics of different type of problem
- demonstrate the model problem for civil engineering application
- choose suitable algorithm for a specific problem

- analyze using various techniques
- appraise the traditional and non-traditional algorithms
- develop tools for civil engineering problems

Unit I - INTRODUCTION AND BASIC PRINCIPLES OF OPTIMIZATION TECHNIQUE: Definition-Objective function, constraints-equality and inequality constraints-design space- feasible and infeasible- convex and concave-active constraint-local and global optima - Differential calculus-optimality criteria-Single variable optimization-Multivariable optimization with no constraints-Lagrange multiplier method with equality constraint-Kuhn Tucker Criteria with inequality constraints

Unit II - LINEAR PROGRAMMING: Formulation of problems-Graphical solution –Analytical methods-Standard form-Slack, Surplus and artificial variable-canonical form-basic feasible solution –Simplex method –Two phase method-Penalty method-Duality theory-Primal Dual algorithm

Unit III - NON LINEAR PROGRAMMING: One dimensional minimization methods: Unidimensional – Unimodal function-Exhaustive and Unrestricted search-Dichotomous search-Fibonacci method –Cauchy’s steepest descent method-Conjugate gradient method (Fletcher Reeves)

Unit IV - GEOMETRIC AND DYNAMIC PROGRAMMING: Posynomial –degree of difficulty – reducing GPP to a set of simultaneous equations – unconstrained and constrained problems with zero degree of difficulty-Concept of solving problems with one degree of difficulty

Bellman’s principle of optimality-Representation of multistage decision problems-concept of sub optimization using classical and tabular methods

Unit V - NON TRADITIONAL OPTIMIZATION ALGORITHM: Genetic algorithms, working Principle, Difference and Similarities between GAs and traditional methods, GAs for constrained optimization - Introduction to neural network and fuzzy logic

Text Books

1. Taha H.A., “Operations Research: an Introduction”, Prentice Hall of India, New Delhi, 2003.
2. Rao.S.S., “ Engineering Optimization, theory and Practice”, New Age International (p) Ltd., New Delhi.,2002

Reference Books:

1. David.W.A. Rees., “Mechanics of optimal Structural Design”, John Wiley and Sons, 2009
2. Rajasekaran.S, and Vijayalakshmi Pai, “Neural Networks, Fuzzy logic and Genetic algorithm”, Prentice Hall of India Pvt. Ltd, Delhi, 2003.
3. Kalyanmoy Deb., “Multi-Objective Optimization using evolutionary Algorithm”, John Wiley and Sons, 2001
4. Fletcher R., “Practical Methods of Optimization Volumes 1,2”, John Wiley 1980, 1981.
5. Luenberger and Ye, “Linear and Nonlinear Programming”, Third Edition, Springer, 2008.

17CE2064 DISASTER MANAGEMENT AND MITIGATION

Credit: 3:0:0

Course Objectives

- To introduce the students about types of natural and environmental disasters.
- To help students to develop skills in various stages of disaster preparedness, mitigation and management.
- To teach the students the methodologies for disaster risk assessment.

Course Outcomes:

At the end of the course, the student will be able to

- recall the types of natural and environmental disasters and its causes
- discuss about organizational and Administrative strategies for managing disasters
- demonstrate the early warning systems, monitoring of disasters effect and necessity of rehabilitation
- compare the engineering and non-engineering controls of mitigating various natural disasters
- appraise the key roles of capacity building to face disaster among government bodies, institutions, NGO’s, etc
- develop methodologies for disaster risk assessment with the help of latest tools like GPS, GIS, Remote sensing, information technologies, etc

Unit I - NATURAL DISASTERS – OVERVIEW: Introduction- Natural disasters around the world- Natural Disaster Risk Assessment- Earth and its characteristics Human dimensions of global environment change – Disaster mitigation, preparedness, response and recovery- comprehensive emergency management Early warning systems and Disaster Preparedness– Rehabilitation, Vulnerable Populations - Logistics and services, food, nutrition and shelter -Role of UN Red Cross and NGOs.

Unit II - NATURAL HAZARDS: Introduction and Review - Natural Disasters -Principles, Elements, and Systems - Geological- Geomorphological aspects, - Earthquake-Geology, Seismology, Characteristics and dimensions– Landslides- Human impact on the mountainous terrain and its relationship with Rainfall, liquefaction etc- Tsunami - Nature and characteristics.

Unit III - CLIMATE SYSTEM ASPECTS AND PROCESSES: Oceanic, Atmospheric and Hydrologic cycles - Severe Weather & Tornadoes , Cyclones, Floods and Droughts - Global Patterns - - Mitigation & Preparation – Drought – Famine- nature and dimensions – Drought Assessment and Monitoring.

Unit IV - NATURAL DISASTER COMMUNICATION: Mapping - Modeling, risk analysis and loss estimation – Natural disaster risk analysis - prevention and mitigation - Applications of Space Technology (Satellite Communications, GPS, GIS and Remote Sensing and Information / Communication Technologies (ICT) in Early warning Systems - Disaster Monitoring and Support Centre– Information Dissemination, mobile communication – etc.

Unit V - ADMINISTRATIVE MECHANISMS: Community and Social organizations – Education and Training – Establishment of capacity building among various stake holders – Government - Educational institutions – Use of Multi-media knowledge products for self education.

Text Books

1. Kovach, Robert L. Earth's Fury, An Introduction to Natural Hazards and Disasters, Englewood Cliffs, N.J., Prentice Hall, 1995
2. Iyengar, C.B.R.I., “Natural Hazards in the Urban Habitat” , Tata McGraw Hill Co., 2001.

Reference Books

1. Jon Inglestone, “Natural Disaster management”, Tulor Rose, 1999.
2. Singh, R.B., “Disaster Management”, Rawat Publications, 2000.
3. Sachindra Narayan, “Anthropology of Disaster management”, Gyan Publishing House, 2000
4. Damon P. Coppola, “Introduction to International Disaster Management”, Elsevier Publication, 2011

17CE2065 WATER RESOURCES SYSTEMS AND OPERATION

Credit: 3:0:0

Course Objectives:

- To introduce the student to the concept of Mathematical approaches for managing the water resources system.
- To make the students apply an appropriate system approach to simulate a water resource system.
- To enable the student to carryout the procedures required for a system operation

Course Outcomes

At the end of the course, the student will be able to

- recall the concepts of system approach
- discuss the concepts of socio economical aspects and analysis of water resources system
- demonstrate the concepts of integrated planning of a water resources project
- experiment with various systems problems through linear and dynamic programming
- select the appropriate programming technique for systems operation and allocation
- formulate the problem according to real world problem and solve it

Unit I - SYSTEM APPROACH: Philosophy of modelling – Goals and Objectives – Basics of system analysis concept – scopes and steps in systems engineering.

Unit II - PHYSICAL AND SOCIO - ECONOMIC DATA: Collection, evaluation and processing – project appraisal – public involvement, master Comprehensive and integrated planning of water resources project.

Unit III - LINEAR PROGRAMMING: Operation research - introduction - Problem Formulation-graphical solution- Simplex method – Sensitivity analysis - simple applications

Unit IV - DYNAMIC PROGRAMMING: Optimality criteria Stage coach problem – Bellman’s optimality criteria
Problem formulation and Solution - simple applications

Unit V – SIMULATION: Basic principles – Methodology and Philosophy – Model development – input and outputs – Deterministic simulation - simple applications

Text Books

1. Vedula, S., and Majumdar, P.P. “Water Resources Systems – Modeling Techniques and Analysis”, Tata McGraw Hill, 5th reprint, New Delhi, 2010.
2. Chadurvedi M.C., “Water resource Systems Planning and Management”, Tata McGraw Hill inc., New Delhi, 1997

Reference Books

1. Hall Warren, A. and John A. Dracup., “Water Resources System Engineering”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998
2. Taha H.A., “Operation Research”, McMillan Publication Co., New York, 1995.

17CE2066 REMOTE SENSING AND GIS LABORATORY

Credit: 0:0:2

Course Objectives:

- To introduce the basic concepts of GIS
- To carryout satellite image analysis and classification
- To provide an exposure to GIS and its practical applications in civil engineering.

Course Outcomes

At the end of the course, the student will be able to

- recall the principles of remote sensing and GIS
- describe the analysis methods for RS and GIS data
- interpret the data for modeling applications
- distinguish sensors and satellite data for specific applications
- appraise the usage of data models
- formulate methods to solve issues related to environment using RS and GIS techniques

List of experiments:

1. Creating Shape files and assigning co-ordinate system
2. Editing data in shapefile
3. Georeferencing the shapefiles
4. Creating rasters
5. Overlay analysis using vector data
6. Query analysis
7. Creating buffers, using clip, intersect options
8. Image classification using ERDAS and ArcMap
9. Landuse change detection study
10. Creating DEM from contours
11. Watershed delineation
12. Suitability analysis study

Reference Books

1. Lillesand T.M., Kiefer, R.W. and J.W. Chipman. “Remote Sensing and Image Interpretation” 5th Edition, John Wiley and Sons Asia Pvt. Ltd., New Delhi, 2004.
2. Anji Reddy, M. “Textbook of Remote Sensing and Geographical Information System” 2nd edition. BS Publications, Hyderabad, 2001.
3. Lo.C.P. and A.K.W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Prentice Hall of India Pvt. Ltd., New Delhi, 2002
4. Peter A. Burrough, Rachael A. McDonnell, “Principles of GIS”, Oxford University Press, 2000
5. Ian Heywood, “An Introduction to GIS”, Pearson Education Asia, 2000

17CE3001 ADVANCED CONCRETE STRUCTURES

Credits: 3:0:0

Course Objectives:

- To impart knowledge on the limit state design of RC Structural components
- To understand the behavior of various structures
- To design the special structural elements as per Indian standard codes of practice.

Course Outcomes

At the end of the course, the student will be able to

- interpret the concept of rcc design
- classify different types of roofing system
- discuss the structural behavior of special structures
- design different types of rcc structures
- evaluate the quality of rcc construction
- identify the solution for failure of structures

Unit I - LIMIT STATE DESIGN: Review of limit state design of structural elements – Moment rotation behavior - Limit state serviceability - Design for bond - Calculation of deflection and crack width according to IS, BS and ACI Codes

Unit II - DESIGN OF FLAT SLABS: Introduction - Action of flat slabs - Direct design methods - Shear in flat slabs - Equivalent frame method - Design of edge beam - Effect of openings

Unit III - DESIGN OF SPECIAL RCC ELEMENTS: Plates and Shells - Types - Design of Shell Roof - Cylindrical and hyperbolic paraboloid - Structural behaviour and Design of folded plates

Unit IV - DESIGN OF SPECIAL STRUCTURE: Introduction - Difference between bunker and silo - Design of Bunkers – Design of Silo – Design of RC walls.

Unit V - FIELD PRACTICE AND DETAILING Reason for building failure - Structural Integrity - Ductility detailing - Design of joints in frames - Construction details at connections and special situations - Fire resistance of structural members – Quality control of concrete

References:

1. Unnikrishna Pillai and Devdass Menon “Reinforced concrete Design”, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007.
3. Varghese, P.C., “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
4. Bhavikatti S.S., “Advanced RCC Design”, New age International Pvt. Ltd. 2006.
5. Varghese, P.C., "Advanced Reinforced concrete structures ", Prentice – Hall of India Ltd, New Delhi 2003.
6. Krishnaraju,N., "Advanced Reinforced Concrete Design", CBS publications, New Delhi 2005

17CE3002 STRUCTURAL DYNAMICS

Credits: 3:0:0

Course Objectives:

- To gain knowledge on the basic principles of free and forced vibration (both undamped and damped) of single degree of freedom system
- To learn modal analysis of multiple degree of freedom systems as well as distributed parameter systems
- To get exposed to the solution techniques for free and forced vibration analysis of building frames subjected to dynamic loads

Course Outcomes

At the end of the course, the student will be able to

- identify the elements of vibratory system and to choose the basic theorems and the relevant mathematical tools for dynamic analysis of structure
- explain the causes and effects of structural vibration and methods of vibration isolation
- determine the fundamental frequency and mode of vibration of structural elements
- calculate the response of the components of structural system due to undamped or damped free and forced vibration

- compare the response of vibrating structural elements obtained by rigorous mathematical approach and functional approximation methods
- model the multi-storied building frame and generate the overall response due to dynamic loads using mode superposition method

Unit I - INTRODUCTION TO PRINCIPLES OF DYNAMICS: Principles of vibration analysis: Elements of vibratory system and simple harmonic motion - D'Alembert's principle - Hamilton's principle – Principle of virtual work; Idealization of a structure as SDOF system - Equation of motion - Damped and undamped free vibrations - Critical damping - Logarithmic decrement Undamped forced vibration - Response to support motion - Response to harmonic excitation, damped or undamped - Response to arbitrary periodic loading- Response to general dynamic loading (blast or earthquake) - Duhamel's integral –Vibration isolation.

Unit II - DYNAMIC RESPONSE OF TWO DEGREE OF FREEDOM SYSTEM: Mathematical model for two degree of freedom system- free and forced vibration with and without damping – normal modes of vibration – application to vibration absorber and tuned mass damper.

Unit III - DYNAMIC RESPONSE OF MULTI DEGREE OF FREEDOM SYSTEM: Mathematical model of MDOF system - Free vibration of undamped MDOF systems - Natural frequencies and mode shapes – Orthogonality conditions - Analysis for natural frequencies and mode shapes - Solution of the Eigen value problems: Stodola Power method - Jacobi method - Holzer method - Transfer matrix methods - Dunkerlay's equation – Rayleigh and Rayleigh-Ritz methods; Response to forced vibration by mode superposition method.

Unit IV - DYNAMIC RESPONSE OF CONTINUOUS SYSTEM: Mathematical model for continuous system-free and forced vibration of bars - Analysis for undamped free and forced vibration of simply supported and cantilever beams - Effect of axial loads; Rayleigh Ritz method.

Unit V - ANALYSIS OF MULTI STORIED BUILDINGS SUBJECTED TO DYNAMIC LOADS:

Idealizations of multi-storeyed building frames for dynamic analysis - Shear buildings – Stiffness - flexibility and mass matrices - Free and forced vibration with and without damping – solution by step by step direct integration - Central Difference method - Houbolt method - Wilson- θ -method - Newmark method.

References:

1. Clough, R.W., and Penzien, “Dynamics of Structures”, McGraw Hill Book Co Ltd, 1986.
2. Paz Mario, “Structural Dynamics - Theory and Computation”, CBS Publishers and Distributors Pvt. Ltd., 2004
3. Leonard Meirovitch, “ Elements of Vibration Analysis”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007
4. Anil K. Chopra, “Dynamics of Structure”, Pearson, 2015
5. Joseph W. Tedesco, William G. McDougal and C. Allen Ross., “ Structural Dynamics”, Addison Wesley Longman Inc., California, 1998

17CE3003 APPLIED ELASTICITY AND PLASTICITY

Credits: 3:0:0

Course Objectives:

- To understand the concept of 3 dimensional stress and strain analysis.
- To obtain solutions for selected problems in rectangular and polar coordinates as well as torsion of prismatic bars, thin walled open sections and closed tubes
- To understand the plastic stress-strain relations, criteria of yielding and elasto- plastic problems

Course Outcomes

At the end of the course, the student will be able to

- recite the basic equations of elasticity and plasticity and recognize the methods of solution of elastic, elastic-plastic and plastic problems of solid mechanics
- explain the concept of stress at a point, strain at a point, stress or strain transformation, principal plane and principal stress, strain- displacement relations, yield criteria, yield surface, plastic stress -strain relation
- calculate the principal stress/strain at a point in a stressed body and their associated directions
- carry out rigorous analysis of a stressed body, examine its stress distribution and to compare the same with results obtained by strength of material approach

- justify the importance of rigorous analysis of solid mechanics problems by theory of elasticity and theory of plasticity for weight- sensitive applications
- develop equations governing the behaviour of physical problem consistent with the kinematic constraints

Unit I - ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONAL CARTESIAN COORDINATES: Analysis of stress in 3D Cartesian coordinates: Body force, Surface forces - Uniform state of stress – Stress at a Point – Differential equations of equilibrium- Stress transformation laws – Principal stresses - Analysis of strain in three dimension - Strain displacement relations – St.Venant Compatibility conditions - State of strain at a point - Strain transformations - Principal strain - Principle of superposition - Stress-strain relations - Generalized Hooke's law; Methods of formulation of elasticity problems - St.Venant principle.

Unit II - TWO DIMENSIONAL PROBLEMS IN RECTANGULAR AND POLAR COORDINATES:

Two Dimensional Problems in Cartesian Coordinates: Plane stress and plane strain problems – Airy's stress function - Polynomials -Application to; bending of a beam - Stress distribution; Symmetrical Stress distribution in thick cylinder - rotating disc - Pure bending of curved bars; Bending of a curved bar by force at the end - Effect of circular hole on stress distribution - Concentrated force at a point of a straight boundary - Forces on wedges - Circular disc with diametric loading.

Unit III - TORSION OF NON-CIRCULAR SECTIONS: Torsion of noncircular sections: General solutions of the problem by displacement (St. Venant's warping function) and force (Prandtl's stress function) approaches - Membrane analogy - Torsion of shafts of noncircular (elliptic, triangular and rectangular) cross sectional shapes - Torsion of thin rectangular section - torsion of thin walled open sections - torsion of hollow thin walled single and multi-celled sections.

Unit IV - BEAMS ON ELASTIC FOUNDATION: Analysis of prismatic Euler beam on elastic foundation: Idealization of soil medium – Winkler model – Infinite beams – Semi infinite and Finite beams – Point load and uniformly distributed load – Various boundary conditions – Solution by closed form integration and finite difference method.

Unit V - INTRODUCTION TO PLASTICITY: Elasto-plastic and Plastic analysis: Yield criteria – Rankine's theory - St.Venant's theory - Tresca's criterion - Beltrami theory - Von-Mises criterion; Stress-space representation of Von-Mises and Tresca yield criteria through Westergard stress space - Elasto-Plastic problems - Beams in bending - Thick hollow cylinders subjected to internal pressure - Torsion of bar of circular cross section - Nadai's sand heap analogy.

References:

1. Chakrabarthy, T., "Theory of Plasticity", Elsevier, New Delhi, 2014.
2. Chandramouli, P.N., "Theory of Elasticity", Yes Dee Publishing Private Ltd., Chennai, 2017
3. Chow, P.C and Pagano, N.J., "Elasticity, Tensor, Dyadic and Engineering approaches", Dover Publications Inc, New York, 1992.
4. Mendelson, A., "Plasticity - Theory and Applications", MacMillan Co., New York, 1968
5. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New.Delhi, 1995
6. Sadhu Singh, "Theory of Plasticity", Khanna Publishers, New.Delhi, 1995
7. Timoshenko, S. and Goodier, J.N., "Theory of Elasticity", McGraw-Hill Book Co., New Delhi, 2010

17CE3004 PRESTRESSED CONCRETE STRUCTURES

Credits: 3:0:0

Course Objectives:

- Understand the Principles of pre-stressing
- Analyse and design the prestressed concrete elements
- Apply the concepts of prestressing techniques

Course Outcomes

At the end of the course, the student will be able to

- Identify the suitable pre-stressing systems and methods
- Choose the appropriate pre-stressing system
- Interpret the behaviour of PSC structural elements
- Analyze the PSC structural elements
- Design PSC structural elements

- Evaluate the strength and durability of PSC structures

Unit I – INTRODUCTION: Review - Basic concepts of prestressing - IS 1343-2012 code provisions - Factors affecting strength and deflection - Layout of cables - Introduction to ACI and BS codal provisions

Unit II - DESIGN FOR FLEXURE, SHEAR AND TORSION: Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion.

Unit III - DESIGN OF CONTINUOUS AND CANTILEVER BEAMS: Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and gap cables – Analysis and design of cantilever beams

Unit IV - DESIGN OF POST TENSIONED CONCRETE SLAB: Design of one way and two way spanning floors - flexure in flat slab - tendon profile - anchorage bursting reinforcement - Design of railway sleepers

Unit V - DESIGN OF COMPOSITE MEMBERS: Composite beams - Applications - analysis and design, ultimate strength - Partial prestressing - advantages and applications.

References:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Lin.T.Y.,and Burns.H, “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, New York, 2009.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

17CE3005 FINITE ELEMENT ANALYSIS OF STRUCTURES

Credits: 3:0:0

Course Objectives:

- To understand the basic concept of finite element and the finite element procedure
- To study the development of shape functions, strain displacement relations, stiffness matrix and load vector for one, two, and three dimensional finite elements including plate and shell elements.
- To get exposure to mesh generation techniques and the working of commercial softwares

Course Outcomes

At the end of the course, the student will be able to

- Reproduce conservation of energy principle, variational principle and methods of weighted residual for developing finite element model
- Explain the finite element procedure by taking a simple 2D truss problem.
- Develop the shape function, strain displacement-relation, stiffness matrix and consistent load vector for structural members.
- Analyze scalar and vector variable problems
- Justify the approximate solution by finite element method by comparing with closed form solution of bench mark problem.
- Choose appropriate finite element for analysis depending on the nature of the problem.

Unit I - ANALYSIS OF ONE DIMENSIONAL PROBLEM: Concept of Finite Element: Element types – Strong and weak formulations - Variational principles - Principle of virtual work - Rayleigh-Ritz method - Galerkin’s method of weighted residual - Energy Principles - Displacement, stress and hybrid models - Convergence and compatibility requirements; One Dimensional Problems: scalar and vector variable problems concept of shape functions – Bar, beam and truss elements– global, local and natural coordinate systems – generation of stiffness matrix and consistent load vector– finite element procedure

Unit II - ANALYSIS OF TWO DIMENSIONAL PROBLEMS: Two Dimensional Problems: Plane stress and plane strain problems - Triangular Elements - Constant strain triangle - Element stiffness matrix - Various Methods of evaluating element stiffness - higher order triangular elements - comparison of different elements. Rectangular Elements - Serendipity family - Lagrangian family - Hermitian family – static condensation technique; Sub-Iso-Super parametric elements - Shape function - Mapping - Linear iso-parametric quadrilateral

Unit III - ANALYSIS OF THREE DIMENSIONAL PROBLEMS: Three dimensional problems: Numerical Integration using Gaussian Quadrature - Weights and Gauss points - Selective and reduced integration -

Axisymmetric stress analysis - Tetrahedron element family - Parallelepiped element - Hexahedron Element family - ZIB 8 and ZIB 20 elements.

Unit IV - ANALYSIS OF PLATES AND SHELLS: Analysis of plates; Introduction to Kirchhoff and Mindlin plate theories- Triangular and rectangular elements - BFS Element, Mindlin plate element; Analysis of Shells: Faceted element for shells - Semi-loof elements - Degenerated shell elements – 4 noded bilinear shell element- Axisymmetric shell elements – shear and membrane locking; Finite strip method: Development of stiffness matrix and consistent load vector - Application to folded plates and bridge decks

Unit V - MESHING AND SOLUTION PROBLEMS: Component mode synthesis –finite element model for vibration and buckling – elements for fracture analysis - Ill conditioned elements- Discretization errors - error evaluation - Higher order elements - Auto and adaptive mesh generation techniques – Mesh refinement technique - P and H methods of mesh refinement – requirement for selection of commercial software for structural analysis- Principles of modeling and analysis using software.

References:

1. Bathe, K.J., “Finite Element Procedure”, Prentice Hall of India, New Delhi, 2014
2. Chandrakant, S.Desai and John, F.Abel, "Introduction to the Finite Element method, A numerical Method for Engineering. Analysis", CBS Publishers and Distributors Pvt. Ltd., New Delhi, 2005
3. Chennakesava R. Alavala, “Finite Element Method: Basic Concept and Applications”, Prentice Hall inc., 2014
4. Cook R.D., “Concepts and Applications of Finite Element Method”, Wiley John & Sons, 2014
5. Moaveni,S., “ Finite Element Analysis: Theory and Application using ANSYS”, Pearson Education, 2011
6. Rajasekaran, S., “Finite Element Methods in Engineering Design”, S.Chand & Co Ltd., New Delhi, 2015
7. Rao, S.S., “ Finite Element Method in Engineering”, Butterworth - Heinemann, 2014
8. Reddy, J.N., “ An Introduction to Finite Element Method”, McGraw-Hill International edition, 2008
9. Tirupathi, R.Chandrupatla and Ashok, D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India Private Limited., New Delhi, 2004.
10. Zienkiewicz, O.C., “The Finite Element Method”, Vol. 1 & 2", Mc Graw Hill Book Company, New York, 1999.

17CE3006 DESIGN OF BRIDGES

Credits: 3:0:0

Course Objectives:

- Know the loading standards of IRC
- Study the design principles of bridges
- Analyse and design different types of bridges.

Course Outcomes

At the end of the course, the student will be able to

- Classify bridges according to different loading standards
- Choose the appropriate bridge with respect to span and loading
- Analyse different types of bridges
- Design the different components of bridges
- Examine the stability of sub structure
- Interpret the intricacies in construction and failure of bridges

Unit I - SHORT SPAN RC BRIDGES: Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges -analysis and design of slab culverts , Tee beam and slab bridges.

Unit II - LONG SPAN RC BRIDGES: Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts - Cable stayed and suspension bridges.

Unit III - PRESTRESSED CONCRETE BRIDGES: Flexural and torsional parameters – Courbon’s theory – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block

Unit IV - STEEL BRIDGES: General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

Unit V - BEARINGS AND SUBSTRUCTURES: Different types of bearings – Design of bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations.

References:

1. Jagadeesh.T.R. and Jayaram.M.A, “Design of Bridge Structures”, Prentice Hall of India Pvt. Ltd. 2004.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Oxford and IBH Publishing Co. New Delhi, 2001.
3. Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, 2008.
4. Raina V.K. “Concrete Bridge Practice”, Tata McGraw Hill Publishing Company, New Delhi, 2010

17CE3007 ADVANCED STEEL STRUCTURES

Credits: 3:0:0

Course Objectives:

- Study the behaviour of steel connections
- Analyse and design the Industrial buildings
- Evaluate the performance of light gauge steel structures

Course Outcomes

At the end of the course, the student will be able to

- select the suitable structural steel section
- explain the behaviour of different types of connection
- perform plastic analysis of frames
- design components of industrial building
- assess the performance of the joints
- evaluate the strength of light gauge steel structures

Unit I – GENERAL: Limit state method - Design of members subjected to combined forces – Design of Purlins and Gable column – Design of slab base and Gusseted bases and Moment Resisting Base Plates.

Unit II - DESIGN OF CONNECTIONS:Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Eccentric connections - Split beam Connections – Framed Connections.

Unit III - ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS: Types of roof system - loads - Analysis and design of roof truss – Analysis and design of industrial buildings – Pre-Engineered buildings - Sway and non sway frames – seismic design of steel buildings

Unit IV - PLASTIC ANALYSIS OF STRUCTURES: Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment - Design of continuous beams. Transmission line structure - loads - bracing system - design of microwave towers

Unit V - DESIGN OF COLDFORMED STEEL STRUCTURES: Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Design of Compression Members – Wall Studs

References:

1. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, 1990.
2. Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008.
3. Wie Wen Yu, “Design of Cold Formed Steel Structures”, Mc Graw Hill Book Company, 1996.

17CE3008 SEISMIC ANALYSIS AND DESIGN OF STRUCTURES

Credits: 3:0:0

Course Objectives:

- To understand the principles of plate tectonics and seismology
- To analyse the forces in the members as per IS 1893 and ductile detailing as per IS 13920
- To study the principle of vibration control methods and retrofitting techniques

Course Outcomes

At the end of the course, the student will be able to

- sequence the basic principles of engineering seismology
- estimate the forces on the structures
- assess the methods for seismic resistant design
- illustrate the codal provisions for seismic resistant design
- recommend suitable alternate techniques
- formulate methods of damaged structures

Unit I - EARTHQUAKES AND GROUND MOTION: Engineering Seismology, Seismotectonics, Earthquake Monitoring and Seismic Instrumentation (Indian Scenario), Estimation of Earthquake Parameters, Seismic Zoning of India- Microzonation- Peak Horizontal acceleration (PHA)

Unit II - ANALYSIS OF STRUCTURES FOR SEISMIC FORCES: Dynamics of Structures (SDOFS/ MDOFS), Response Spectra - Evaluation of Earthquake Forces as per codal provisions – Static and dynamic methods- Lessons Learnt From Past Earthquakes

Unit III - EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES: Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration

Unit IV - EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES: Earthquake Resistant Design of R.C.C. Buildings – Ductile detailing of structures –Rigid Frames – Shear walls.

Unit V - VIBRATION CONTROL TECHNIQUES: Vibration Control - Principles and application- Case Studies, Important structures- methods of retrofitting.

References:

1. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2004.
2. C. A. Brebbia, “Earthquake Resistant Engineering Structures VIII”, WIT Press, 2011
3. Mohiuddin Ali Khan “Earthquake-Resistant Structures: Design, Build and Retrofit”, Elsevier Science & Technology, 2012
4. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2009.
5. Paulay, T and Priestley, M.J.N., “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1992.
6. S K Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.

17CE3009 STABILITY OF STRUCTURES

Credits: 3:0:0

Course Objectives:

- To learn the basic principles of stability of structures
- To gain knowledge on equilibrium and energy approaches for the buckling of compression members and beam columns made of solid as well as thin walled open sections
- To understand the buckling behaviour of plates and shells and imperfection sensitivity

Course Outcomes

At the end of the course, the student will be able to

- memorize the stability criteria, energy theorems, and basic mathematical techniques used to determine the critical loads of structural elements
- explain the cause of bifurcation and limit point buckling of structural elements
- apply equilibrium and energy approaches and develop mathematical equations for buckling of structural elements
- carry out buckling analysis of structural elements and determine the buckling loads and the associated buckling modes
- justify the applicability of approximate solution techniques for buckling of structures
- predict the buckling behaviour of a building frame by using stability function and by using linear elastic stiffness and geometric stiffness of the experiments

Unit I - INTRODUCTION AND ELASTIC BUCKLING: Buckling of columns: States of equilibrium - Stability criteria - Static and dynamic approach - Higher order differential equations - Various boundary conditions - Initially bent column - Eccentrically loaded column – Energy method - Rayleigh-Ritz method - Galerkin method –Finite Difference method - Effect of shear on buckling - Large deflection of columns – Inelastic buckling of columns: Double modulus theory - Tangent modulus theory

Unit II - BUCKLING OF BEAM COLUMNS: Theory of Beam Columns: Beam-columns with concentrated lateral loads - Distributed loads - Effect of axial force on bending stiffness - Stability of frames with and without sway- Use of Stability functions – Buckling analysis by finite element method

Unit III - TORSIONAL AND LATERAL BUCKLING: Lateral stability of beams: Differential equations for lateral buckling - Lateral buckling of beams in pure bending - Lateral buckling of cantilever and simply supported I beams; Buckling of Thin-Walled Open Sections: Torsional buckling - Torsional flexural buckling - Equilibrium and energy approaches.

Unit IV - BUCKLING OF PLATES: Stability of plates: Governing differential equation – Equilibrium and energy concepts - Critical load of a thin plate under uni-axial and biaxial compression – analysis for various boundary conditions - Critical load of plate in shear - Galerkin's method - Finite difference method – inelastic buckling of plate - Post-buckling strength.

Unit V - BUCKLING OF SHELLS: Buckling of shells: Donnel's equation - Symmetrical buckling of cylinder under uniform axial compression - Cylinder under uniform external lateral pressure - Cylinder subjected to torsion; Imperfection sensitivity: Perfect systems - Imperfect systems - Sensitive and insensitive systems - Symmetric and asymmetric bifurcation - Bifurcation and limit points

References:

1. Ashwini Kukar, "Stability of Structures", Allied Publishers Limited, New Delhi, 1998.
2. Brush, D.O., and Almorh B.O., "Buckling of Bars, Plates and Shells", McGrawHill, 1975.
3. Chajes, A., "Principles of Structural Stability Theory", Prentice Hall, New Delhi, 1974.
4. El Naschie, M.S., "Stress, Stability and Chaos in Structural Engineering: An Energy Approach", McGraw Hill International Editions, 1992.
5. Iyengar, N.G.R., "Elastic Stability of Structural Elements", Macmillan India Ltd., New Delhi, 2007.
6. Murali, L. Gambir, "Stability Analysis and Design of Structures", Springer-Verlog, Berlin, 2013.
7. Robert Millard Jones, "Buckling of Bars, Plates and Shells", McGraw-Hill, 2006
8. Simister G.J. and Hodge D.H., "Fundamentals of Structural Stability", Elsevier Ltd., 2008
9. Timoshenko, S.P., and Gere, J.M., "Theory of Elastic Stability", 2nd Ed. McGraw-Hill, 2013.

17CE3010EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

Credits: 3:0:0

Course Objectives:

- Acquire knowledge on various techniques for experimentation
- Illustrate the construction and working principles of various devices
- Formulate complex structures for static and dynamic load

Course Outcomes

At the end of the course, the student will be able to

- plan various experiments and the instruments
- classify the force measurements and the strain measurements for various tests
- choose the vibration analyser and data recorders
- examine various parameters with the appropriate device
- develop complex structures for static and dynamic load
- evaluate the distress in structures

Unit I - FORCES AND STRAIN MEASUREMENT: Choice of Experimental stress analysis methods - Errors in measurements – Force measurements - Principles of operations of UTM - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines - Strain gauges - principle, types, performance and uses - Photo elasticity - principle and applications – Long term monitoring – vibrating wire sensors – Fibre optic sensors.

Unit II - VIBRATION MEASUREMENT: Characteristics of Structural Vibrations – Vibration excitors - Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements - Vibration

meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter— Digital data Acquisition systems.

Unit III - FLOW MEASUREMENT: Principles of Pressure and flow measurements - Pressure transducers - Sound level meter - Flow meters – Venturimeter – Wind tunnel Test - its use in structural analysis

Unit IV - MODEL ANALYSIS: Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems – Usage of influence lines in model studies.

Unit V - DISTRESS MEASUREMENTS AND CONTROL: Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell - construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Holography – use of laser for structural testing – Brittle coating – Half cell potentiometer – corrosion analyzer – rebar locator - impulse radar techniques

References:

1. Hollman J. P, “Experimental Methods for Engineers”, 7th edition, McGraw Hill Education Pvt. Ltd. 2007
2. Dalley .J. W and Riley. W. F, “Experimental Stress Analysis”, McGraw Hill Book Company, New York 1991
3. Jindal U. C, “Experimental Stress Analysis”, Pearson, New Delhi, 2013.
4. Sirohi.R.S, Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.
5. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.

17CE3011 ADVANCED STRUCTURAL ENGINEERING LABORATORY

Credits: 0:0:1

Course Objectives:

- To learn the concepts of mix design
- To understand the flexural behaviour of RCC and steel beam by experimental Investigation
- To get an exposure on NDT methods

Course Outcomes

At the end of the course, the student will be able to

- determine the properties of concrete in fresh and hardened state
- explain the behaviour of structural elements
- evaluate the strength and durability of concrete

Experiments

1. Concrete Mix Design as per IS and ACI
2. Studies on Bending Strength and Deflection Behaviour of RCC Beam
3. Studies on Axial Load Capacity of RCC Column
4. Testing of Steel Beam for Strength and Deflection Behaviour
5. Durability test on concrete using RCPT
6. Non Destructive Testing on structures using
 - a) Ultra-Sonic Pulse Velocity
 - b) Rebound Hammer
 - c) Corrosion Analyser
 - d) Rebar and Cover meter

References:

1. IS 10262:2009 Indian Standard code for Concrete Mix Design, Bureau of Indian Standards, New Delhi
2. Shetty, M. S., “Concrete Technology”, S. Chand and Co., New Delhi, 2005
3. Neville, A.M., “Concrete Technology”, Longman Scientific & Technical, 2005.

17CE3012 COMPUTER AIDED DESIGN LABORATORY

Credits: 0:0:1

Course Objectives:

- Introduce the application of FEM in Software Packages
- Analyze and design various structural elements using software packages
- Impart knowledge on computer application in civil engineering

Course Outcomes

At the end of the course, the student will be able to

- model the structures with appropriate loading as per the standards
- analyse and design the structures for static and dynamic loads
- estimate the design stresses of structural elements

Experiments

1. Analysis of RCC/Steel building frame for static loads
2. Analysis of RCC/Steel building for dynamic loads
3. Analysis and design of truss
4. Analysis of Continuous beam/frame (2D)
5. Analysis of Solid beam (3D)
6. Analysis of Plate

References:

1. STAAD Pro 2007 V8i Analysis Reference Manual, 2015.
2. ANSYS 17.1 - Analysis Reference Manual, 2016.
3. Rudra Pratap, "Getting Started with MATLAB", Oxford University Press, 2002

17CE3013 ADVANCED CONCRETE TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To know more about advanced construction chemicals
- To study the strength and durability properties of concrete
- To perform mix design for concrete

Course Outcomes

At the end of the course, the student will be able to

- identify suitable admixture for concreting
- explain the hydration reaction
- choose the appropriate type of concrete
- analyze the properties of hardened concrete
- recommend suitable mix proportions methods
- evaluate the quality of concrete

Unit I – MATERIALS: Introduction - Concrete ingredients - workability - Role of chemical admixtures - super plasticizers - self curing agents - viscosity modifying agents - high strength non shrink grouts - foaming agents - water proofing agents - polymers in concrete - Supplementary cementitious material

Unit II - CONCRETE CHEMISTRY: Hydration chemistry – cooling of aggregates- factors affecting hydration - CSH gel formation - secondary gel - structure of hydrated cement paste - properties of fresh and hardened concrete – -factors affecting strength properties of concrete - stress strain relation - strength porosity relationship - failure modes in concrete - maturity of concrete

Unit III - DURABILITY OF CONCRETE: Hot weather concreting - effect of temperature in concrete - Cold weather concreting - resistance to freezing and thawing - concrete expansion and contraction - Concrete in marine environment - corrosion of steel in concrete - corrosion analysing techniques - abrasion resistance - Rapid chloride penetration test

Unit IV - SPECIAL CONCRETE: Self compacting concrete - Flowability and segregation resistance - mix design - geopolymer concrete - Fibers in concrete - pumped concrete - light weight concrete - pervious concrete - ultra high strength concrete - nano materials in concrete - reactive powder concrete - recycled aggregate concrete – Shot-Crete – foam concrete

Unit V - MIX DESIGN AND QUALITY CONTROL: Statistical quality control - Sampling and testing -

Acceptance and rejection criteria - Standard deviation - Concepts of mix design - factors affecting mix proportion - mix design as per BIS, ACI and BS code- mix design of concrete with admixtures – on-line quality assurance and control

References:

1. A.R. Santhakumar “Concrete Technology”, Oxford University Press N Delhi, 2006
2. Neville, A.M., “Concrete Technology”, Longman Scientific & Technical, 2003
3. IS 10262:2009 - Guideline for mix proportioning, Bureau of Indian standards

17CE3014 ANALYSIS AND DESIGN OF TALL BUILDINGS

Credits: 3:0:0

Course Objectives:

- To understand the behaviour of tall buildings
- To analyse the resultant forces in various structural forms
- To analyse the stability of tall buildings

Course Outcomes

At the end of the course, the student will be able to

- identify the loads on tall buildings
- illustrate the behaviour of various structural forms
- adopt suitable techniques for analysis
- analyse the forces in the structures
- assess the long term effects in tall buildings
- integrate second order effects into the analysis of tall buildings

Unit I - LOADING AND DESIGN PRINCIPLES: Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Design philosophy - working stress method, limit state method and plastic design.

Unit II - BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS: Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

Unit III - ANALYSIS AND DESIGN : Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

Unit IV - STRUCTURAL ELEMENTS: Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance

Unit V - STABILITY ISSUES: Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

References:

1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.
2. Beedle.L.S, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
3. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.
4. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
5. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.

17CE3015 OFFSHORE STRUCTURES

Credits: 3:0:0

Course Objectives:

- To learn the theories on offshore structures.
- To understand the behavior and design aspects of offshore structures.
- To understand the accidental loads on offshore structures.

Course Outcomes

At the end of the course, the student will be able to

- identify the structures for the specified offshore field theoretically
- explain the significance of offshore structures in oil industry
- choose the various loads and load combination on the structures
- analyze the primary components of the offshore structures
- determine the optimum feasible structure
- design the structure and estimate the global response of the structure

Unit I - LOADS ON OFFSHORE STRUCTURES: Loads on offshore structures -wind loads; wave and current loads; calculation based on Maximum base Shear and Overturning Moments; Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth; Fatigue Load Definition and Joint Probability distribution; Seismic Loads.

Unit II - CONCEPTS OF FIXED PLATFORM JACKET AND DECK: Concepts of Fixed Platform Jacket and Deck - Jacket concepts, redundant framing arrangement; Launch and Lift jackets; Simple Deck configurations for Lift and float-over installations; In-service and Pre-service Loads and analysis.

Unit III - STEEL TUBULAR MEMBER DESIGN: Steel Tubular Member Design - Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines).Tubular Joint Design for Static and Cyclic Loads - Simple tubular joints, design using allowable loads; stress concentration factors; S-N curves and fatigue damage calculations.

Unit IV - SUBMARINE PIPELINES AND RISERS: Submarine Pipelines and Risers - Route selection and Diameter / wall thickness calculations; Pipeline stability, free span calculations; Concrete coated pipelines and pipe-in-pipe insulated pipelines; Design using DNV 81 code.

Unit V - DESIGN AGAINST ACCIDENTAL LOADS: Design against Accidental Loads (Fire, Blast and Collision). Behavior of steel at elevated temperature; Fire Rating for Hydrocarbon fire; Design of structures for high temperature; Blast Mitigation-Blast walls; Collision of Boats and energy absorption; Platform survival capacity and Plastic design methods.

References:

1. Chakrabarti, S.K, “Hydrodynamics of Offshore Structures” Springer-Verlag. 2005.
2. Chakrabarti, S.K, “Handbook of Offshore Engineering”Elseviers, 2005.
3. Gopu, B, Song, S, Chacko, J, and Ghalambor, A,“Offshore pipelines” GPP Publishers, 2006
4. W.F.Chen and E.M.Lui, “Structural Stability - Theory and Implementation” , Elsevier, 2006
5. Thomas, H.Dawson, “Offshore Structural Engineering”, Prentice Hall Inc., Englewood Cliffs, N.J, 1983.
6. Brebia C.A, and Walker S., “Dynamic Analysis of Offshore structures”, New-nestButterworth, U.K., 1979.

17CE3016 GEOTECHNICAL EARTHQUAKE ENGINEERING

Credits: 3:0:0

Course Objectives:

- To understand the dynamics of earth and its response, effect on earth structure and measures to mitigate the effects.
- Students are able to develop the design ground motion for a site by suitable response analysis
- To analyse and design geotechnical structures. Students are able to prepare a hazard and risk map.

Course Outcomes

At the end of the course, the student will be able to

- apply the principles of earthquake loading
- quantify earthquake intensity and ground motion
- estimate seismic soil design parameters

- analyze and design seismic resistant foundation for buildings
- prepare soil risk and micro zonation maps
- assess the hazard resistance to maintain and modify the soil sample

Unit I - ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS: Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

Unit II - GROUND MOTION CHARACTERISTICS: Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

Unit III - GROUND RESPONSE ANALYSIS - LOCAL SITE EFFECTS AND DESIGN GROUND MOTION: Wave propagation Analysis - Site Amplification, Ground Response Analysis - Method of analysis - One Dimensional Analysis - Equivalent linear Analysis – shear beam Analysis - site effects - Design Ground Motion - Developing Design Ground Motion. Application of software package - codal recommendations

Unit IV - SEISMIC STABILITY ANALYSIS: Earthquake Resistant Design of foundation of buildings - Design considerations - Geotechnical - Architectural - Structural - Capacity Design - Seismic analysis. Earthquake Response of slopes - Evaluation of slope stability - Pseudostatic Analysis - Newmark's Study of Block Analysis - Dynamic Analysis - Earth pressure due to ground shaking valuation - Lateral Deformation - codal provisions.

Unit V - EARTHQUAKE HAZARD MITIGATION: Seismic risk vulnerability and hazard - Risk mapping - scale – changing percept of risk – vulnerability Atlas of India - Hazard assessment - Maintenance and modifications to improve hazard resistance; Seismic microzonation – methodology – scale of mapping - Different type of foundation and its impact on safety

References:

1. Mahanti, N.C. Samal, S.K. Datta, P. Nag.N.K., Diaster Management, Narosa Publishing House, New Delhi, India, 2006.
2. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
1. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
2. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
3. McGuire, R.K. Seismic Hazard and Risk Analysis Earthquake Engineering Research Institute, 2004.
4. Mahanti, N.C. Samal, S.K. Datta, P. Nag.N.K., Diaster Management, Narosa Publishing House, New Delhi, India, 2006.
5. Wai-Fah Chen and CgharlesScawthem, Earthquake Engineering Hand book, Caspress, 2003.
6. Robert W. Day, Geotechnical Earthquake Engineering Hand book, McGraw Hill, 2002.

17CE3017 STRUCTURAL OPTIMIZATION

Credits: 3:0:0

Course Objectives:

- To enable the student to understand the importance of optimization of structures
- To bring out the difference between traditional and nontraditional algorithm
- To apply algorithm in method of analysis and design paradigms in different civil engineering problems.

Course Outcomes

At the end of the course, the student will be able to

- identify the structural optimization techniques
- illustrate the linear, nonlinear, polynomial and dynamic programming problems
- solve the minimum cost problems in civil engineering
- analyze using various techniques
- choose suitable optimization method
- formulate the optimization algorithm for real time complex problems

Unit I – INTRODUCTION: Basic Concepts of minimum weight - Minimum cost design – Objective function, constraints. Linear and Non-Linear Programming: Formulation of problems simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm - Exhaustive and unrestricted search - Dichotomous

search - Fibonacci method - Golden section method - Interpolation methods – Unconstrained optimization techniques.

Unit II - GEOMETRIC PROGRAMMING: Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty - Dynamic Programming: Bellman's principle of optimality - Representation of a multistage decision problem - Concept of sub-optimization problems using classical and tabular methods.

Unit III - GENETIC ALGORITHM: Genetic Algorithms – Operators – Reproduction – Mutation – Cross Over – Evolution Strategies – Methods for optimal design of structures, continuous beams and single storeyed frames – Minimum weight design for truss members - Ant Colony Algorithm: Ant algorithm – Network – The ant – Initial population – Ant movement – Ant tours – Pheromone – Evaporation – Sample problem.

Unit IV - ARTIFICIAL NEURAL NETWORKS TO STRUCTURAL OPTIMIZATION: Basic concepts – Biological systems - Artificial neural network - Application characteristics - Overview of learning methods - Review of probability concepts.

Unit V - FUZZY LOGIC IN CIVIL ENGINEERING: Fuzzy set theory and logic – Fuzzy sets operation – Fuzzy relations - Membership function defuzzification - Fuzzy based rule systems –Application

References:

1. Rao, S.S., "Engineering Optimization, Theory and Practice", New Age International (p) Ltd., New Delhi, 2002.
2. Ross, T.J., "Fuzzy Logic with Engineering Applications", Mc.Graw Hill, 1995.
3. Goldberg, D.E., "Genetic Algorithm in Search, Optimization and Machine Learning", Addison – Wesley, 1989.
4. Spunt, L., "Optimum Structural Design", Prentice Hall, New Jersey, 1971.
5. Gary Parker, R. and Ronald, L., "Discrete Optimization", Academic press 1988.
6. David Corne, Marco Dorigo and Fred Glover, "New Ideas in Optimization", McGraw Hill Company, London, 1999.
7. Rajasekaran, S. and Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm", Prentice Hall of India Pvt. Ltd, Delhi, 2003
8. Belegundu A. and T. Chandrupatla, "Optimization Concepts and Applications in Engineering", Prentice Hall, 1999.
9. Gen, M. and R. Cheng, "Genetic Algorithms and Engineering Optimization", Wiley, 2000.
10. Fletcher R., Practical Methods of Optimization Volumes 1,2, John Wiley 1980, 1981.

17CE3018 DESIGN OF SUBSTRUCTURES

Credits: 3:0:0

Course Objectives:

- To make students to learn principles of subsoil exploration,
- To design the sub structures.
- To evaluate the soil shear strength parameters.

Course Outcomes

At the end of the course, the student will be able to

- understand the principles of subsoil exploration
- identify and evaluate the soil shear strength parameters
- determine the load carrying capacity of each type of foundation
- understand the concepts of settlement analysis
- select appropriate foundations type based on available soil conditions
- design of reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations

Unit I - SITE INVESTIGATION: In-situ testing of soils - Subsoil exploration - Classification of foundations systems - General requirement of foundations - Selection of foundations - Computations of Loads - Design concepts.

Unit II - CONCEPT OF SOIL SHEAR STRENGTH PARAMETERS: Settlement analysis of footings, Shallow foundations in clay, Shallow foundation in sand & C- Φ soils, Footings on layered soils and sloping ground, Design for Eccentric or Moment Loads.

Unit III - TYPES OF RAFTS, BEARING CAPACITY & SETTLEMENTS OF RAFT FOUNDATION: Rigid methods, Flexible methods, soil-structure interaction, different methods of modeling the soil - Combined footings (rectangular & trapezoidal), strap footings & wall footings - Raft – super structure interaction effects & general concepts of structural design, Basement slabs

Unit IV - DEEP FOUNDATIONS: Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, Laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles- sheet piling.

Unit V - TYPES OF CAISSONS: Analysis of well foundations - Design principles - Well construction and sinking - Foundations for tower structures: Introduction, Forces on tower foundations - Selection of foundation type - Stability and design considerations - Ring foundations – general concepts.

References:

1. Bowles J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York, 1986.
2. Swamy Saran, "Analysis and Design of substructures", Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
3. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.
4. Varghese.P.C, “Design of Reinforced Concrete Foundations” –PHI learning private limited, New Delhi, 2009.
5. Nayak. N.V., “Foundation design manual for practicing engineers”, DhanpatRai and Sons, 1982.
6. Dr.K.R.Arora, “Soil Mechanics & Foundation Engineering”, Standard Publishers & Distributors, 2005.
7. Winterkorn. H. F., and Fang, H. Y., “Foundation Engineering Hand Book”, Van Nostrand, Reinhold, 1976.

17CE3019 SPACE STRUCTURES

Credits: 3:0:0

Course Objectives:

- Acquire knowledge on space structure configuration
- Relate the behavior of space structure
- Design the space structure and the node connectors

Course Outcomes

At the end of the course, the student will be able to

- relate the space structure and its behaviour
- identify the materials for space structure
- develop the behavior of various space structures
- design the node connectors
- evaluate the structure and design the support systems
- construct the dynamic and stability analysis

Unit I - SPACE STRUCTURE INTRODUCTION: Space frames - configuration - types of nodes - Design Philosophy — Single and Multi-layer grids - barrel vaults- domes – towers tension Structures - pneumatic structures - patterns - Material - steel - aluminum - plastics - protection coats for the members - Practical construction methods – Drainage - Transportation problem - Lifting technique - corrosion protection - Maintenance and fire protection

Unit II – BEHAVIOUR: Behaviour of Space Structures - Different forms of space structures - Tensile structures, cable roofs - cable supported bridges - tensegrity frame work - pneumatic Structures – Tubular Structures - Prefabricated Space Structural Systems: Mero, Space Deck, Nodus, Unistrut, Triodetic, Unibat, and NS truss

Unit III - NODE CONNECTORS: Mero - Octatube - Nodus System – Triodetic - Modular System - Tomo Unit Truss

Unit IV - ANALYSIS: Analysis of space frames - Finite element method - Linear – Nonlinear - Collapse - Dynamic and Stability analysis - Design of Members: Joints - Support systems – Foundations.

Unit V - CONFIGURATION PROCESSING: FORMIAN for generation of configuration - Case Studies - Failures

References:

1. Ramaswamy G. S, Mick Eekhout,Suresh G. R, “Analysis, Design and Construction of Steel Space Frames”, Thomas Telford 2002

2. Subramanian,N. “Space Structures: Principles and Practice I” Multi Science Publishing Company 2006.
3. Subramanian.N , “Principles of Space Structures”, Wheeler Publishing Co. 1999
4. Woinowsky-Kriege S., “Theory of plates and shells”, Mc Graw Hill 2003.
5. Reinhold Kienzler, Holm Altenbach, Ingrid Ott “Theories of Plates and Shells: Critical Review and New Applications”, Springer 2013

17CE3020 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

Credits: 3:0:0

Course Objectives:

- Develop an understanding on the behaviour of composite structures
- Study the design of steel concrete composite elements
- Impart knowledge on shear connectors

Course Outcomes

At the end of the course, the student will be able to

- classify different types of shear connectors
- recommend suitable type of profile sheeting
- examine the elastic behaviour of composite structural members
- analyze the steel concrete composite elements
- design different types of composite elements
- evaluate the strength of shear connectors

Unit I – INTRODUCTION: Introduction to steel - concrete composite construction – materials - Composite action – Moment of resistance - Serviceability - Design criteria - provisions on IS, BS and Euro codes

Unit II - DESIGN OF COMPOSITE FLEXURAL MEMBERS: Design of composite beams - simply supported and continuous - Design of slabs - profiled sheeting - stiffeners

Unit III - DESIGN OF COMPOSITE COLUMNS AND TRUSSUS: Design of columns - Encased column - Infilled column - Axially, uni-axially and bi-axially loaded columns, design of composite trusses.

Unit IV - DESIGN OF CONNECTIONS: Shear connectors – Types – Design of connections in composite structures – behaviour of shear connectors – Partial and full interaction of shear connectors

Unit V - CASE STUDIES: Case studies on steel - concrete composite construction in buildings - fire resistance - seismic behaviour of composite structures.

References:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, “Steel Designers Manual”, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.

17CE3021 INDUSTRIAL STRUCTURES

Credits: 3:0:0

Course Objectives:

- Understand the requirements and functional planning of industrial structures
- Analyse the industrial structures
- Learn the design of towers and chimneys

Course Outcomes

At the end of the course, the student will be able to

- identify the suitable industrial roofing system
- explain the requirements of industrial building
- analyse transmission towers with required foundations
- design various components of industrial buildings
- discuss the behaviour of machine foundation
- plan industrial structures for functional requirements

Unit I - PLANNING AND FUNCTIONAL REQUIREMENTS: Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.

Unit II - INDUSTRIAL BUILDINGS: Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase

Unit III - POWER PLANT STRUCTURES: Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures

Unit IV - TRANSMISSION LINE STRUCTURES AND CHIMNEYS: Analysis and design of transmission line towers - Sag and Tension calculations, testing of towers – Design of self supporting chimney, Design of Chimney bases.

Unit V – FOUNDATION: Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation

References:

1. Jorgen Axel Adam, Katharina Hausmann, Frank Juttner, Klaus Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers, 2004.
2. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., “Transmission Line Structures”, Tata McGraw Hill, 1992.
4. Srinivasulu P and Vaidyanathan.C, “Handbook of Machine Foundations”, Tata McGraw Hill, 1976.

17CE3022 NONLINEAR ANALYSIS OF STRUCTURES

Credits: 3:0:0

Course Objectives:

- To learn the various type of nonlinearities and their sources
- To study the techniques for static nonlinear analysis
- To gain knowledge in carrying out nonlinear elastic-plastic analysis of structural members.

Course Outcomes

At the end of the course, the student will be able to

- recognize the types of non linearities encountered in structural analysis
- explain the causes of non linearities and the importance of including the same in structural analysis
- calculate maximum deflection of beam, plate, column, truss and frame by carrying out large deflection analysis
- carry out step by step non linear analysis and arrive at the post buckling behaviour and inelastic behaviour of structural elements
- justify the elastic-plastic analysis of structural elements for rational and economic design
- develop non linear stiffness matrix for complex structural member with arbitrary geometry, loading and boundary conditions

Unit I – INTRODUCTION: Types of nonlinearities: Geometric nonlinearity, Material nonlinearity - Nonlinear governing Equation for beams: geometric nonlinearity due to stretching, material nonlinearity - geometrically nonlinear beam problems - Cantilever beam: Moment-curvature nonlinearity - Centrally loaded beam with two supports - Cantilever beam subjected to tip load.

Unit II - NONLINEAR STATIC ANALYSIS OF PLATES: Nonlinear static analysis of plates: Geometric and material nonlinearities - governing nonlinear equations of plates: stress function approach, displacement equations approach - Boundary conditions and method of solution - large deflection of rectangular plates.

Unit III - NONLINEAR ANALYSIS OF COLUMN: Nonlinear analysis of column: Post buckling of cantilever column - Large deflection of column with both ends hinged.

Unit IV - NONLINEAR ANALYSIS OF TRUSSES AND FRAMES: Nonlinear analysis of trusses and frames: Derivation of nonlinear stiffness matrix - Matrix displacement method for nonlinear analysis of structures - Nonlinear analysis of plane frames.

Unit V - ELASTIC-PLASTIC ANALYSIS: Elastic-plastic analysis: Displacement transformation matrix for a member with a hinge - Overall stiffness matrix - Elastic-plastic analysis of a propped cantilever - Elastic plastic analysis of frames.

References:

1. Bathe, K.J., "Finite Element Procedure", Prentice Hall of India, New Delhi, 2014
2. Fertis, D.G., "Nonlinear mechanics" CRC Press, 1999
3. Iyengar, N.G.R., "Elastic Stability of Structural elements", Macmillan and Co., 2007
4. Madhu B. Kanci, "Matrix methods of structural analysis", Wiley Eastern Ltd., New Delhi, 1993
5. Majid, K.I., "Non Linear Structures", Butterworth Publishers, London, 1972.
6. Reddy, J.N., "Nonlinear Finite Element Analysis", Oxford University Press, 2008
7. Sathyamoorthy, M., "Nonlinear Analysis of Structures", CRC Press, New York, 1998.
8. Zienkiewicz and Taylor R.L., "The Finite Element Method – Vol. 2", 4th Edition, McGraw-Hill Book Company, London, 1991

17CE3023 ANALYSIS AND DESIGN OF PRECAST CONCRETE STRUCTURES**Credits: 3:0:0****Course Objectives:**

- Study different types of prefabricated building system
- Analyse and design precast buildings
- Learn the connections in precast buildings

Course Outcomes

At the end of the course, the student will be able to

- select the suitable prefabricated building system
- identify the suitable erection technique
- explain the behaviour of pre-stressed precast element
- analyze the precast structural frame
- design the precast structural element
- examine the behaviour of joints in precast frame

Unit I - PRECAST CONCRETE BUILDING SYSTEMS AN OVERVIEW: Prefabrication technology - planning - Materials - fabrication and erection - Transportation - over all structural systems - systems for lateral load resistance - Roof and floor systems – Components

Unit II - STRUCTURAL ANALYSIS AND DESIGN: Introduction - Materials - Loads - Load factors - Analysis of frame with stability elements - modelling and analysis - Design consideration - Safety against progressive collapse - Design problems - Beams and Slabs

Unit III - PRE-STRESSED PRECAST CONCRETE: Background and scope - Advantages - typical applications of pre-stressing for precast elements - Limitations - Special analysis and design aspects for pre-stressed precast elements - pre-tensioned elements - post tensioned elements - Case studies on construction

Unit IV - SEISMIC DESIGN OF PRECAST STRUCTURES: Design philosophy - design approaches - limitations of precast concrete applications in seismic regions - moment resisting frames - structural walls - diaphragms - support details - detailing

Unit V - JOINTS AND CONNECTIONS IN PRECAST BUILDINGS: Introduction - requirements - details of connections - column to foundation connections - wall panel to foundation connections - column to column to connection - floor to beam connection - wall panel to wall panel connection - connection materials

References:

1. Kim S Elliott, Colin Jolly., "Multi-Storey Precast Concrete Framed structures", Wiley, 2013
2. IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice
3. Code of Practice for Precast concrete construction 2003, PCI Design hand book

17CE3024 ANALYSIS AND DESIGN OF PLATES AND SHELLS

Credits: 3:0:0

Course Objectives:

- To introduce the classical theory of thin plates and shells
- To study the derivation of basic governing equations and their solutions
- Applying the plate and shell theory and design folded plates and shells of different geometries and boundary condition

Course Outcomes

At the end of the course, the student will be able to:

- identify and classify the various types of shells and plates
- differentiate the behavior of different types of shell and plates and their limitations
- apply plate and shell theory to problems using basic governing equations
- analyze problems involving different geometries and boundary conditions
- design different plates and shell structures and give the reinforcement detailing
- implement the detailing for the folded plates in the site

Unit I - CLASSICAL THEORY OF PLATES: Differential equation of laterally loaded and thin rectangular plates- Levy and Navier solution of plates - small deflection theory of plates - analysis of laterally loaded (concentrically loaded) circular, thin plates with simply supported or clamped edge

Unit II - DESIGN OF FOLDED PLATE ROOFS: Assumptions in the analysis of folded plates - Analysis of folded plate roofs as per the ASCE task committee recommendations -Design steps - Minimum thickness and reinforcements as per I.S. specifications for R.C. folded plates.

Unit III - CLASSICAL THEORY OF SHELLS AND DESIGN OF SHELLS OF DOUBLE CURVATURE: Classification of shells - Translational and rotational shells Ruled surfaces - Methods of generating the surface of different shells - : Design of (a) Spherical shell, (b) Conical shell, (c) Paraboloid and Ellipsoid.

Unit IV - DESIGN OF CYLINDRICAL SHELLS: Design of R.C. cylindrical shell with edge beams using theory for long shells - Design of shells with ASCE manual coefficients like hyperbolic paraboloid, elliptic paraboloid, conoid etc - Membrane theory of doubly curved shells - Edge disturbances.

Unit V - DESIGN OF HYPERBOLIC PARABOLOID SHELLS: Surface definition - Determination of forces - Forces in the edge members - Buckling consideration - Design example - Detailing of reinforcement - Design of R.C. Northlight Shells: Analysis of stresses in northlight shells - Design example.

References:

1. Ramaswamy, G.S., "Design and Construction of Concrete Shell roofs", Revised Ed. R.E.Krieger, Malabar, Florida, 1984.
2. Timoshenko, S. "Theory of Plates and Shells, McGraw Hill Book Co., New York, 1990.
3. Chatterjee, B.K., "Theory and design of concrete Shells", Oxford and IBH publishing co, 1971.
4. "Phase 1 - Report on Folded plate construction – Report of the Task Committee on Folded Plate Design, ASCE Structural Division", Dec 1963, pp 365– 406.
5. Kelkar, V.S. and Sewell, R.T., "Fundamentals of the analysis and design of shell K structures", Prentice Hall, Inc. New Jersey, 1987.
6. P.L. Gould, "Analysis of Shells and Plates," Springer Verlag, New York, United States, July 2012
7. Reddy, J. N., "Theory and Analysis of Elastic Plates and Shells," CRC, 2nd edition, December 2006
8. Rudolp Szilard, "Theory and Analysis of Plates", John Wiley and Sons, New York, United States, February 2004.

17CE3025 WIND AND CYCLONE EFFECTS ON STRUCTURES

Credits: 3:0:0

Course Objectives:

- To understand the principles of wind forces
- To study the modelling for experimental and analytical studies
- To analyse and design the structures for cyclone

Course Outcomes

At the end of the course, the student will be able to

- identify the wind parameters on structures
- estimate the wind forces on buildings
- determine the response of structures
- analyse different structures for wind forces
- analyse the forces due to cyclone
- design cyclone resistant structures

Unit I – INTRODUCTION: Introduction, Types of wind – Characteristics of wind – Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - Dynamic nature of wind – Pressure and suctions - Spectral studies, Gust factor.

Unit II - WIND TUNNEL STUDIES: Wind Tunnel Studies, Types of tunnels, - Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design - Modeling requirements - Aero dynamic and Aero-elastic models.

Unit III - EFFECT OF WIND ON STRUCTURES: Classification of structures – Rigid and Flexible – Effect of wind on structures - Static and dynamic effects on Tall buildings – Chimneys.

Unit IV - DESIGN OF SPECIAL STRUCTURES: Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – design of Tall Buildings – Chimneys – Transmission towers – Industrial sheds

Unit V - CYCLONE EFFECTS: Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding

References:

1. Cook.N.J. “The Designer’s Guide to Wind Loading of Building Structures”, Butterworths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, “Wind Effects on Civil Engineering Structures”, Elsevier Publications, 1984
3. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers, London, 1980.
4. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1978.

17CE3026 ENERGY EFFICIENT BUILDINGS

Credits: 3:0:0

Course Objectives:

- To learn green building concept and ecological design concepts applicable to modern buildings
- Acquaint students with the principle theories of material and construction technique to create green buildings
- To provide exposure to various national and International rating system as compliance requirements for green buildings

Course Outcomes

At the end of the course, the student will be able to

- examine the concept of green building
- classify the suitable materials and components
- illustrate the significance in reducing the environmental impacts of buildings
- analyze the ecological footprint of construction operations
- evaluate the green building commissioning
- predict the economic performance of buildings

Unit I - GREEN BUILDING PROCESS AND ECOLOGICAL DESIGN: Conventional versus green building delivery systems –Green building project execution- the integrated design process-green building- green building documentation requirements - design versus ecological design - historical perspective - contemporary ecological design - future ecological design - green design to regenerative design.

Unit II - GREEN BUILDING SYSTEMS: Sustainable sites and landscaping – enhancing ecosystems - building envelop – selection of green materials - products and practices - passive design strategy – internal load reduction – indoor environment quality – building water and waste management – relevance to LEED / IGBC standards.

Unit III - GREEN BUILDING IMPLEMENTATION: Site protection planning - health and safety planning - construction and demolition waste management - reducing the footprint of construction operations - maximizing the

value of building commissioning in HVAC System, lighting and non mechanical Systems - costs and benefits relevance to LEED / IGBC standards.

Unit IV - GREEN BUILDING ASSESSMENT: USGBC LEED building assessment standard - LEED certification process – green globes building assessment protocol- international building assessment systems - LEED-NC Platinum / gold / silver building case studies – trends in building rating systems – IGBC standards – ECBC compliance.

Unit V - ECONOMICS OF GREEN BUILDINGS: Business case for high-performance green buildings - the economics of green building - benefits - managing initial costs - cost barrier in project management - long-term environment benefits.

References:

1. Jerry Yudelson, “Green building A to Z, Understanding the Language of Green Building”, New Society Publishers, Canada, 2007.
2. Green building guidelines: Meeting the demand for low-energy, resource-efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.
3. Jerry Yudelson, “Green Building through Integrated Design”, McGraw Hill, USA, 2009
4. Means, R.S., “Green building: Project Planning & Cost Estimating”, Wiley, Kingston,

17CE3027 DESIGN AND SAFETY OF STRUCTURES UNDER FIRE

Credits: 3:0:0

Course Objectives:

- Impart the knowledge on fire resistance of concrete
- Understand the behaviour of structural members under fire
- Design the structural elements for fire load

Course Outcomes

At the end of the course, the student will be able to

- classify different types of fire
- identify the types of spalling
- explain the material characteristics under fire
- analyse the distribution of temperature in concrete
- design the structural elements for fire loading
- evaluate the strength of fire affected member

Unit I – INTRODUCTION: Classification of fire - Fire action - Fire scenario - Fire test and assessment procedures - Consequences of a fire on a concrete structure – Codal provisions (IS 456, IS 3809 and EN 1992) – Time temperature relations - ISO and hydrocarbon curve - Concrete and Fire safety - failure modes in fire.

Unit II - STRUCTURAL BEHAVIOUR AND MATERIAL CHARACTERISTICS: Factors affecting fire resistance of concrete and steel - material characteristics - Effect of cover and size on fire resistance - Density - moisture content - porosity - Effect of rebar mechanical properties of concrete under fire - stress strain behaviour - performance of structural steel.

Unit III - THERMAL BEHAVIOUR: Thermal properties - Thermal conductivity- Specific heat - Coefficient of thermal expansion - thermal diffusivity - Significance and types of spalling - thermal stress - thermal strain - Thermal cracks - Temperature distribution - Thermo-gravimetric analysis - Differential thermal analysis.

Unit IV - DESIGN OF STRUCTURAL ELEMENTS: Fire Resistance of RCC and Steel structures –Fire resistant Design problems as per EN standards - Isotherm method – RCC slab – Simply supported beam – Column – Steel beams and columns – Composite structures.

Unit V - POST-FIRE INVESTIGATION AND REPAIR OF FIRE-DAMAGED CONCRETE STRUCTURES: Introduction - Data collection - Damage analysis - Diagnosis - Chemical analysis - Damage classification - Repair criteria - Repair methods - Role of fibers - NDT methods - Case studies on fire damaged structures.

References:

1. IS 3809-1979, Fire Resistance Test of Structures, Bureau of Indian Standards, New Delhi
2. Tom Iennon, “Structural Fire Engineering”, ICE Publications 2011

3. “Fire Resistance Design of steel framed buildings”, SCI hand book
4. Paulo Vila Real & Jean-Marc Franssen, “Fire Design of Steel Structures”, Wiley Publications 2012

17CE3028 FORENSIC ENGINEERING

Credits: 3:0:0

Course Objectives:

- To study the causes of damages observed in concrete and steel structures
- Analyse the failure and damage mitigation of structures.
- To know the structural retrofitting and rehabilitation techniques

Course Outcomes

At the end of the course, the student will be able to

- classify the types of cracks
- identify the reasons of distress in structures
- explain the causes of failure of structures
- apply appropriate retrofitting technique
- recommend suitable structural rehabilitation techniques
- evaluate the failure of structure

Unit I - FAILURE OF STRUCTURES: Review of the construction theory – performance problems – responsibility and accountability – case studies – learning from failures – causes of distress in structural members – design and material deficiencies – over loading

Unit II - DIAGNOSIS AND ASSESSMENT OF DISTRESS: Visual inspection – non-destructive tests – ultrasonic pulse velocity method – rebound hammer technique – ASTM classifications – pull-out tests – Bremor test – Windsor probe test – rebar detection - crack patterns- crack detection techniques – case studies – single and multi-storey buildings – Fibre optic method for prediction of structural weakness assessments

Unit III - ENVIRONMENTAL PROBLEMS AND NATURAL HAZARDS: Effect of corrosive environments, chemical and marine environments – pollution and carbonation problems – detection and measurement of corrosion - Corrosion analyser, durability of RCC structures – damage due to earthquakes and strengthening of buildings – provisions of S 1893 and 4326, 13935 and IS 456

Unit IV - GEOTECHNICAL INVESTIGATIONS: Causes of Foundation Failure in Buildings - unequal settlement and horizontal movement - Overturning - Soil liquefaction - Lateral instability - seasonal changes - drainage problems - soil saturation

Unit V - MODERN TECHNIQUES OF RETROFITTING: Structural elements - first aid after a disaster – use of chemicals in repair – application of polymers – ferrocement, fiber composites and fiber reinforced concretes as rehabilitation materials – strengthening by pre-stressing – case studies – bridges – water tanks – cooling towers – heritage buildings – high rise buildings.

References:

1. Dovkaminetzky, “Design and Construction Failures”, Galgotia Publication, New Delhi, 2001
2. Hand book on “Seismic retrofit of buildings”, CPWD - Indian building congress, April 2007
3. Hand book on “Repair and rehabilitation of RCC buildings” - CPWD - GoI, 2012

17CE3029 CEMENT AND CONCRETE CHEMISTRY

Credits: 3:0:0

Course Objectives:

- To understand the hydration chemistry
- To study the microstructure of concrete
- To know about modern micro structure analysis techniques

Course Outcomes

At the end of the course, the student will be able to

- classify the phase system of cement
- explain the cement hydration process
- list the types of pores in concrete

- analyse the properties of cement paste and concrete
- discuss the hydration of cement with mineral admixtures
- examine the properties of hardened paste

Unit I - PHASE SYSTEMS: Principles of Cement Classification - Different Phase Systems of Cement Chemistry (CaO–SiO₂–Al₂O₃–Fe₂O₃) system - Thermo chemistry of Clinkering Process - Phase Composition of Portland Cement - Tricalcium Silicate and Alite Phase - Dicalcium Silicate and Belite Phase - Aluminate Phase in Clinker

Unit II - CEMENT HYDRATION: Effect of constituents of cement on Hydration – Properties of Cement Paste - Rheological Properties of Concrete - Microstructure and Strength of Cement Paste - Volume Changes of the Plastic Paste - Permeability of Paste - The interfacial transition zone (ITZ) - Chromium Reducers - Phases in the CaO–SiO₂–H₂O System

Unit III - CHEMICAL STRUCTURE AND BOND: The Microstructure of C-S-H Gel - The Chemical Structure of C-S-H Phases - Delayed Ettringite - Cement Paste–Aggregate Bond - Paste–Reinforcement Bond - Corrosion of Concrete in the Chlorides Solutions - Effect of High temperature on Hydrated Cement Paste - Microstructure of the Hydrated cement paste - Solids in the Hydrated cement paste - Voids in the Hydrated cement paste - Water in the Hydrated cement paste

Unit IV - PORE STRUCTURE: Introduction - pore structure and surface area of cement paste - water content of CSH gel - pore system and classification of pores - application of mercury intrusion porosimetry - effect of w/c ratio on age and curing conditions of concrete –

Unit V - MICROSTRUCTURE INVESTIGATION: Mineral Admixtures for Cement Production and its Properties - Mineral Admixture - Flyash, silica fume, slag and metakaolin - formation of secondary gel - Scanning Electron Microscopy (SEM) - X-Ray Diffraction (XRD) - Energy Dispersive X Ray Spectroscopy (EDAX) - Transmission electron microscopy (TEM) - Fourier transform infrared spectroscopy (FTIR) - TGA - DSC

References:

1. Kurdowski & Wieslaw, “Cement and Concrete Chemistry”, Springer Publications 2014
2. Neville, A.M., “Concrete Technology”, Longman Scientific & Technical, 2005
3. Santhakumar A.R, “Concrete Technology” Oxford University press, Delhi, 2006

17CE3030 MAINTENANCE AND REHABILITATION OF STRUCTURES

Credits: 3:0:0

Course Objectives:

- To get exposed to the repair and rehabilitation structures and structural elements
- To know the materials used for repair.
- To have a knowledge about the repair techniques

Course Outcomes

At the end of the course, the student will be able to

- identify the failures in the structure
- diagnosis the distress/defects in structures
- apply suitable repair techniques
- analyze the various remedial measures
- justify the strength of rehabilitated structure with reference to original structure
- develop suitable method of rehabilitation relevant to the complex situations

Unit I – INTRODUCTION: General consideration – Quality Assurance - Inspection – Structural appraisal - Economic appraisal - Types of defects – Cracks: types: structural and non-structural -,monitoring of cracks-Distresses monitoring- Causes of distresses –diagnosis – remedial measures.

Unit II - CONCRETE STRUCTURES: Introduction - Causes of deterioration - Diagnosis of causes - Flow charts for diagnosis - Repairing, spalling and disintegration – remedial measures; Moisture Penetration: Sources of dampness - Moisture movement from ground - Reasons for ineffective DPC - Roof leakage -Dampness in solid walls – Ill effects of dampness- remedial treatments.

Unit III - STEEL STRUCTURES AND MASONRY STRUCTURES: Steel structures:Types and causes for deterioration - preventive measures - Repair procedure- welded joints: Defects: remedial measures- Corrosion: Mechanism of corrosion, preventive measures and remedial measures. Fabrication and erection: errors, Distress,

remedial measures; Masonry Structures: Stone masonry structures: Discoloration and weakening of stones - Biocidal treatments - Preservation – Brick masonry structures: Distresses, remedial measures.

Unit IV - MATERIALS AND TECHNIQUES FOR REPAIR: Repair materials: special mortar and concretes, concrete chemicals, Special Cements And High Grade Concrete – Expansive Cement, Polymer Concrete, Sulphur Infiltrated Concrete, Ferro Cement, Fiber Reinforced Concrete- admixtures of latest origin; Techniques for Repair:- surface repair – material selection – surface preparation - rust eliminators and polymers coating for rebars during repair – repair of cracks in concrete and masonry-methods of repair.

Unit V - RETROFITTING AND DEMOLITION: Retrofitting: causes, types, remedial measures - Strengthening Measures - Flexural Strengthening, Beam Shear Capacity Strengthening, Column Strengthening, Shoring, Under Pinning and Jacketing - Demolition of Buildings – Introduction – Planning, Precautions and Protective Measures in Demolition Work-Sequence of Operations - Demolition of Structural Elements

References:

1. Johnson, S.M., “Deterioration, Maintenance and repair of Structures”, McGraw-Hill Book Company, Newyork, 1965.
2. SP25-84 - Hand Book on Causes and Prevention of Cracks on Buildings, Indian Standards Institution, NewDelhi, 1984.
3. Richardson, B.A., “Remedial Treatment of Buildings”, Construction Press, London, 1980.
4. Dension, C Alien and Roper, H., “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical, UK, 1991.
5. Alien, R.T. and Edwards S.C., “Repair of Concrete Structures”, Blakie and Sons, UK, 1987.
6. Guha R.K., “Maintenance and Repairs of Buildings”, New Central Book Agency (P) Ltd, Calcutta, 1985.

17CE3031 STRUCTURAL HEALTH MONITORING

Credits: 3:0:0

Course Objectives:

- To implement fundamental concepts in structural health monitoring.
- Demonstrate the working principles of sensors and actuators made from smart materials.
- Describe the current real-world applications of damage identification in the aerospace, civil, and mechanical engineering fields.

Course Outcomes

At the end of the course, the students will be able to

- identify various health monitoring techniques
- interpret the acquired data using diagnostic methods
- predict appropriate shm system for structures
- examine the use of low-cost, long term monitoring systems
- justify the need for health monitoring
- adapt the concepts of rapid after disaster assessment of civil infrastructure

Unit I - INTRODUCTION: Structural damage - measurement principles and error sources - design of measuring system for SHM - Monitoring needs – Benefits - structural health monitoring process – case study

Unit II - SENSORS: Fiber optic Technology – Fiber Bragg grating sensor - sensor packing – sensing cables – strain components - Elastic and plastic strain – Thermal strain - creep – shrinkage - Distributed strain sensor measurement - Data management and signal processing systems

Unit III - ELECTRO – MECHANICAL IMPEDENCE TECHNIQUE: Mechanical Impedence of structures – EMI Technique - Electrical impedance based methods, electric waves and magnetostrictive sensors – Data Acquisition Systems - Electrical Impedance and wave propagation- signal processing methods

Unit IV - MONITORING STRATEGIES: Building structural members – columns - Frames – slabs – walls – Bridges – Dams - Statistical pattern recognition and damage detection in structural health monitoring of civil infrastructure - maintenance strategies and non-destructive evaluation

UNITV: DAMAGE ASSESSMENT: Magnetoelastic stress sensors – PZT patches for load measuring - Vibration based damage detection techniques - structural health monitoring of infrastructure - Operational modal analysis

References:

1. Chee-Kiong Soh, Yaowen Yang, Suresh Bhalla, "Smart Materials in Structural Health Monitoring, Control and Biomechanics", Springer Science & Business Media, 2012
2. Branko Glisic, Daniele Inaudi, "Fibre Optic Methods for Structural Health Monitoring", John Wiley & Sons, Technology & Engineering, 2008
3. Keith Worden, "Structural Health Monitoring: A Machine Learning Perspective", Wiley-Blackwell, November 2012.
4. Adams Douglas E, "Health Monitoring of Structural Materials and Components: Methods with Applications", John Wiley & Sons Inc., 2007

17CE3032 DESIGN OF SHELLS AND SPATIAL STRUCTURES**Credits: 3:0:0****Course Objectives:**

- Understand the structural behaviour of plate and shell structures
- Study the design of shells, folded plates and space frames
- Apply the software packages for the analysis of shells

Course Outcomes:

At the end of the course, the student will be able to

- classify different types of shell
- explain the behaviour of folded plate
- discuss the design principles of space frame
- analyze and various types of shells
- design folded plates and space frames
- compute the forces of elements using software packages

Unit I - CLASSIFICATION OF SHELLS: Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31.

Unit II - FOLDED PLATES: Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof.

Unit III - INTRODUCTION TO SPACE FRAME: Space frames - configuration - types of nodes - general principles of design Philosophy - Behaviour.

Unit IV - ANALYSIS AND DESIGN: Analysis of space frames – detailed design of Space frames – Introduction to Computer Aided Design and Software Packages.

Unit V - SPECIAL METHODS: Application of Formex Algebra, FORMIAN for generation of configuration

References:

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982.
2. ASCE Manual No.31, Design of Cylindrical Shells.
3. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 1986.
4. Subramanian.N, "Principles of Space Structures", Wheeler Publishing Co. 1999.
5. Varghese.P.C. "Design of Reinforced Concrete Shells and Folded Plates", PHI Learning Pvt. Ltd., 2010.

17CE3033 SOIL STRUCTURE INTERACTION**Credits: 3:0:0****Course Objectives:**

- To study the basics of soil structure interaction, soil foundation models.
- To impart knowledge on finite difference and finite element analysis
- To understand elastic analysis of piles and piled raft.

Course Outcomes:

At the end of the course, students will be able to

- understand various soil response models applicable to soil-foundation interaction analysis
- come up with elastic solutions for problems of pile
- analyse soil-foundation system using software packages
- understand interaction analysis on piles and pile groups

- predict load deflection on laterally loaded piles
- design of pile raft system

Unit I - SOIL - FOUNDATION INTERACTION: Introduction to soil – Foundation interaction problems -Soil behaviour -Foundation behaviour, Interface - behaviour -Scope of soil-foundation interaction analysis -soil response models. Winkler - Elastic continuum - two parameter elastic models - Elastic – plastic behaviour -Time dependent behaviour

Unit II - BEAMS ON ELASTIC FOUNDATION - SOIL MODELS: Infinite beam - two parameters -Isotropic elastic half space - Analysis of beams of finite length - Classification of finite beams in relation to their stiffness – Analysis through application packages.

Unit III - PLATE ON ELASTIC MEDIUM: Infinite plate – Winkler -Two parameters - Isotropic elastic medium -Thin and thick plates - Analysis of finite plates -rectangular and circular plates - Numerical analysis of finite plates - simple solutions - Analysis of braced cuts – Application packages.

Unit IV - ELASTIC ANALYSIS OF PILE: Elastic analysis of single pile - Theoretical solutions for settlement and load distribution - Analysis of pile group - Interaction analysis - Load distribution in groups with rigid cap – Pile raft – Application packages.

Unit V - LATERALLY LOADED PILE: Load deflection prediction for laterally loaded piles - subgrade reaction and elastic analysis - Interaction analysis -pile raft system - solutions through influence charts - Application packages.

References:

1. Saran, S., “Analysis and design of substructures”, Taylor & Francis Publishers, 2006.
2. Hemsley, J.A., “Elastic Analysis of Raft Foundations”, Thomas Telford, 1998.
3. Poulos, H.G., and Davis, E.H., “Pile Foundation Analysis and Design”, John Wiley, 2008.
4. Murthy, V.N.S., “Advanced Foundation Engineering”, CBS Publishers, New Delhi, 2007.
5. McCarthy, R.N., “Essentials of Soil Mechanics and Foundations: Basic Geotechnics”, Sixth Edition, Prentice Hall, 2002.
6. Selvadurai, A.P.S., “Elastic Analysis of Soil Foundation Interaction”, Elsevier, 1979.
7. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
8. Structure Soil Interaction – State of Art Report, Institution of structural Engineers, 1978.
9. ACI 336, “Suggested Analysis and Design Procedures for Combined Footings and Mats”, American Concrete Institute, Delhi, 1988

17CE3034 SHALLOW FOUNDATIONS

Credits: 3:0:0

Course Objectives

- To impart knowledge in selection of foundations
- To design the foundation based on bearing capacity and settlement
- To study different types of shallow foundation.

Course Outcomes:

At the end of the course, student will be able to

- identify the requirements of good foundation
- select suitable foundation based on bearing capacity
- explain the soil structure interaction
- evaluate the foundation settlement
- design shallow and special foundations
- suggest suitable measures for expansive and difficult soils

Unit I - FOUNDATIONS – GENERAL: Developments – Need of foundation Engineering – Responsibility of foundation engineer Shallow and deep foundations – Classification - Requirements of good foundations – Selection of type of foundation – Additional consideration – Hostile environment – Structural integrity – Economy.

Unit II - BEARING CAPACITY: Introduction – Criteria for computing Bearing Capacity – Theoretical methods – Terzaghi’s formula – Meyerhoff’s method – Effect of compressibility of soil, water table, shape and width of

foundation, inclination of load, eccentricity of load, stratification, sloping ground and adjacent footing – Vesic's approach – Allowable bearing pressure – Evaluation of bearing capacity from in-situ tests - I.S. code provisions.

Unit III - SETTLEMENT EVALUATION: Introduction – Immediate and time dependant settlement – Determination – Causes of settlement – Prediction of settlement – Minimizing settlement – Uniform, tolerable and allowable settlement – Differential settlement – Causes and effects – Factors influencing – I.S. Code provisions – Special considerations for expansive and collapsible soils.

Unit IV - DESIGN OF FOUNDATIONS: Analysis of foundation – Isolated – Strip – Combined footings and mat foundations -Conventional – Elastic approach – Soil Structure Interaction Principles – Application –Structural design of shallow foundations – Working stress method – Limit state method – Codal recommendations-Software applications.

Unit V - SPECIAL FOUNDATIONS: Introduction to special foundations – Floating foundation – Foundation in expansive soils – Foundation on recent refuse fills – Design of foundation for seismic forces – Methods of improving bearing capacity.

Reference Books

1. Peck, R.B. Hansen, V.E., and Thornburn, W.H., "Foundation Engineering", John Wiley, 1974.
2. Winterkorn, H.F and Fang, Y.F., "Foundation Engineering Handbook", Van Nostrand Reinhold, 1994.
3. Bowles, J.E. "Foundation Analysis and Design", McGraw Hill, New York, 2001.
4. Tomlinson, M.J., "Foundation Engineering", ELBS, Long man Group, UK Ltd, England, 1995.
5. Swami Saran, "Soil Dynamics and Machine Foundation", Galgottia Publications Pvt. Ltd., New Delhi, 2010.
6. Day, R.W., "Geotechnical and Foundation Engineering", Design and Construction, McGraw Hill, 2010.
7. Donald P.Coduto, "Geotechnical Engg, Principles and Practices", Pearson Education, 2010.
8. Robert Wade Brown, "Practical Foundation Engineering Handbook", McGraw Hill, New York, 1996.
9. Vargheese, P.C., "Limit State Design of Reinforced concrete", Prentice-Hall of India 2009.
10. Muni Budhu, "Soil Mechanics and Foundation", John Wiley and Sons, INC, 2000.

17CE3035 STRENGTH AND DEFORMATION CHARACTERISTICS OF SOILS

Credits: 3:0:0

Course Objectives

- To impart knowledge on stress-strain characteristics of soils.
- To study the behaviour in the form of stress path.
- To gain knowledge on the concepts of yield and failure criteria.

Course Outcomes:

At the end of the course, the student will be able to

- identify shear strength parameters under different drainage conditions
- distinguish stress strain behaviour between cohesionless and cohesive soil
- illustrate stress path for different conditions
- examine the failure criteria of soils
- design rheological models
- justify Elasto plastic laws

Unit I - SHEAR STRENGTH OF COHESIONLESS SOILS: Shear strength of granular soils – Direct shear – Triaxial Testing – Drained and undrained – Stress-strain behaviour – Dilatation – Contraction and critical states – Liquefaction and Liquefaction potential. Factors influencing – Stress-strain – Volume change behaviour of soils.

Unit II - SHEAR STRENGTH OF COHESIVE SOILS: Shear strength of clays – Stress-strain behaviour – Vane shear – UCC – Triaxial testing and stress path plotting – Pore pressure parameter of Skempton and Henkel – Total stress and effective stress approach – Shear strength of partially saturated clay in terms of stress state variables – Drained and undrained – Factors influencing stress-strain and shear strength.

Unit III - YIELD CRITERION: Concepts of yield and failure in soils – Yield criteria of von Mises, Tresca, KvikPatriak, Drucker and Prager and their extended form – their applicability to soils – Detailed discussion of Mohr – Coulomb failure criterion.

Unit IV - STRESS PATH AND STRESS – STRAIN LAWS: stress path for different cases – Stress path tests – Stress-strain laws for soils – Hyperbolic law – Linear visco-elastic and Elasto – Plastic laws – Yield functions,

hardening law, flow rules and plastic strain computation – Elastic module – Cyclic loading – Limitation of linearity elastic model – Hyperbolic stress-strain model.

Unit V - CRITICAL STATE SOIL MECHANICS AND RHEOLOGICAL MODELS: Introduction to critical state soil mechanics –boundary Surface – Roscoe and Hvorslev's – Rheological models of Kelvin, Maxwell and Burger as applied to soils.

Reference Books

1. Lambe, T.W. and Whitman R.V., "Soil Mechanics in S.I. Units" John Wiley, 1979.
2. Hotlz, R.D. and Kovais, W.D., "Introduction of Geotechnical Engineering", Prentice – Hall, 1981
3. Atkinson, J.H and Brandsby, P.L., "Introduction to critical state soil mechanics", Cambridge University Press, New York, 1990
4. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2016.
5. Keedwell, M.J., "Rheology and Soil mechanics", Elsevier Applied Science Publishers Ltd. 1984.
6. Braja, M. Das, "Advanced soil mechanics", McGraw Hill, 1997.
7. Wood. D.M., "Soil behaviour and Critical State Soil Mechanics", Cambridge University Press New York, 1990.
8. Bazant, Z.P., "Mechanics of Geo-materials", Rocks, Concrete and Soil, John Willey and Sons, Chichester, 1985.

17CE3036 EXPERIMENTAL GEOMECHANICS

Credits: 3:0:0

Course Objectives

- To impart knowledge in excavations and boring techniques
- To study in situ soil testing methods
- To gain knowledge on geophysical methods

Course Outcomes:

At the end of the course, students will be able to

- Recall the different methods of soil investigation.
- Evaluate the properties of soil at different depths.
- Identify the samplers to collect the disturbed and undisturbed soil
- Conduct field test for bearing capacity.
- Design suitable field instrumentation.
- Prepare subsoil investigation reports.

Unit I – GENERAL: Scopes and objectives of explorations – Planning a subsurface exploration – stages in sub surface exploration – Explorations for preliminary and detailed design – spacing and depth of exploration.

Unit II - OPEN EXCAVATION AND BORINGS OF EXPLORATION: Pits and Trenches – Drifts and Shafts – Methods of boring – Auger Borings – Wash Borings –Rotary Drilling –Percussion Drilling – Core Drilling.

Unit III - SOIL SAMPLES AND SAMPLERS: Types of soil samples – Disturbed samples –Undisturbed samples – Design Features affecting the sample Disturbance –Split spoon samplers – Scraper Bucket Samplers –Shell by Tubes and Thin walled Samplers – Piston Samplers – Denis Samplers – Preservation and handling of samples.

Unit IV - IN-SITU TESTING: Field tests – Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test–Plate Load Test – monotonic and cyclic –Field Permeability Tests – In-situ Tests using Pressure meter – Observation of Ground Water Table. - Instrumentation in soil engineering, strain gauges, resistance and inductance type.

Unit V - GEOPHYSICAL METHODS: Geophysical methods-types-Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method –Electrical Sounding Method – seismic refraction method – Sub-soil Investigation Report.

Reference Books:

1. Hvorslev, M.J, "Sub surface exploration and Sampling of soils for Civil Engineering Purpose", Waterways Station, Vicksburg, Missispi, 1949.

2. S.P. Brahma, "Foundation Engineering", Tata McGraw Hill Publishing Company Limited, New Delhi, 1985.
3. Shamsheer Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, "Analysis and Design of Foundations and Retaining Structures", Meerut, 1979.
4. V.N.S. Murthy, "Soil Mechanics & Foundation Engineering", Vol. 2, Sai Kripa Technical Consultants, Bangalore, 2002
5. C. Venkataramaiah, "Geotechnical Engineering", Wiley Eastern Ltd., New Delhi. 2006

17CE3037 SLOPE STABILITY AND LAND SLIDES

Credits: 3:0:0

Course Objectives

- To impart knowledge on investigation of slopes
- To study stabilization techniques of slopes
- To gain knowledge on analysis and design of slopes

Course Outcomes:

At the end of the course, the student will be able to

- identify the purpose of computing slope stability
- classify irregular slopes with different approaches
- evaluate pore water pressure
- analyse the stability of slopes
- interpret the failures of case studies
- execute suitable ground improvement techniques in the field

Unit I - STABILITY OF SLOPES: Introduction – Importance – General characteristics - Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

Unit II - STABILITY ANALYSIS: Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

Unit III - IRREGULAR SLOPES: Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – composite surfaces of sliding – Block sliding.

Unit IV - LAND SLIDES: General Characteristics-sources-Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows - Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – long term stability of clay slopes.

Unit V - FIELD OBSERVATIONS AND SLOPE STABILIZATION: Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinator – Case histories. Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Soil Reinforcement– Soil nailing.

Reference Books:

1. Chowdhury, D.F., "Slope analysis", Prentice Hall, 1988.
2. Winterkorn, H.F. and Fang, H.Y., "Foundation Engineering Handbook", Van Nostrand Reinhold, 1994.
3. Bramhead, E.N., "The Stability of Slopes", Blackie Academic and Professionals Publications, Glasgow 1986.
4. Anderson, M.G., and Richards, K.S., "Slope Stability", John Wiley, 1987.

17CE3038 THEORETICAL SOIL MECHANICS

Credits: 3:0:0

Course Objectives

- To learn elastic solutions.
- To understand stress-strain behaviour.

- To impart knowledge on theory of elasticity in anisotropic and non-homogeneous soil.

Course Outcomes

At the end of the course, the student will be able to

- recall the stress strain behaviour in soil
- explain the theories of equilibrium and compatibility of soil
- evaluate stress developed using different approaches
- calculate stress-displacement in perfectly plastic material
- develop suitable solutions for different loading conditions
- arrive at solutions by flow net under steady state condition

Unit I - THEORY OF ELASTICITY: Introduction – Material behaviour – Idealistic behaviour – Elastic, viscous and plastic – Elasticity and stability problems, concept of stress and strain – Plane stress, plane strain and axisymmetric problems – Equation of equilibrium and compatibility – Stress functions.

Unit II - STRESSES AND DISPLACEMENTS (ELASTIC SOLUTIONS): Stresses in elastic half-space medium by external loads – Fundamental solutions – Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – Elastic displacement.

Unit III - LIMIT EQUILIBRIUM ANALYSIS: Limit equilibrium analysis – Perfectly plastic material – Stress – strain relationship – Stress and displacement field calculations – Slip line solutions for undrained and drained loading.

Unit IV - LIMIT ANALYSIS: Limit analysis – Principles of virtual work – Theorems of plastic collapse – Mechanism for plane plastic collapse – Simple solutions for drained and undrained loading – Stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations.

Unit V - FLOW THROUGH POROUS MEDIA: Flow through porous media – Darcy's law – General equation of flow – Steady state condition – Solution by flow net – Fully saturated conditions – Flownet in anisotropic soils – construction of flownet for different cases.

Reference Books

1. Aysen, A., "Soil Mechanics: Basic concepts and Engineering Application", A.A.Balkema Publishers, 2002.
2. Ulrich Smolte, YK, "Geotechnical Engineering Handbook (Vol. 1)" Ernst & Sohn, 2002.
3. Aysen, A., "Problem Solving in Soil Mechanics", A.A.Balkema Publisher, 2003.
4. Davis, R.O. and Selvadurai, A.P.S., "Elasticity and Geomechanics", Cambridge University Press, 1996.
5. Taylor, R.N., "Geotechnical Centrifuge Technology", Blackie Academic and Professional 1995.
6. Wai-Fah Chen, and Liu, X.L., "Limit Analysis in Soil Mechanics", Elsevier Science Ltd., 1991.
7. Muni Budhu, "Soil Mechanics and Foundations", John Wiley and Sons, Inc, Network, 2000.
8. Atkinson, J.H., "Foundations and Slopes", McGraw Hill, 1981.
9. Harr, M.E., "Foundations of Theoretical Soil Mechanics", McGraw Hill, 1966.
10. Cedergren, H.R., "Seepage Drainage and Flownets", John Wiley, 1997.
11. Winterkorn, H.F., and Fang, H.Y., "Foundation Engineering Handbook" Galgottia, Booksource, 2000.

17CE3039 DEEP FOUNDATIONS

Credits: 3:0:0

Course Objectives

- To gain knowledge on the design of deep foundations
- To understand the construction of deep foundations
- To study the construction of Cofferdams and underpinning

Course Outcomes:

At the end of the course, the student will be able to

- select suitable deep foundations under given situations
- explain the behaviour of single and group of piles
- evaluate bearing capacity and settlements for piles and pile group
- design of caisson foundations
- construct well foundations in field
- choose the right type of foundation

Unit I - PILE FOUNDATIONS: General considerations – Function – Classification – Piling equipments and methods – Pile driving – Pile installation – Load tests on piles – Cyclic load tests – Indian Standard method – Uses and limitations of load tests – Model studies and their limitation. Pile spacing – Bearing capacity of groups of piles – Distribution of loading on piles – Culmann's method – Stress distribution under pile foundation – Settlement of pile foundation - elastic and consolidation settlements – Negative skin friction.

Unit II - DESIGN OF PILE FOUNDATIONS: Length of piles – Type and structural design – Design of pile caps – Uplift and lateral forces – Batter piles – Damage to adjacent structural alignment of piles – Wave equation analysis – Problem on pile foundation in sands, clay, silt, loose and non uniform soils.

Unit III - PIERS AND CAISSONS: Piers – Drilled caissons – Large bored piles – Types – Design – Bearing capacity – Skin friction – Caisson – Classification – Design aspects – Design loads – Skin friction and sinking effort - Design of various components of caisson – Open, Pneumatic and floating caissons – Construction aspects of caissons.

Unit IV - WELL FOUNDATIONS: Well foundations – Advantages – Elements of a well foundation – Design aspects – Grip length – Forces acting – Design of various components of well foundation – Stability of well – Terzaghi's analysis – IRC method – Construction of well foundation.

Unit V - COFFER DAMS AND UNDER PINNING: Cofferdams – Problems of Foundations in bad ground and under water – Types of coffer dams- Braced coffer dam – Cellular cofferdams - design – Lateral pressures stability – Pippings – Average width of coffer dam – Cofferdam on rock – Cofferdam in deep soil deposit – Interlock stresses in cellular coffer dams – Construction of different types of coffer dams. Reasons for underpinning – Preliminary support columns and footings – Pier underpinning

Reference Books

1. Peck, R.B. Hansen, V.E., and Thornburn, W.H., Foundation Engineering, John Wiley, 1974.
2. Tomlinson, M.J., Foundation Engineering, ELBS, Long man Group, UK Ltd, England, 1995.
3. Bowles, J.E., Foundation Analysis and Design, McGraw Hill, New York, 2001.
4. Cernica, J.N., Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
5. Das, B.M., Principles of Foundation Engineering, Design and Construction, PWS., Publishing, 1999 (Fourth Edition).
6. Donald, P. Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.
7. Grigorian, Pile Foundation for Buildings and structures in collapsible Soil, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, 1999.
8. Poulos, H.G., Davis E.H., Pile foundation analysis and designs, John Wiley and Sons, New York, 1980.
9. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Von Nostrand Reinhold, 1994.

17CE3040 FINITE ELEMENT METHOD IN GEOTECHNICAL ENGINEERING

Credits: 3:0:0

Course Objectives

- To develop skills in the finite element analysis of for 1D and 2D problems
- To learn the iso-parametric element formulation problems for 3
- To apply finite element method for analysis of foundations, seepage and consolidation

Course Outcomes:

At the end of the course, the student will be able to

- reproduce conservation of energy principle, variational principle and methods of weighted residual for developing finite element model
- explain the finite element procedure by taking a simple 2d truss problem
- develop the shape function, strain displacement-relation, stiffness matrix and consistent load vector for structural members
- analyse scalar and vector variable problems
- justify the approximate solution by finite element method by comparing with closed form solution of benchmark problem
- choose appropriate finite element for analysis depending on the nature of the problem in geo-technical engineering

Unit I - INTRODUCTION TO ELASTICITY: Basic equations of solid mechanics – Review of equilibrium conditions – Strain Displacement relations – Stress strain relations – Equilibrium – Compatibility – Principle of virtual work and Principle of stationary Potential energy – Variational principles – Rayleigh Ritz method – Galerkin method of weighted residual

Unit II - ELEMENT PROPERTIES: Discretization – Displacement model – Element properties – Convergence and compatibility requirements – Natural coordinate system – Generalized Coordinates – Shape function – Element Stiffness matrix – Nodal load vector – Elements in plane stress and plane strain – Static condensation – Simple problems only; Boundary conditions, Problems on simple beams, Trusses .

Unit III - TWO DIMENSIONAL ELEMENTS: Lagrangean and Serendipity elements– Mapping – Uniqueness of mapping – Sub – Iso – Super parametric elements – Numerical integration using Gaussian Quadrature – Examples two dimensions.

Unit IV - THREE DIMENSIONAL ELEMENTS: Hexahedral elements -Tetrahedral elements- axi-symmetric elements – axi-symmetric stress analysis due to axi-symmetric loading – Simple examples; Introduction to plate and shell elements- Introduction to nonlinear finite element analysis

Unit V - APPLICATIONS: Analysis of foundations, dams , underground structures and earth retaining structures – analysis of flow trough (seepage) dams and foundations – application to consolidations problems – application to geotechnical designs – requirement of software for analysis of stress in foundation and for stability analysis

Reference Books:

1. Krishnamurthy, Finite Element Analysis – Theory and programming, Second edition, Tata McGraw Hill Publishing Co., 1994.
2. Desai C.S., Elementary Finite Element Method, Prentice Hall, INC, 1979.
3. Rajasekaran S., Finite Element Analysis in Engineering Design, Wheeler publishing 1993.
4. Chandrapatla Tirupathi, R and Belegundu Ashok, D., Introduction to Finite Elements in Engineering, Second edition, Prentice Hall of India, 1997.
5. Potts, D.M., and Zdravkovic, L., “ Finite Element Analysis in Geo-technical engineering”, Thomas Telford, 2001

17CE3041 SOIL DYNAMICS AND MACHINE FOUNDATIONS

Credits: 3:0:0

Course Objectives

- To gain knowledge on different types of machine foundation.
- To understand the dynamic properties of soils.
- To impart knowledge on exposure on vibration isolation techniques.

Course Outcomes:

At the end of the course, the student will be able to

- describe the theories of vibration to solve dynamic soil problems
- evaluate the dynamic properties of soil using laboratory and field tests
- analyse the different types of machine foundation
- design of machine foundation
- compare vibration of foundation studies
- implement vibration isolation techniques

Unit I - THEORY OF VIBRATION: Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

Unit II - DYNAMIC SOIL PROPERTIES: Dynamic stress – Strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

Unit III - MACHINE FOUNDATIONS: Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half – Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.

Unit IV - DESIGN OF MACHINE FOUNDATION: Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance - Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer – Codal recommendations.- Empirical approach - Barken's method – Bulb of pressure concept – Pauw's analogy – Vibration table studies.

Unit V - VIBRATION ISOLATION: Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

Reference Books

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.
2. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.
3. Moore, P.J., Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.
4. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.
5. Arya, S., O'Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.
6. Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and III Budapest, 1964.
7. Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974.
8. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.
9. Das B.M., Principles of Soil Dynamics, McGraw Hill, 1992.
10. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series, Pearson Education (Singapore) Pvt Ltd, 2004.
11. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.

17CE3042 GROUND IMPROVEMENT TECHNIQUES

Credits: 3:0:0

Course Objectives

- To identify weak soils.
- To suggest suitable improvement methods.
- To be familiar with equipment used for improvements.

Course Outcomes:

At the end of the course, the student will be able to

- define the parameters of weak soil
- describe field compaction methods
- apply drainage techniques in soil improvements
- analyse the reinforcement techniques in soil
- design load carrying capacity of stone columns
- adopt suitable grouting techniques

Unit I - DEWATERING: Introduction – Scope and necessity of ground improvement – New Technologies – Basic concepts – Drainage methods – Ground water lowering by well points – Deep well, Vacuum and Electro – Osmosis methods.

Unit II - COMPACTION AND SAND DRAINS: In-situ compaction of cohesionless and cohesive soils – Shallow and deep compaction – Vibration methods – Vibro-compaction, Blasting, Vibrating probe, Vibratory rollers, Vibro-displacement compaction, Vibroflotation – Concept, Factors influencing compaction – Heavy Tamping – Vertical drains – Preloading with sand drains, Fabric drains, Wick drains – Design of sand drains – Relative merits of different methods – Limitations.

Unit III - STONE COLUMN AND CONSOLIDATION: Precompression and consolidation – Dynamic consolidation – Electro-osmotic consolidation – Stone column – Functions – Methods of installation – Design estimation of load carrying capacity of stone column – Settlement of stone column – Lime piles – Earth reinforcement – Soil Nailing – Types of reinforcement material – Applications.

Unit IV - STABILIZATION Introduction – Stabilization methods – Mechanical, Cement, Lime, Bitumen, Chemical stabilization – Electrical stabilization – Stabilization by Thermal and Freezing techniques – Ground

improvement by excavating and replacing – Stabilization of expansive clays – Prewetting – Special methods – Introduction to geopolymer, Nano and bio stabilization.

Unit V - GROUTING: Introduction – Applications – Functions – Characteristics of grouts – Types of grout – Suspension and solution grouts – Basic requirements of grout – Displacement – Compaction grouting, displacement – Soil fracture grouting, Jet – Displacement grouting, Permeation grouting – Grouting equipment – Injection methods – Grout monitoring.

Reference Books:

1. Purushothama Raj, P., “Ground Improvement Techniques”, Laxmi Publications (P) Ltd., New Delhi, 2005.
2. Moseley M.D., “Ground Treatment”, Blackie Academic and Professional, 1998.
3. Shroff, A.V., “Grouting Technology, in Tunneling and Dam”, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.
4. Koerner, R.M., “Designing with Geosynthetics” (fourth edition), Prentice Hall, New Jersey, 1999.

17CE3043 PAVEMENT ENGINEERING

Credits: 3:0:0

Course Objectives

- To gain knowledge on stress assessment
- To Design Flexible and rigid pavements
- To study different rehabilitation techniques

Course Outcomes:

At the end of the course, the student will be able to

- identify the properties of various road materials
- indicate the factors affecting the pavements
- examine the distress in pavements for stability
- design the pavements as per indian standards
- compare causes remedial measures for rehabilitation
- suggest stabilization techniques for soft soils

Unit I - BASIC CONCEPTS: Pavement- types – Historical developments – Approaches to pavement design – Vehicle and traffic considerations – Behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

Unit II - FLEXIBLE PAVEMENT: Factors affecting flexible pavements – Material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – Failure criteria for bituminous pavements – IRC design guidelines

Unit III - RIGID PAVEMENT: Factors affecting rigid pavements – Design procedures for rigid pavement – IRC guidelines – Airfield pavements - Highway pavement – CRC pavements

Unit IV - PAVEMENT EVALUATION AND REHABILITATION: Pavement evaluation and rehabilitation, condition and evaluation surveys – Causes and types of distress in flexible and rigid pavements – PSI models – Serviceability index of rural roads – Overlay design, pavements maintenance management and construction.

Unit V - STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS: The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation for rural roads – Use of geofabrics in road construction – Case studies.

Reference Books

1. Wright, P.H., “Highway Engineers”, Johwiley& Sons, Inc. New York, 2009.
2. Yoder, R.J and Witchak, M.W., “Principles of Pavment Design”, John wiley, 2000.
3. Khanna, S.K and Justo C.E.G., “Highway Engineering”, New Chand and Brothers, Roorkee, 1998.
4. Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
5. Guidelines for the Design of Flexible Pavements, IRC: 37 – 2001, The Indian Roads Congress, New Delhi.
6. Guidelines for the Design of Rigid Pavements, IRC: 58 – 1998, The Indian Roads Congress, New Delhi.
7. O’ Flaherty, C.A., “Highway Engineering”, (Vol. 2), Edward Arnold Cp. 1978.
8. Kadiyali, L.R., “Transport planning & Traffic Engineering”, Khanna Publishers, 2008.

17CE3044 ADVANCED GEOTECHNICAL ENGINEERING LABORATORY

Credits: 0:0:1

Course Objectives

- To attain adequate knowledge in assessing index properties.
- To gain knowledge on Compaction and Compressibility of soils.
- To enrich knowledge on Swell Characteristics and permeability of soils.

Course Outcomes:

At the end of the course, the student will be able to

- recall the index properties of soil
- classify soil as per indian standard
- evaluate cbr value
- interpret chemical analysis
- calculate the consolidation properties
- predict the expansive nature of soil

Students will be capable of assessing various properties of soils by conducting appropriate tests.

LIST OF EXPERIMENTS

INDEX TESTS: Specific gravity of soil solids-Grain size distribution (Sieve analysis and Hydrometer analysis) - Liquid limit and Plastic limit tests - Shrinkage limit and Differential free swell tests - Field density Test

CHEMICAL TESTS: Chemical analysis – pH – Conductivity – quantification of ions through flame Photometer – Determination of organic, sulphate and chlorite content

COMPACTION AND CBR TESTS: Compaction tests - Determination of moisture – density relationship – Influence of compaction energy – CBR Test.

CONSOLIDATION AND PERMEABILITY TESTS: One dimensional consolidation test, C_v , C_c and m_v determination. Permeability of soil – constant and falling head methods

SWELL TESTS: Determination of percent swells – swell pressure - constant volume method; expanded - loaded method.

References:

1. Alam Singh and Chowdary, G.R., “Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation”, CBS Publishers and Distributors, NewDelhi, 2006.
2. Head, K.H., “Manual of Soil Laboratory Testing”, Vol.I and II, Pentech Press, London 1990.
3. Head, K.H., “Manual of Soil Laboratory Testing”, Vol.III, 2nd Edition, John Wiley & Sons, 1998.
4. Bowles, J.E., “Engineering properties of soils and their measurements”, McGraw Hill, 1992.
5. Das, B.M., “Soil Mechanics Laboratory Manual”, Engineering Press, Austin, 1997.
6. Al-Khatiji, A.W. and Anderstand, O.B., “Geotechnical Engineering & Soil Testing”, Sounders College Publishing, Fort Worth, 1992.
7. “Soil Engineering Laboratory Instruction Manual”, Published by the Engineering College Cooperative Society, Chennai, 1996.
8. Lambe T.W., Soil Testing for Engineers”, John Wiley and Sons, New York, 1990.
9. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

17CE3045 ADVANCED COMPUTER AIDED GEOTECHNICAL LABORATORY

Credits: 0:0:1

Course Objectives

- To introduce the application of FEM in Software Packages
- To Analyse and design various structural elements using software packages
- To Impart knowledge on computer application in civil engineering

Course Outcomes:

At the end of the course, the student will be able to

- recall the appropriate loading as per the standards
- analyse for static and dynamic loads
- design for static and dynamic loads

- estimate the design stresses
- evaluate foundation settlement
- suggest suitable foundation.

Experiments

1. Analysis of building with flexible foundation.
2. Analysis of building with rigid foundation.
3. Analysis of raft foundation.
4. Analysis of frame. (2D)
5. Analysis of flexible pavements.
6. Analysis of rigid pavements.
7. Evaluation of settlement under different building foundations
8. Analysis of stress distribution in soils.

References:

1. STAAD Pro 2007 V8i Analysis Reference Manual, 2015.
2. ANSYS 17.1 - Analysis Reference Manual, 2016.
3. PLAXIS 3D 2016 - Analysis Reference Manual, 2016

17CE3046 EARTH RETAINING STRUCTURES

Credits: 3:0:0

Course Objectives

- To impart knowledge on earth pressure theories
- To design retaining walls with and without geosynthetic reinforcements.
- To study sheet pile walls with and without geosynthetic reinforcements.

Course Outcomes:

At the end of the course, the student will be able to

- define various classical earth pressure theories
- classify different types of earth retaining structures
- demonstrate braced excavation with practical examples
- evaluate forces on the structures under different conditions
- design earth retaining structures based on stability considerations
- adopt appropriate retaining structures based on field observations

Unit I - EARTH PRESSURE THEORIES: Introduction – state of stress in retained soil mass – Classical earth pressure theories – Active and Passive earth pressures – Earth pressure at rest- Earth pressure due to external loads – Empirical methods – Wall movements and complex geometry – Graphical method of computing earth pressure – Rehmann’s and Culmann’s approach.

Unit II - RETAINING WALLS: Retaining walls – Uses and types – forces on retaining walls – design of retaining walls by limit state method – general principles – design and construction details – Design of solid gravity walls, Semi – gravity walls, cantilever walls, counterfort walls – Stability of retaining walls – Drainage arrangements and its influence.

Unit III - SHEET PILE WALLS: Earth retaining structures – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchor – Diaphragm and bored pile walls – design requirements.

Unit IV - BRACED EXCAVATION: Braced cuts in sand and clay – Lateral pressure on sheeting in Braced excavation – Stability against piping and bottom heaving – Procedure for computation of lateral earth pressure for braced cuts and Flexible Bulk heads – Soil anchors – Soil nailing – Soil pinning – Methods of design.

Unit V - REINFORCED EARTH RETAINING WALL: Reinforced earth retaining wall – General principles, Concepts and mechanism of reinforced earth – Design consideration of reinforced earth – Geotextile, geogrids, metal strips and facing elements – Construction – Selection of type of retaining structures – construction practice – Field observations.

References:

1. Winterkorn H.F. and Fang H.Y., “Foundation Engineering Hand book”, Galgotia Book-source, 2000.

2. Rowe R.K., "Geotechnical and Geo environmental Engineering Hand Book", Kluwer Academic Publishers, 2001.
3. Militisky .J and Woods R., "Earth and earth retaining structures", Routledge, 1992.
4. Das B.M., "Principles of Geotechnical Engineering", 4th edition, The PWS series in Civil Engineering, 1998.
5. Clayton C.R.I. Militisky, J and Woods R., "Earth pressure and earth retaining structures", 2nd edition, Survey University Press, 1993.
6. McCarthy D.F., "Essentials of soil Mechanics and foundations; Basic Geotechnics", 6th Edition, Prentice Hall, 2002.

17CE3047 GEOLOGY IN GEOTECHNICAL ENGINEERING

Credits: 3:0:0

Course Objectives

- To understand microscopic study of rocks
- To impart knowledge on geophysical exploration of ground water and structural geology
- To study the causes and preventing measures of landslides.

Course Outcomes:

At the end of the course, the student will be able to

- identify mineral content, texture and structural behaviour of rocks using microscopic study
- classify different faults in rocks
- demonstrate various geophysical investigations
- analyze the causes of landslides
- explain the scope of ground water investigations in civil engineering
- interpret the causes of faults based on field recognition of unconformity

Unit I – INTRODUCTION: Soil formation – Survey – Soils of India – Texture and structure of igneous, sedimentary and metamorphic rocks - Microscopic study – Microscopic study of rocks with particular reference to texture – microscopic study of unconsolidated sediments with reference to their grain size and mineral content

Unit II - GEOPHYSICAL INVESTIGATION: Geophysical methods of exploration – Electrical, Magnetic, gravitational, seismic, radioactive and geochemical methods – Influence of structure and texture of rocks, Engineering properties, foundation problems in igneous, sedimentary and metamorphic rocks including recent sediments- case histories. Investigations for foundation of dams and reservoirs – Problem encountered and treatment, case studies – Investigation of canals and deep cuts – Case studies.

Unit III - LAND SLIDES: Land Slides – Causes – Preventive and control measures – Engineering problems related to earthquakes, case studies.

Unit IV - GROUND WATER: Ground Water problems – Location of water tables, composition of ground water – Ground water surveys – Conservation of ground water – Scope of ground water investigation in Civil Engineering.

Unit V - STRUCTURAL GEOLOGY: Altitude of beds – Dip and Strike, Characteristics, Types, Causes and mechanism of folding, Classification, Causes and mechanism of faults- Field evidences and Recognition of faults - Joint systems – Classification and its types, Difference between faults and joints - Definition, importance and field recognition of unconformity

References

1. ParbinSingh, "Engineering and General Geology", Katson Publication House, 1987.
2. Blyth, "Geology for Engineering", ELBS 1995.
3. Legget, "Geology and Engineering", McGraw Hill Book Company, 1998.
4. Krynine and Judd, "Principles of Engineering Geology and Geo techniques", CBS Publishers & Distributors, 1998.

17CE3048 REINFORCED SOIL STRUCTURES

Credits: 3:0:0

Course Objectives

- To impart knowledge on geosynthetics.
- To study the design principles and mechanism of reinforced soil and soil nailing.
- To enlighten the applications in dams, embankments, pavements and foundation structures.

Course Outcomes:

At the end of the course, the student will be able to

- recall the soil reinforcement interaction mechanism
- classify the materials used in reinforced soil structure
- demonstrate various testing and prevention methods
- design various soil reinforcement structures
- summarize the concepts of geosynthetics in earth reinforcement
- judge the performance of reinforced structures

Unit I - PRINCIPLES AND MECHANISMS: Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – Reinforcement interactions

Unit II - MATERIALS AND MATERIAL PROPERTIES: Materials used in reinforced soil structures- Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages – Preservation methods.

Unit III - DESIGN PRINCIPLES AND APPLICATIONS : Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls – Foundations - Embankments and slopes.

Unit IV - GEOSYNTHETICS AND APPLICATIONS: Introduction – Historical background – Applications - Design criteria – Geosynthetics in roads – Design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – Design of landfills – Barrier walls.

Unit V - SOIL NAILING AND CASE HISTORIES: Soil nailing – Introduction – Overview – Soil – Nail interaction – Behaviour – Design procedure – Behaviour in seismic conditions - Performance studies of reinforced dams, embankments, Pavements, Railroads, Foundations - Case studies.

References

1. Jewell, R.A., “Soil Reinforcement with Geotextile”, CIRIA, London, 1996.
2. John, N.W.M., “Geotextiles”, John Blackie and Sons Ltd., London, 1987.
3. Jones, C.J.F.P., “Earth Reinforcement and Soil Structures”, Earthworks, London, 1982.
4. Koerner, R.M., “Designing with Geosynthetics”, 3rd Edition, Prentice Hall, 1997.
5. Proc. Conference on polymer and Reinforcement, Thomas Telford Co., London, 1984.
6. Gray, D.H., and Sotir, R.B., “Biotechnical and Soil Engineering Slope Stabilization. A Practical Guide for Erosion Control”, John Wiley & Son Inc., New York, 1996.
7. Ramanatha Ayyar, T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive reference book on Coir Geotextile, Centre for Development for Coir Technology, 2002.

17CE3049 MECHANICS OF UNSATURATED SOILS

Credits: 3:0:0

Course Objectives

- To study the soil water system
- To interpret the results of direct shear and triaxial test.
- To learn development of hydraulic conductivity models.

Course Outcomes:

At the end of the course, the student will be able to

- identify the physical properties of air and water
- explain the interdisciplinary nature of unsaturated soil
- estimate the effective stress state variable and shear strength parameters

- prepare suction and moisture profile
- develop hydraulic conductivity models
- interpret soil water characteristic curves

Unit I - STATE OF UNSATURATED SOIL: Definition – Interdisciplinary nature of unsaturated soil – soil classification – Nature and practice – stress profiles, stress state variables - material variables – constitutive law – suction potential of soil water

Unit II - PHYSICS OF SOIL WATER SYSTEM: Physical properties of Air and water – partial pressure and relative Humidity Density of moist air – surface Tension – cavitation of water. Solubility of Air in water – Air – water solid interface –vapour pressure lowering – soil water characteristic-curve - Capillary tube model – contacting sphere model -Young Laplace equation – Height of capillary rise – Rate of capillary rise – capillary pore size distribution – theoretical basis – determination – laboratory method

Unit III - STRESS STATE VARIABLES AND SHEAR STRENGTH: Effective-stress – stress between two spherical particles – Hysteresis in SWCC – stress parameter, stress tensor – stress control by Axis Translation - analytical representation of stress –volume change characteristics. Extended Mohr – Coulomb criterion – shear strength parameters–Interpretation of Direct shear test results and Tri axial test results – unified representation of failure envelope – Influence of suction in earth pressure distribution.

Unit IV - STEADY AND TRANSIENT FLOWS: Driving mechanism – Permeability and Hydraulic conductivity – capillary barriers – steady infiltration and evaporation – Vapor flow – Air diffusion in water - Principles for pore liquid flow – Rate of infiltration, Transient suction and moisture profiles. Principles for Pore Gas flow Barometric pumping Analysis.

Unit V - MATERIAL VARIABLE MEASUREMENT AND MODELLING: Measurement of total suction – psychrometers – Filter paper measurement of matric suction – High Air Entry disks – Direct measurements – Tensiometers – Air-translation technique – Indirect measurements – Thermal conductivity sensors – measurement of osmotic suction – squeezing technique – soil water characteristic curves and Hydraulic conductivity models.

References:

1. Fredlund, D.G. and Rahardjo, H. “Soil Mechanics for unsaturated soils”, John Wiley & Sons, INC, New York.2003.
2. Ning Lu and William, J. Likes, “Unsaturated Soil Mechanics”, John Wiley & sons, INC. New Jersey, 2004
3. Ng Charles, W.W., Menzies Bruce, “Advanced unsaturated Soil Mechanism and Engineering”, Taylor & Francis Group, 2007.
4. Ning Lu, Laureano R. Hoyes and Lakshmi Reddi, “Advances in unsaturated soil, seepage and Environmental Geotechnics”, ASCE., Geotechnical special publication No.148.

17CE3050 PROFESSIONAL PRACTICES IN DESIGN OF GEOTECHNICAL STRUCTURES

Credits: 3:0:0

Course Objectives

- To gain knowledge on practical aspects of design relating to substructure elements using software.
- To impart knowledge on Geotechnical construction practices.
- To apply knowledge on field execution.

Course Outcomes:

At the end of the course, the student will be able to

- identify the various field practices in geotechnical engineering
- indicate the various safety and quality control aspects in site
- apply the various design aspects in earthquake resistant structures
- design foundations for special structures using software
- evaluate dynamic properties of soil
- choose the appropriate finite element analysis software applied to Geotechnical Engineering

Unit I - Construction Techniques: Project planning – Geotechnical Engineering practices – Soil Profile – Bore log report review and preparation – Geotechnical Plant and Machinery – Safety aspects at site – Construction management – Quality Control – Quality Management – Geosynthetics – Geomembrane.

Unit II - Retaining Structures: Design of retaining wall – Design of culvert – Design of Deep excavations – Sheet pile – Diaphragm walls – Shoring system – Design of Caisson.

Unit III – Substructures: Design of tower foundation – Design of floating foundation – Design of Pile and Pile group – Design of underreamed pile – Design of abutment – Design of Pier – Design of Mat foundation – Design of piled raft foundation

Unit IV - Dynamic Response of Foundations: Soil behaviour – Dynamic properties of soil – Seismic performance analysis – Calculation of seismic load in foundation – Design procedure for earthquake resistant foundation – Soil structure interaction – Retrofitting

Unit V - Finite Analyses and Software Application: Finite Element Analysis applied to Geotechnical Engineering – ANSYS – Modelling – Applications – PLAXIS.

Reference Books

1. Helmsley, “Design Applications of Raft Foundations”, Thomas Telford, 2000
2. Michael John Tomlinson, R.Boorman, “Foundation Design & Construction”, Prentice Hall PTR, 2001.
3. George paaswell, “Retaining Walls: Design & Construction”, Biblibazaar, 2009.
4. Design and Construction of bridge approaches, Transportation Research Board, 1990.
5. M.J. Tomlinson, Taylor and Francis ltd., “Pile design and construction practice”, 1994.
6. Davies and Poulos, “Analysis and Design of Pile foundation”, John wiley and sons, 1980.
7. J.E. Bowles, “Foundation Analysis and Design”, McGraw – Hill, 1997.
8. V.N.S. Murthy, “Advanced Foundation Engineering”, CBS Publishers & Distributors, 2007.
9. Swami Saran, “Soil Dynamics and Machine Foundations”, Galgotia Publications, New Delhi.
10. Potts and Zdravkovic, “Finite Element Analyses applied to Geotechnical Engineering”, Vol.1 (Theory) and Vol.2 Applications.

17CE3051 ROCK MECHANICS IN ENGINEERING PRACTICE

Credits: 3:0:0

Course Objectives

- To understand the properties of rock and pattern of failure.
- To study the evaluation of stresses.
- To interpret the stability considerations of rock masses.

Course Outcomes:

At the end of the course, the student will be able to

- recall the formation and classification of rocks in india
- explain the strength parameters of rocks
- evaluate the in-situ stresses developed and methods of measurement
- analyse slope stability
- summarize the design aspects in rocks
- select the appropriate reinforcement of rocks

Unit I - CLASSIFICATION OF ROCKS: Rocks of peninsular India and the Himalayas – Index properties and classification of rock masses, competent and incompetent rock – Value of RMR and ratings in field estimations

Unit II - STRENGTH CRITERIA OF ROCKS: Behaviour of rock under hydrostatic compression and deviatoric loading – Modes of rock failure – Planes of weakness and joint characteristics – Joint testing, Mohr – Coulomb failure criterion and tension cut-off, Hoek and Brown Strength criteria for rocks with discontinuity sets.

Unit III - DESIGN ASPECTS IN ROCKS: Insitu stresses and their measurements, flat jack - Over and under coring methods – stress around underground excavations – Design aspects of openings in rocks – Case studies.

Unit IV - SLOPE STABILITY OF ROCKS: Rock slopes – Role of discontinuities in slope failure, slope analysis and factor of safety – Remedial measures for critical slopes – Case studies.

Unit V - REINFORCEMENT OF ROCKS: Reinforcement of fractured and jointed rocks – Shotcreting – Bolting – Anchoring – Installation methods – Case studies.

References

1. Goodman, R.E., “Introduction to Rock Mechanics”, John Wiley and Sons, 1989.
2. Hool, E and Bray, J., “Rock Slope Engineering”, Institute of Mining and Metallurgy, U.K. 1981.
3. Hoek, E and Brown, E.T., “Underground Excavations in Rock”, Institute of Mining and Metallurgy, U.K. 1981.
4. Obvert, L. and Duvall, W., “Rock Mechanics and the Design of Structures in Rock”, John Wiley, 1967.

5. Bazant, Z.P., "Mechanics of Geomaterials Rocks, Concrete and Soil", John Wiley and Sons, Chichester, 1985.
6. Wittke, W., "Rock Mechanics: Theory and Applications with Case Histories", Springer-Verlag, Berlin, 1990.

17CE3052 ENVIRONMENTAL GEOTECHNOLOGY

Credits: 3:0:0

Course Objectives

- To acquire knowledge on the geotechnical engineering problems associated with soil contamination
- To study various methods of safe disposal of waste, stabilization of waste and transportation of contaminant
- To suggest site remediation techniques

Course Outcomes:

At the end of the course, the student will be able to

- identify the causes of soil pollution and suggest suitable methods of remediation for the contaminated sites
- classify the various techniques of waste disposal
- illustrate the contaminant transport and the transformation processes
- evaluate the bearing capacity of compacted fills
- explain the case studies on utilization of solid waste and soil improvement
- implement suitable methods of remediation for contaminated sites

Unit I - SOIL – POLLUTANT INTERACTION: Introduction to Geoenvironmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil – Pollutant interaction – Failures of foundations due to pollutants – case studies.

Unit II - SITE SELECTION AND SAFE DISPOSAL OF WASTE: Safe disposal of waste – Site selection for landfills – Characterization of landfill sites– Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid and flexible liners.

Unit III - TRANSPORT OF CONTAMINANTS: Contaminant transport in sub surface – Advection – Diffusion – Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Hydrological consideration in landfill design – Ground water pollution – Bearing capacity of compacted fills – Foundation for waste fill ground – Pollution of aquifers by mixing of liquid waste – Protection of aquifers.

Unit IV - WASTE STABILIZATION AND DISPOSAL: Hazardous waste control and storage system – Stabilization/Solidification of wastes – Micro and Macro encapsulation – Absorption, adsorption, precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – Case studies.

Unit V - REMEDIATION OF CONTAMINATED SOILS : Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio – remediation, incineration, soil washing, electro kinetics, soil heating, vitrification, bio-venting – Ground water remediation – Pump and treat, air sparging, reactive well –Case studies.

Reference Books

1. Wentz, C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989.
2. Daniel, B.E., "Geotechnical Practice for waste disposal", Chapman and Hall, London, 1993.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. Ott, W.R., "Environmental Indices, Theory and Practice", Ann. Arbor, 1978.
5. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
6. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
7. Westlake, K., "Landfill Waste pollution and Control", Albion Publishing Ltd., England, 1995.
8. Lagrega, M.D., Buckingham, P.L., and Evans, J.C., "Hazardous Waste Management", McGraw Hill, Inc. Singapore, 1994.

17CE3053 APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Credits: 3:0:0

Course Objectives

- To impart knowledge on the transformation of chemicals in the environment
- To educate the basics of microbiology involved in air, water and soil.
- To study the basics of environmental chemistry, chemical reactions and electro kinetic properties.

Course Outcomes:

At the end of the course, the student will be able to

- learn basic chemical contents in the context of environmental studies
- gain competency in solving environmental issues of chemicals based Pollution
- able to determine chemical calculations required for treatment purpose
- identify contaminating chemicals and learn the conceptual skills required for environmental chemistry research
- apply micro organisms for the treatment of wastes, bioleaching and bioaugmentation
- have insight into type, growth metabolism and culturing techniques of micro organisms and their application to environmental engineering

Unit I - Introduction: Stoichiometry and mass balance - Solubility product - Chemical kinetics Principles of green chemistry

Unit II - Aquatic Chemistry: Environmental significance and determination - Fate of chemicals in aquatic environment – Colloidal and surface Chemistry- Treatment– Oxidation and reduction – sorption- adsorption - Freundlich and Langmuir isotherms – Applications in water and wastewater treatment.

Unit III - Atmospheric And Soil Chemistry : Atmospheric structure - Chemical and photochemical reactions in the atmosphere –Photochemical smog- Ozone layer depletion – Acid rain- Agricultural chemicals in soil- Reclamation of contaminated land; Electrokinetic remediation.

Unit IV - Pathogens In Wastewater: Introduction to water borne pathogens and parasites and their effects on human, animal and plant health, transmission of pathogens – Control of microorganisms; Microbiology of biological treatment processes – Microbiology of sewage sludge.

Unit V - Biodegradation And Toxicology: Microbiology of wastewater treatment – Biodegradation, bioaugmentation, biomagnification, bioassay, microbial leaching - Ecotoxicology – Toxicity testing.

References:

1. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F. "Chemistry for Environmental Engineers", 3rd Edition. Tata McGraw Hill, New Delhi, 2013
2. Ronbald A. Hites, "Elements of Environmental Chemistry", Wiley, 2007.
3. Bhatia, S.C., "Handbook of Environmental Microbiology", Vol. I, II & III, Atlantic Publ. & Dist. Ltd., 2008.

17CE3054 WATER AND WASTEWATER TREATMENT

Credits: 3:0:0

Course Objectives

- To impart knowledge on characteristics of water and wastewater, primary and secondary treatment.
- To educate the methods of disposal of sludge and treated wastewater.
- To educate the students on the working principles and design of various physical, chemical treatment systems for water and wastewater.

Course Outcomes:

At the end of the course, the student will be able to

- design the water supply and wastewater treatment systems
- determine the treatment efficiency of treatment units
- ability to estimate wastewater generation
- discuss the characteristics and composition of wastewater
- perform basic design of the unit operations
- plan house drainage including onsite wastewater treatment and disposal

Unit 1: Introduction: Water and Wastewater Quantity Estimation Population forecast-Water demand for various purposes- Estimation of wastewater quantity -Temporal and spatial variation in quantity of water and wastewater - Water supply/distribution systems -Wastewater collection systems-Underground drainage systems.

Unit 2: Physical Treatment: Wastewater characteristics-Primary, secondary and tertiary treatment-Physical unit processes: screening, commutation, grit removal, equalization, sedimentation.

Unit 3: Chemical Treatment: Coagulation-Flocculation-Filtration- Disinfection- Aeration and gas transfer- Precipitation Softening- Adsorption and ion exchange-Membrane technology.

Unit 4: Biological Treatment: Biological Treatment of Wastewater Types of microorganism -Aerobic treatment: suspended growth aerobic treatment processes-Activated sludge process and its modifications-Attached growth aerobic processes: Trickling filters and rotating biological contactors-Anaerobic treatment: fluidized bed and sludge blanket systems-Nitrification- Denitrification.

Unit 5: Natural Treatment: Natural Wastewater Treatment Systems Ponds and lagoons-Wetlands and root-zone systems-Surface and ground water treatment for potable water supply

References

1. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.
2. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Simla, 2003
3. Metcalf and Eddy, "Wastewater engineering, Treatment and Reuse", Tata McGraw-Hill, New Delhi, 2003.
4. Kuruvilla Mathew, Stewart Dallas, Goen Ho, Decentralized Water and Wastewater Systems, IWA Publications, 2008

17CE3055 ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL

Credits: 3:0:0

Course Objectives:

- To impart knowledge about atmospheric pollution.
- To introduce various measurement techniques and control measures.
- To make use of different tools available for atmospheric environmental pollution.

Course Outcomes

At the end of the course, the student will be able to

- understand the principles of atmospheric chemistry in air pollution
- classify, characterize and quantify different types of air pollutants
- analyse the effects of air pollution on environment
- choose appropriate technology to control air pollution
- apply suitable measures in controlling air pollution
- develop model for atmospheric pollution

Unit I - Basic Concepts: sources and types of air pollutants, effects on environment, sampling and measurement of particle and gaseous pollutants

Unit II - Dispersion of air pollutants: atmospheric stability and inversion-plume rise estimation, dispersion theories

Unit III - Particulate and gaseous pollutant control: control methods, selection of control equipment, principle and design aspects of settling chambers, cyclone separators, scrubbers, filters, electrostatic precipitators- absorption, adsorption and precipitation, engineering control concept

Unit IV - Air pollution emission standards and legislation: Standards and legislation for air pollution emission control - Control measures for industrial application

Unit V - Introduction to air pollution models: CALINE, SCREEN 3, ISCST3; basics of AERONET; case studies.

References:

1. Rao C S, "Environmental Pollution Control Engineering", New Age International (p) Limited, 2006.
2. M. N. Rao, "Air Pollution", Tata Mc-Graw Hill Publication, 1989.
3. Noel de Nevers, "Air Pollution control Engineering", Mc-Graw Hill Publication, New York, 1999.

4. Lawrence K.Wang, Norman C Perelra, Yung-Tse Hung, “Air Pollution Control Engineering”, Tokyo, 2004.
5. David H.F Liu, Bela G.Liptak, “Air Pollution”, Lewis Publishers, 2000.
6. Anjaneyulu.Y, “Air Pollution & Control Technologies”, Allied Publishers (P) Ltd, India, 2002.
7. Mudakavi, J R, “Principles and Practices of Air Pollution Control and Analysis” IK International, 201

17CE3056 SOLID AND HAZARDOUS WASTE MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To impart knowledge on solid and hazardous wastes.
- To choose appropriate method for solid and hazardous waste handling.
- To apply suitable technique for disposal of solid and hazardous waste.

Course Outcomes

At the end of the course, the student will be able to

- understand the characteristics of different types of solid and hazardous wastes
- classify waste in different categories
- suggest suitable technical solutions for treatment
- identify suitable methods of storage, collection and transport
- explore waste processing techniques
- propose suitable waste disposal method

Unit I - SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK: Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management — Salient features of Indian legislations on management and handling of municipal solid wastes and hazardous wastes

Unit II - WASTE CHARACTERIZATION AND SOURCE REDUCTION: Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – Waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility

Unit III - STORAGE, COLLECTION AND TRANSPORT OF WASTES: Handling and segregation of wastes at source – Storage and collection of municipal solid wastes – Analysis of collection systems - Need for transfer and transport – Transfer stations optimizing waste allocation– Compatibility, storage, labeling and handling of hazardous wastes

Unit IV - WASTE PROCESSING TECHNOLOGIES: Objectives of waste processing – Material separation and processing technologies – Biological and chemical conversion technologies – Methods and controls of composting - Thermal conversion technologies and energy recovery – Incineration - Treatment of biomedical wastes

Unit V - WASTE DISPOSAL: Waste disposal options – Disposal in landfills: Landfill Classification, types and methods, site selection, design and operation of sanitary landfills, secure landfills and landfill bioreactor- Leachate and landfill gas management

References:

1. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
2. Vesilind P.A., Worrell W and Reinhart, “Solid waste Engineering”, Thomson Learning Inc., Singapore, 2002.
3. Paul T Williams, “Waste Treatment and Disposal”, Wiley, 2005
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E, “Hazardous waste Management”, Mc-Graw Hill International edition, New York, 2001
5. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.

17CE3057 ENVIRONMENTAL IMPACT ASSESSMENT

Credits: 3:0:0

Course Objectives:

- To enable students to acquire necessary skills to assess the impact of environmental and water resources projects
- To help students in taking necessary steps to bring down the adverse environmental impacts during inception of new projects
- To make the students prepare environmental audit reports for EIA projects

Course Outcomes

At the end of the course, the student will be able to

- identify environmental attributes to be considered for the EIA study
- prepare environmental base map based on impact evaluation and analysis
- specify methods for prediction of the impacts
- conduct environmental audit
- evaluate the audit data and prepare the report
- formulate environmental management plan

Unit I - INTRODUCTION TO EIA: Basic concept of EIA: Initial environmental examination - Elements of EIA - Factors affecting EIA - Impact evaluation and analysis-Preparation of Environmental base map -Classification of environmental parameters.

Unit II - METHODS OF EIA: EIA methodologies: introduction, criteria for selection of EIA methodology- EIA methods: ad-hoc methods, matrix methods, network method, environmental media quality index method, overlay methods -Cost/benefit analysis.

Unit III - ENVIRONMENTAL IMPACTS: Hydrologic and water quality impacts – Ecological and biological impacts – Social and cultural impacts – Soil and landscape changes – Agro economic issues – Human health impacts – Ecosystem changes.

Unit IV - ENVIRONMENTAL AUDITING: Environmental audit and environmental legislation -Objectives of environmental audit- Types of environmental audit -Audit protocol- Stages of environmental audit -Onsite activities- Evaluation of audit data -Preparation of audit report.

Unit V - APPLICATION OF EIA: Case studies and preparation of environmental impact assessment statement for a few water resources development projects.

References:

1. John, G., Riki, T., Andrew, C., “Introduction to Environmental Impact Assessment”, Routledge Taylor & Francis Group, III Edition, 2005.
2. Prabhakar, V.K., “Environmental Impact Assessment”, Anmol Publications, 2001.
3. Marriott, Betty B., “Environmental Impact Assessment: a Practical Guide”, McGraw-Hill, 1997.
4. Richard, K.M., “Environmental Impact Assessment- a Methodological Perspective”, Kluwer Academic Publishers, 2002

17CE3058 ELEMENTS OF HYDROLOGY

Credits 3:0:0

Course Objectives:

- To introduce hydrological processes in water balance studies
- To develop the ability in hydrological data acquisition, analysis and interpretation
- To make them understand the importance of management of groundwater resources

Course Outcomes

At the end of the course, the student will be able to

- understand the components of hydrologic cycle
- predict hydrologic extreme events for hydrologic design
- interpret groundwater field data
- compute hydrologic mass balance in a river basin
- conduct pumping test and estimate groundwater potential

- carryout groundwater budget

Unit I - HYDROLOGICAL PROCESSES: Description of hydrologic cycle - Precipitation: rain gauge network, test for consistency and continuity of data, analysis of rainfall data, intensity-duration-frequency analysis and depth-area-duration analysis-

Unit II - ABSTRACTIONS FROM PRECIPITATION: Evaporation: estimation using Thornthwaite and Penman-Monteith methods- Evapotranspiration -Infiltration process: infiltration indices and effective rainfall;

Unit III - STREAM FLOW MEASUREMENT: stream flow measurement, stage-Discharge relationship and rating curve, runoff characteristics – Hydrograph theory: direct runoff hydrograph, unit hydrograph, hyetograph - Occurrence and movement of groundwater: groundwater budget; classification of aquifers

Unit IV - PHYSICAL PROPERTIES OF SUBSURFACE MEDIA: Darcy's law, hydraulic head, permeability, hydraulic conductivity, porosity, void ratio, transmissivity, storativity, steady state flow and transient flow;

Unit V - GROUNDWATER HYDRAULICS: Steady state equations of flow (confined and unconfined aquifers) – Uniform and radial flow to a well (confined and unconfined) - Theis equation-Dupit equation- Unsteady state flow in confined and unconfined aquifers - Thiem method for estimating drawdown using observation wells–Pumping test and estimation of parameters.

References:

1. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Wiley & Sons Inc., 2007.
4. Bear, J., "Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 2008.
6. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 2010.
7. Maidment, D.R. (editor), "Handbook of Hydrology". McGraw-Hill, New York, 1993.
8. Singh V.P., "Elementary Hydrology", Prentice Hall of India, New Delhi, 1994.

17CE3059 DESIGN OF HYDRAULIC AND CONVEYANCE STRUCTURES

Credits 3:0:0

Course Objectives:

- To impart knowledge about various types of hydraulic structures
- To introduce the planning and design concepts of hydraulic structures.
- To inculcate the importance of basic water supply and drainage systems in society

Course Outcomes

At the end of the course, the student will be able to

- understand the design criteria for various the types of dams
- analyse and design various hydraulic structures
- design a water supply distribution network
- design a storm water drainage system
- develop a water reuse system
- design irrigation channels and cross drainage works

Unit I - Dams: types and classification, selection of site for dams, choice of dams, dam safety, Design and construction of gravity and earth dams, flow nets;

Unit II - Spillways: principles and classification, design of ogee and open channel spillways - Energy dissipation devices, basins, buckets and gates - Canals: types, components, selection, design of irrigation canals, maintenance of canals;

Unit III - Irrigation channels: Design of irrigation channels- Irrigation outlets- Canal masonry works - Principles of design, use of flow net- Khosla's theory - Highway drainage: importance, principles of surface drainage, roadside drains; cross drainage works

Unit IV - Water distribution networks: flow through pipes, solving pipe network flow problems - Use of computer software for network analysis -Cross country pipeline; hydraulic transient analysis;

Unit V - Basic approaches to urban drainage- Runoff quantity and quality - Wastewater and stormwater reuse- Major and minor systems

References:

1. Punmia & Pandey, "Irrigation & Water Power Engg." Laxmi Publications (P) Ltd., New Delhi, 2016.
2. M.M.Dandekar and K.N.Sharma, "Water Power Engineering", 2nd edition Vikas publishers, 2013.
3. Asawa G.L. "Irrigation and Water Resources Engineering" -New Age International (P) Ltd. Publishers, 1st edition, 2005.
4. Garg S.K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers N.D. 13th edition, 1998.
5. Modi,"Irrigation, Water Resources and Water Power Engineering", P.N. -Standard Book House,New Delhi, 2nd edition, 1990.
6. Design of small dams, United States Bureau of Reclamation, Third Edition, 1987.

17CE3060 WATER RESOURCES PLANNING AND SYSTEMS ENGINEERING

Credits 3:0:0

Course Objectives:

- To introduce application of systems concepts to water resources planning
- To make the students learn the optimization techniques in modeling water resources systems
- To impart knowledge on National Water Policy

Course Outcomes

At the end of the course, the student will be able to

- understand the steps involved in planning a water resources project in an integrated way
- gain knowledge about different components of National Water Policy
- understand the economic policy to carryout cost-benefit analysis
- formulate the objective function and constraints
- apply few optimization tools and techniques
- develop reservoir operation policy

Unit I - CONCEPTS OF SYSTEMS ANALYSIS: definition, approach to water resources planning and management- Water resources management: reservoir operation and water allocation policy

Unit II - OPTIMIZATION TECHNIQUES: Overview, objectives and constraints - Formulation of linear programming models- Graphical method - Simplex method - Sensitivity analysis - Application of linear programming in water resources

Unit III - DYNAMIC PROGRAMMING: Bellman's principle of optimality: forward and backward recursive dynamic programming; curse of dimensionality; application of dynamic programming for resource allocation; reservoir capacity expansion.

Unit IV - WATER RESOURCES PLANNING: concepts and definitions, functions and role of water resources - Phases of water resources planning - Data requirements for water resources planning - National Water Policy: planning objectives, public involvement in identifying objectives, project scale - Implementation of water resources projects - Planning strategies for water resources projects - Constitutional provisions for water resources development.

Unit V - ECONOMIC POLICY: Water allocation priorities; Master plan approach; mechanics of water resources plan; shadow pricing on project costs- International funding agencies.

References:

1. Vedula, P.P., and Mujumdar, S., "Water Resources Systems: Modelling Techniques and Analysis", Tata-McGraw Hill, 2005.
2. Leonard Douglas James and Robert Rue Lee, "Water Resources Economics" Oxford Publishers, 2005.
3. Bhawe, P. R., "Optimal Design of Water Distribution Networks", Narosa Publishing house, 2003.
4. Loucks, Daniel P., van Beek, Eelco; Stedinger, Jerry R., Dijkman, Jozef P.M., Villars, "Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications" , UNESCO publishing, 2005.
5. Quentin Grafton R., and Karen Hussey, " Water Resources Planning and Management", Cambridge University Press, 2011.

17CE3061 PRINCIPLES OF INTEGRATED WATER RESOURCES MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To introduce the concepts of IWRM and highlight the inter-disciplinary nature
- To expose to sustainable water resources management, water security and public-private partnership issues
- To brief about integrated multi-sectoral and multi-dimensional issues in developing water resource management plans

Course Outcomes

At the end of the course the student will be able to

- understand the concepts of IWRM principles
- plan integrated water resources development projects considering sustainability aspects
- involve in water management projects from a multi-objective and multi-purpose perspective
- develop various water conservation techniques
- understand Private Public Partnership (PPP)
- analyse the environmental and health issues due to different water issues

Unit I - CONCEPTS, PRINCIPLES AND TERMINOLOGIES: IWRM: definition and principles- Social, economic, environmental and institutional factors in water management - Water needs for human beings and nature- Concepts of 'blue', 'green' and 'grey' water- Ecosystem approach- Global climate change and its effect on water resources.

Unit II - SUSTAINABLE WATER RESOURCES MANAGEMENT: Concept of sustainable development- Dublin Conference and Earth Summit- National Water Policy: highlights and limitations –River basin approach – Small watershed management- Environmental flows- Minimum water table.

Unit III - WATER RELATED ENVIRONMENTAL AND HEALTH PROBLEMS: Floods –Droughts- Soil erosion- Reservoir sedimentation-Salinity intrusion into surface and groundwater sources- Waterlogging in command areas-Sand mining-Impact of population and anthropogenic activities on water resources

Unit IV - TRADITIONAL AND MODERN TECHNIQUES FOR WATER SECURITY: Role of water in development - Rainwater harvesting – Artificial recharge – Conjunctive use of surface and groundwater-Inter basin transfer-Conservation of 'green' water – Treatment of 'grey' water- Basics of desalination and water treatment and recycling

Unit V - PPP AND PRIVATE MARKETS: Introduction to water economics- Water pricing - Private sector involvement in water resources management: PPP objectives, options, process and limitations-PPP case studies

References:

1. Negi S.S., "Integrated Watershed Management", Oriental Enterprises, 2001
2. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York, 2003.
3. Cap-Net, Tutorial on Basic Principles of Integrated Water Resources Management, Cap-Net, IRC, IWMI, HRWallingford, IUCN, WSS, UNDP (www.cap.net.org).
4. Integrated Water Resources Management Plans, Training Manual and Operational Guide, CIDA, 2005.

17CE3062 HYDROLOGY LABORATORY

Credits: 0:0:2

Course Objectives:

- To impart practical knowledge in hydrologic processes
- To help the students in understanding the practical implications of aquifer parameters
- To enable them to conduct field experiments

Course Outcomes

At the end of the course, the student will be able to

- gain better understanding of hydrologic processes
- make use of groundwater flow and transport models
- estimate the aquifer parameters

- analyse the subsurface characteristics
- conduct water balance studies
- carryout groundwater budget

Experiments:

1. Rainfall data collection by natural siphon recording type raingauge and determination of mass curve and hyetograph from obtained data
2. Determination of Φ - index by double ring type infiltrometer
3. Measurement of permeability
4. Determination of rate of evaporation
5. Pumping test on well
6. Theissen polygon method
7. Calculation of crop water requirement
8. Determination of soil particle size distribution for textural analysis
9. Determination of hydraulic conductivity
10. Determination of field density by sand replacement method
11. Electrical resistivity method

References:

1. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Wiley & Sons Inc., 2007.
4. Bear, J., "Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 2008
6. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 2010.

17CE3063 ADVANCED ENVIRONMENTAL ENGINEERING LABORATORY

Credits: 0:0:1

Course Objectives:

- To demonstrate the sampling techniques and analytical methods in assessing air and water quality in the laboratory
- To introduce the principles of instrumentation in air and water quality analysis
- To enable the students to conduct characterisation studies on solid waste

Course Outcomes

At the end of the course, the student will be able to

- collect the samples for analysis
- monitor and assess air and water quality of samples
- design suitable treatment method and control measures for water and air pollution problems
- analyse the pollution impact
- develop water and air quality index
- make use of instrumentation techniques

Experiments:

1. Determination of heavy metals in the sample using UV Spectrophotometer
2. Estimation of Total Organic Carbon
3. Determination of Chemical and Biological Oxygen Demand Microbial analysis
4. Synthesis of nanoparticles (1 experiment)
5. Solid Waste Analysis (Density, Components and Energy value)
6. Noise Measurement by using sound level meter
7. Determination of Air Quality by air sampler.

References:

1. "Standard Methods for the Examination of Water and Wastewater", 14th ed, American Public Health Association, Washington, DC, 1999.
2. http://cpcb.nic.in/upload/NewItems/NewItem_171_guidemanualw&wwanalysis.pdf.

3. CPHEEO, Manual on “Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India,” New Delhi, 2010.
4. C.N. Sawyer, P.L. MacCarty and G.F. Parkin, “Chemistry for Environmental Engineering and Science”, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.

17CE3064 GIS AND COMPUTATIONAL LABORATORY

Credits: 0:0:2

Course Objectives:

- To demonstrate the application of different components of GIS and computational techniques in environmental and water resources systems
- To impart soft computing skills
- To enable the students to apply statistical tools

Course Outcomes

At the end of the course, the student will be able to

- understand and analyse numerical solutions for linear and nonlinear systems
- apply GIS for temporal and spatial data acquisition and analysis
- develop forecasting and prediction
- estimate groundwater potential
- develop soft computing techniques for prediction and forecasting
- apply multivariate statistical methods

Experiments:

1. Computation of flow duration curve based on field data
2. Testing and validation of simple monthly rainfall-runoff model
3. Factor Analysis using SPSS
4. Prediction using Artificial Neural Network
5. Estimation of evapotranspiration using Penman-Monteith Method
6. DO fluctuation model in streams and rivers
7. Thematic Map creating using ArcGIS
8. Groundwater Quality Assessment using ArcGIS
9. Curve fitting using MATLAB
10. Correlation and regression analysis using MATLAB and SPSS

References:

1. Rastogi, A.K., “Numerical Groundwater Hydrology”, Penram International Publishing (India), 2006
2. John, E. G., “Introduction to Hydraulics and Hydrology with Applications for Stormwater Management”, DELMAR, Thomson Learning, USA, 2002.
3. Ian Heywood Sarah, Cornelius and Steve Carver, “An Introduction to Geographical Information Systems”, Pearson Education, New Delhi, 2002

17CE3065 REMOTE SENSING AND GIS

Credits: 3:0:0

Course Objectives:

- To familiarize the principles of Remote Sensing and GIS
- To demonstrate temporal and spatial data acquisition and analysis
- To impart knowledge in digital image processing

Course Outcomes

At the end of the course, the student will be able to

- understand the principles and components of Remote Sensing and GIS
- analyse and interpret satellite images using digital image processing
- create thematic maps for various applications
- implement overlay analysis for various environmental and water resources application
- create spatial and temporal variation maps
- apply GIS and RS tool in environmental and water resources projects

Unit I - REMOTE SENSING : Basic Concepts of remote sensing - Electromagnetic radiation (EMR), Interaction of EMR with atmosphere, earth surface, soil, water and vegetation - Remote sensing platforms – Monitoring atmosphere, land and water resources - LANDSAT, SPOT, ERS, IKONOS – Scanners, radiometers - Data types and format.

Unit II - DIGITAL IMAGE PROCESSING: Satellite Data analysis - Image interpretation: multi-spectral, multi temporal and multi-sensoral – Digital image processing – Image preprocessing – Image enhancement – Image classification – Data merging.

Unit III - GEOGRAPHIC INFORMATION SYSTEM: Definition – Components of GIS – Map projections and co-ordinate systems – Data structures: raster, vector – Spatial relationship – Topology – Integrated GIS database - Sources of error

Unit IV - SPATIAL ANALYSIS: Thematic mapping – Measurement in GIS: length, perimeter and areas – Query analysis – Reclassification – Buffering - Neighbourhood functions - Map overlay: vector and raster overlay – Spatial interpolation

Unit V - ENVIRONMENTAL AND WATER RESOURCES APPLICATIONS: Spatial data sources – GIS approach for water resources system – Thematic maps - Rainfall-runoff modeling – Groundwater potential mapping– Water quality modeling - Flood inundation mapping and modeling

References:

1. Lillesand T.M. and Kiefer, R.W., “Remote Sensing and Image interpretation”, VI edition of John Wiley & Sons-2000.
2. John R. Jensen, “Introductory Digital Image Processing: A Remote Sensing Perspective”, 2nd Edition, 1995.
3. John A. Richards, “Remote Sensing Digital Image Analysis”, Springer –Verlag, 1999.
4. Ian Heywood Sarah, Cornelius and Steve Carver, “An Introduction to Geographical Information Systems”, Pearson Education, New Delhi, 2002.
5. Charles Elachi and Jakob J. van Zyl, “Introduction to the Physics and Techniques of Remote Sensing”, Wiley Series in Remote Sensing and Image Processing, 2006

17CE3066 FUNDAMENTALS OF MATLAB PROGRAMMING

Credits: 3:0:0

Course Objectives:

- To introduce the elements and application of computer programming through MATLAB
- To impart knowledge about development of GUI
- To make the students familiarize about database management system

Course Outcomes

At the end of the course, the student will be able to

- understand the programming concepts in MATLAB
- develop MATLAB code for solving engineering problems
- analyse the engineering problems using various plots
- develop a Database Information System (DIS)
- create user defined functions using MATLAB commands
- develop GUI for various applications

Unit I - PROGRAMMING ENVIRONMENT: Computer algorithm - Pseudo-code - Flowchart – Introduction to programming logic and MATLAB interface- Data types: expressions, constants, variables -Assignment statement – Matrix operations – Arrays.

Unit II - CONTROL STATEMENTS: Flow control - Conditional statements: If, Else, Elseif - Repetition statements: While, For loop –Nested loops – Switch/ Case.

Unit III - FUNCTIONS AND SCRIPTS: Creating functions – Functions as arguments - Returning functions as values- M-files: script files, function files - Formatted console input-output – String handling - Writing to a text file - Reading from a text file - Randomising and sorting a list.

Unit IV - PLOTTING AND VISUALIZATION OF DATA: Basic plotting - Built in functions – 2D, 3D plots – Mesh and surface plots - Figures and subplots.

Unit V - GRAPHICAL USER INTERFACE: Attaching buttons to action – Handle graphics – Graphics objects – Properties of objects – Menu driven programs - Controls: uimenu and uicontrol.

References:

1. Holly M., "MATLAB for Engineers", Prentice Hall, 3rd Edition, 2012.
2. Rudra P., "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
3. Duane, C.H., "Mastering MATLAB", Pearson Education Inc., 2012
4. Amos, G., "MATLAB: An Introduction with Applications", 4th Edition, 2011

17CE3067 CLEANER PRODUCTION AND SUSTAINABLE DEVELOPMENT

Credits: 3:0:0

Course Objectives:

- To introduce the importance and different approaches of cleaner production in industries
- To impart knowledge on the process of pollution prevention and reduction along with operating costs reduction.
- To give exposure to methodology of cleaner production projects, methods of their implementing into industrial establishment.

Course Outcomes:

At the end of the course the student will be able to

- apply different approaches in clean production
- understand and choose the different principles of sustainable development
- implement green building concepts
- conduct material balance studies
- comment on the evolution of corporate environmental management strategies
- describe cleaner production measures
- conduct energy and waste audit

Unit I - SUSTAINABLE DEVELOPMENT: Indicators of Sustainability – Industrialization and sustainable development – Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus market based approaches.

Unit II - PRINCIPLES OF CLEANER PRODUCTION: Benefits, promotion & barriers – Environmental Management Hierarchy – Source Reduction Techniques – Process and equipment optimization.

Unit III - CLEANER PRODUCTION PROJECT DEVELOPMENT: Assessment Steps - Material Balance – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Preparing a Program Plan – Waste audit.

Unit IV - SUPPORT INSTRUMENTS OF PREVENTION METHODS: Life cycle analysis – Eco Labelling – International Environmental Standards – ISO 14001 – Green building & green energy concepts and management.

Unit V - CASE STUDIES: Industrial applications of CP, LCA, EMS and Environmental Audits, green energy and green process management.

References:

1. Paul L. Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill International, 2000.
2. Prasad modak C. Visvanathan and Mandar parasnis, "Cleaner Production Audit", Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.
3. World Bank Group, "Pollution Prevention and Abatement Handbook towards Cleaner Production", World Bank and UNEP, Washington D.C, 2005.

17CE3068 ELECTROCHEMICAL WATER PROCESSING AND WATER TREATMENT

Credits: 3:0:0

Course Objectives:

- To introduce the basic concepts of electrochemistry
- To help the students understand the electrochemical methods in wastewater treatment

- To familiarize the students with design concepts

Course Outcomes

At the end of the course the student will be able to

- understand the basic concepts of electrochemistry
- analyse the characteristics of the effluent and sludge produced
- design electrochemical reactor
- under the mechanism of electrodialysis for desalination
- apply electrochemical methods for heavy metal removal
- develop new electrodes for electrocoagulation and capacitive deionization

Unit I - BASIC ASPECTS OF ELECTROCHEMISTRY: Chemistry and electricity: Electro neutrality and potential differences at interfaces.-Electrochemical cells: Transport of charge within the cell- Conductivity of electrolyte solutions-Cell description conventions, - Electrodes and electrode reactions- Standard half-cell potentials and reference electrode- Faraday's laws of electrolysis.

Unit II - ELECTROCHEMICAL REACTORS DESIGN: Costing an electrolytic process- Figures of merit: Materials yield-Current efficiency- Percentage conversion- Product quality- Energy consumption- Space time yield- Electrolysis parameters- Principles of cell design: Typical cell designs- Tank cells and Flow cells - Monopolar and Bipolar cells

Unit III - BIOCIDING TECHNOLOGY AND ELECTROCHEMICAL METAL RECOVERY: Biociding technology: Electrolytic production of free halogens- Chlorination process description Bromination process description-Electrolytic generation of bromine and chlorine -Metal ion removal and metal recovery- Electrochemical process for the removal of iron in acid baths

Unit IV - ELECTRODIALYSIS (ED): Electrodialysis: Performance characteristics- General purpose electro-dialysis unit -ED units for specialized application, Demineralizer, Advantages of electrodialysis and general characteristics-Desalination system

Unit V - ELECTROCOAGULATION: Electrocoagulation in water treatment- Principle of Electrocoagulation- Reactions at the electrodes and solutions- Electrode passivation and activation - Comparison between Electrocoagulation and chemical coagulation. Typical designs of the EC Reactors : Factors affecting Electrocoagulation-

References:

1. Ralph Zito, "Electrochemical Water Processing", Wiley 2011.
2. Derek Pletcher, "Industrial Electrochemistry", Chapan and Hall Ltd 1982.
3. Stephen K. Lower, "Electrochemistry- Chemical reactions at an electrode, galvanic and electrolytic cells", 2004.
4. C. Comninellis and G. Chen, "Electrochemistry for the environment" Springer 2010.

17CE3069 ENVIRONMENTAL POLICIES AND LEGISLATION

Credits: 3:0:0

Course Objectives:

- To analyze the legislative and judicial responses to environmental problems
- To apply environment advocacy and approaches for using litigation in environment protection will receive special attention
- To expose to the administrative system of environment related laws such as air, water, land, and hazardous substances etc.

Course Outcomes

At the end of the course the student will be able to

- recall different policies and rules framed for the environmental protection
- recognize the formation of boards at different levels
- discuss the functions of Central Pollution Board and the State Pollution Boards.
- know about different duties of pollution control boards
- assess about the actions taken by government for the violation of rules
- enumerate about the prevention of advanced pollution

Unit I - WATER ACT: Constitution, functions and powers of central and state boards – Prevention and control of water pollution, Penalties – Prevention and control of pollution rules - Annual report.

Unit II - AIR ACT: Constitution, functions and powers of central and state boards – Prevention and control of air pollution, Penalties – Prevention and control of pollution rules - Annual report.

Unit III - ENVIRONMENTAL (PROTECTION) ACT: General powers of the Central Govt., Prevention, Control and abatement of environmental pollution – Rules- recipient system – Standards for emission – Prohibition and restriction on location of industries – Furnishing information to authorities and agencies, prohibition and restriction on handling hazardous substances.

Unit IV - HAZARDOUS WASTES (MANAGEMENT AND HANDLING) RULES: Transboundary movement – Responsibility of the occupier, grant of authorization, power to respond or cancel, packaging, labeling, transport, disposal or import, Accident reporting, appeal. Rules for Manufacture, storage – Mitigation of the major accident, safety reports-Preparation of on- site and off -site emergency plans

Unit V - OTHER RULES AND REGULATIONS: The Bio-medical waste (Management and handling) rules - ozone depleting substances (Regulations & Control) rules – The recycled plastics manufacture and usage rules - Noise pollution rules.

References:

1. C P Kaushik, Anubha Kaushik, “Perspectives in Environmental Studies”, 4th edition, New Age International Publishers Ltd.-New Delhi, 2006
2. Layzer, J. “The Environmental Case: Translating Values into Policy”, 3rd edition, CQ Press, 2012.
3. Vig, N. J. and Kraft, M. E. “Environmental Policy: New Directions for the Twenty-First Century”, 8th edition, CQ Press, 2013.

17CE3070 NOISE POLLUTION AND CONTROL TECHNIQUES

Credits: 3:0:0

Course Objectives

- To learn the fundamental concepts in the field of noise pollution and control.
- To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution.
- To impart knowledge on measurement and analysis of noise.

Course Outcomes:

At the end of the course, the student will be able to

- identify the nature and characteristics of noise pollution
- analyze the noise pollution problems
- detect the various effects of noise pollution
- apply suitable preventive measures
- identify the technologies and methods to control of noise
- choose suitable noise adsorbent materials
- gain knowledge about the various noise pollution regulations

Unit I - SOURCES OF NOISE POLLUTION: Sources - Types - Units and Measurements of Noise – Standards.

Unit II - CHARACTERIZATION OF NOISE POLLUTION: Characterization of Noise – Control Measures – Outdoor and indoor noise propagation - Effects of noise pollution - Noise Pollution Analyzers.

Unit III - PREVENTION & CONTROL OF NOISE POLLUTION: Fundamental Definitions – Prevention and Control of Noise Pollution – Control of noise - Annoyance rating schemes - Sound Absorbent materials – Auditorium Designing – Anti Noise Device.

Unit IV - ACOUSTICS OF NOISE: Industrial Noise Control – Special noise environments - Noise indices - OSHA Noise standards – Public education – other non-legislative measures.

Unit V - REGULATORY ASPECTS OF NOISE POLLUTION: Legislation and Administrative Function – The Rajasthan noise control Act 1963, Railway Act 1890 (Related to noise only), The Aircraft Act 1934 (Related to noise only), Factories Act 1948 (Related to noise only), The Environmental Protection Act 1986 – Noise pollution remedies.

References:

1. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 2009.
2. Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs New Jersey, latest edition
3. Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, 1987

17CE3071 OCCUPATIONAL HEALTH AND SAFETY**Credits: 3:0:0****Course Objectives:**

- To impart knowledge about the occupational hazards, industrial safety issues, control measures and emergency procedures.
- To assist the student in implementing the safe healthy practices in workplace.
- To review methods and controls in order to evaluate occupational safety and health.

Course Outcomes:

At the end of the course, the student will be able to

- identify hazards in workplace
- analyse the industrial toxicology
- understand the significance of health and safety in the workplace
- propose methods to eliminate the hazard
- understand the emergency procedures and safety law
- implement safe work practices

Unit I - INDUSTRIAL CONTAMINANTS AND HEALTH HAZARDS: Theory of accidents - Industrial atmospheric contaminants – Industrial Health Hazards – Asbestos hazards – Hazard reorganization, evaluation and control.

Unit II - INDUSTRIAL TOXICOLOGY AND INDUSTRIAL HYGIENE SURVEY: Hazards in workplace- Modes of entry of toxic substances into the human body - Industrial toxicology – Cleaning chemical spills - Threshold Limit Values - Industrial Hygiene Survey – Diagnosis – Remedial measures – Occupational Health and Safety Management System (OHSMS) - BS OSHAS 18001.

Unit III - INDUSTRIAL VENTILATION: Industrial Ventilation - general principles of air flow - general dilution ventilation - comfort ventilation. Local exhaust ventilation - principles of hood and duct design - duct system design - fans.

Unit IV - CONTROL MEASURES: Air cleaning Devices - relative efficiencies - Testing of local exhaust ventilation systems - Industrial Noise Control - general engineering principles of control standards – Rationale for health and safety training – Ergonomics – Emergency preparedness.

Unit V - INDUSTRIAL ILLUMINATION AND INDUSTRIAL PLANT SANITATION: Industrial illumination - glare – types & levels of illumination. Industrial plant sanitation - housekeeping - worker facilities

References:

1. Industrial Ventilation Manual, American Conference of Government Industrial Hygienists, 1993
2. Friend, Mark A.; Kohn, John P.. "Fundamentals of Occupational Safety and Health", 6th edition. 2010
3. Occupational Health and Safety Management: A Practical Approach, Second Edition, 2008

17CE3072 ENVIRONMENTAL NANOTECHNOLOGY**Credits: 3:0:0****Course Objectives:**

- To introduce nanotechnology and nanoscience
- To demonstrate various techniques for synthesis of nanomaterials
- To make students know about the novel developments of nanotechnology in environmental applications.

Course Outcomes:

At the end of the course, the student will be able to

- understand the principles of nanotechnology
- synthesis different types of nanoparticles for various applications

- conduct characterisation studies of nanomaterials
- develop nanosensors
- analyse the impact of nanomaterials on environment
- design efficient and effective treatment method

Unit I - INTRODUCTION AND SYNTHESIS OF NANOMATERIALS: History –Overview of existing application of nanomaterials in water and wastewater treatment;; Synthesis of nanomaterials: magnetic nanoparticles, Carbonaceous nanoparticles; nanocomposites; clay supported nanoparticles, aerogels- Methods of synthesis: Sol-Gel method, microemulsion method, electrospinning method, plasma technique, Chemical Vapour Deposition (CVD)

Unit II - METHODS FOR STRUCTURAL AND CHEMICAL CHARACTERIZATION OF NANOMATERIALS: Separation techniques- Morphology studies: scanning electron microscopy (SEM) - Surface charge and optical properties of nanoparticles: zeta potential, UV-Vis spectrometry-Elemental composition of single nanoparticles using EDAX, elemental composition of bulk nanoparticles-X-ray diffraction (XRD) - FTIR

Unit III - MEMBRANE PROCESSES: Overview of membrane technology- Types of membrane filtration, microfiltration, ultra filtration, nanofiltration, reverse osmosis – Transport principles-Membrane fabrication and characterization- Nanoparticle membrane reactor

Unit IV - NANOMATERIALS AS ADSORBENTS AND OXIDANTS: Metals oxides (Titanium oxides, Iron oxides, Copper, Zinc) – Carbon nanoadsorbents: CNTs (single and multiwaled), Fullerenes- Molecularly imprinted polymers for removal of micropollutants- Advanced Oxidation Process: Photocatalytic oxidation, Fenton process

Unit V - FATE AND TOXICITY OF NANOPARTICLES AND NANOMATERIALS: Processes determining the fate of NMs /NPs in environment: aggregation, reaction, adsorption, deposition; ecotoxicity of NMs/NPs;- Effect on human health and environment- Introduction to nanosensors

References:

1. Lens P., Virkutyte J., Jegatheesan V., and Al-Abed S., “Nanotechnology for Water and Wastewater Treatment”, IWA Publishing, 2013
2. Ajay Kumar Mishra, “Application of Nanotechnology in Water Research”, Scrivener Publishing LLC. 2014
3. Eugene T, Michele De Kwaadsteniest, “Nanotechnology in Water Treatment Applications”, Caister Academic Press, 2010
4. Handbook of Nanotechnology, Edi-Bharat Bhushan, Springer, 2004.

17CE3073 ISOTOPE HYDROLOGY

Credits: 3:0:0

Course Objectives:

- To introduce fundamentals of isotope hydrology
- To demonstrate the application of this tool to solve simple practical problems in hydrology and water resources engineering
- To familiarize the students in instrumental techniques

Course Outcomes

At the end of the course, the student will be able to

- understand the chemistry involved in isotope hydrology
- apply the isotope fractionation concept in hydrological processes
- understand different instrument techniques involved in analyzing isotopes
- estimate isotope footprints of water samples from various sources
- conduct mass balance studies using stable isotopes
- apply environmental isotopes in identifying the recharge sources, pollution source

Unit I - INTRODUCTION TO ISOTOPES: Introduction: elements, nuclides, isotopes- Isotopes and their characteristics- Natural abundance of radioactive and environment isotopes- Isotope fractionation.

Unit II - ISOTOPE MEASUREMENT TECHNIQUES: Standards and measurement techniques- -Mass spectrometric sampling and analysis of stable isotopes.

Unit III - TRACING THE HYDROLOGIC CYCLE: Meteoric Water Line (MWL) -Partitioning of isotopes in the hydrologic cycle- Deuterium excess and source identification-Condensation/precipitation- Rayleigh distillation-Evaporation.

Unit IV - ISOTOPE APPLICATIONS IN SURFACE WATER HYDROLOGY: Stream flow measurement – Lake dynamics – Water balance: groundwater inflow and outflow estimates – Estimation of lake sedimentation rates – Seepage from dams and reservoirs – Seepage from canals - Percolation tank hydrology.

Unit V - ISOTOPE APPLICATIONS IN GROUNDWATER HYDROLOGY: Determination of groundwater velocity in saturated zone -Identification of recharge processes – Seawater intrusion - Migration of pollutants.

References:

1. Rao, S.M., “Practical Isotope Hydrology”, New India Publishing Agency, 2006.
2. Mook W.G. (Editor), “Environmental Isotopes in Hydrological Cycle, Principles and Applications”, IHP-V, Technical Documents in Hydrology, No 39, Vol 1, UNESCO, Paris, 2000.
3. “Use of Artificial Tracers in Hydrology”, Proc. Adv. Group Meeting, Vienna, IAEA, 1990.
4. Kendall, C.,and McDonnell J.J., “Isotopes in Catchment Hydrology”, Elsevier, 1998.

17CE3074 HYDRO POWER ENGINEERING

Credits 3:0:0

Course Objectives:

- To understand the working principles of different power plants
- To design power canals, silting basin, types of dams
- To explain about transmission system, financial implications etc.,

Course Outcomes

At the end of the course, the student will be able to

- estimate the hydropower potential
- analyse the financial implications and maintenance of hydropower systems
- design various components of hydropower system
- understand the construction details of a hydropower plant
- analyse the implication of hydropower plant in water demand and evaluation
- design silting basin

Unit I - INTRODUCTION: development of water power; estimation of hydropower potential; comparison of hydro, thermal and nuclear power; firm power; secondary power; load and load duration curves; load factor etc.

Unit II - TYPES OF HYDROPOWER PLANTS: classification of hydropower plants; run-of-river plants; valley dam plants, high head diversion plants, diversion canal plants, pumped storage plants, tidal power plants.

Unit III - WATER CONVEYANCE SYSTEM: power canals; alignment; design of power canals; flumes; covered conduits and tunnels; drainage and ventilation in tunnels.

Unit IV - PENSTOCKS: alignment; types of penstocks; anchor blocks; spillways: types; spillway gates; design of stilling basins. types of turbines and their utility;

Unit V - POWER HOUSE: Fore bay; intakes, balancing reservoir; escape; surge shafts/ inclined shafts; underground power stations; general transmission system: general introduction; basic principles of design and construction; financial implications of hydropower plants; maintenance of hydro power plant.

References:

1. Birdie, “Irrigation Engineering (including Water Power Engineering)” – Dhanpat Rai Publishing Company, New Delhi – 110002, 2012.
2. Dr. P.N. Modi, “Irrigation Water Resources and Water Power Engineering”, Standard Book House-Rajsons Publication Private Limited, New Delhi- 110002, 2012.
3. Santosh Kumar Garg, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, Delhi – 110 006 – 28th Revised Edition – 2014.
4. Nigam P.S., Handbook of Hydroelectric Engineering, Nem Chand Publisher, 1985
5. Warnick, C.C., “Hydropower Engineering”, Prentice Hall, 1984.
6. Manual on planning and design of small hydroelectric scheme, publication no. 280, Central Board of Irrigation and Power, 2001.

7. “Guidelines for Hydraulic Design of Small Hydro Plants”, Alternate Hydro Energy Research Centre, 2011.

17CE3075 RIVER MECHANICS AND SEDIMENT TRANSPORT

Credits: 3:0:0

Course Objectives:

- To introduce the concepts of flow through rivers and the theoretical and empirical formulation of energy and momentum principles
- To demonstrate the sediment transport in terms of first principles
- To enable the students understand the causes of river channel change and river training

Course Outcomes

At the end of the course, the student will be able to

- identify the various types of flow and their profile
- analyze the transport of sediments
- estimate the sediment load
- develop strategies for sediment routing
- analyse the impact of erosion, deposition and sedimentation on flow
- design a sedimentation basin

Unit I - BASIC CONCEPTS AND EQUATIONS: Basic mathematical concepts: fluid continuum, fluid element – Kinematics and dynamics – Continuity equations: Equations based on conservation of momentum and energy: mechanical potential energy and kinetic energy

Unit II - VARIED FLOWS: Free surface flow, uniform flow, gradually varied flow - Flow profiles - Prismatic channels energy and momentum principles- Flow measurements: weirs, flumes -Basic equations of various flows, velocity of flood wave discharge, flood routing,

Unit III - ORIGIN AND PROPERTIES OF SEDIMENTS: Incipient movement of sediments -Shields analysis, bed formation and flow regimes- Sampling and measurement techniques of sediment load - Forms of sediment transport- Estimation of bed load transport

Unit IV - SEDIMENT ENTRAINMENT AND TRANSPORT: Geomorphological concepts: load-discharge relations, sediment yield and denudation rate – Forces on sediment particles – Sediment transport: Shield’s diagram, Hjulstrom curves –sediment transport and bed forms- Settling, deposition, consolidation, attrition, erosion, Rouse profile

Unit V - RESERVOIR SEDIMENTATION,: aggradations and degradation - Design of stable channels, river training methods, bank protection - Groynes or spurs, deflectors, cut off - Sedimentation basin

References:

1. Garde, R.J. and Ranga Raju, K.G. “Mechanics of Sediment Transport and Alluvial Stream Problems”, New Age International (P) Ltd. Publications, New Delhi, 2006.
2. Subramanya, K, “Open channel flow”, Tata McGraw Hill, 3rd Edition, 2010.
3. Yang, C.T. “Sediment transport theory and Practice”, McGraw-Hill, New York, 1996.
4. Graf, W.H. “Hydraulics of sediment transport”, McGraw-Hill, New York, 1971.
5. Garde, R.J. “History of Fluvial Hydraulics”, New Age International (P) Ltd. Publishers, New Delhi, 1995.
6. Garde, R.J. “River Morphology”, New Age International (P) Ltd. Publishers, New Delhi, 2006.

17CE3076 FUNDAMENTALS OF COASTAL ENGINEERING

Credits: 3:0:0

Course Objectives:

- To introduce the basics of coastal engineering
- To enable students to understand coastal management problems
- To impart knowledge on coastal protection structures

Course Outcomes

At the end of the course, the student will be able to

- understand the principles of wave theory and hydrodynamics in coastal engineering management
- analyse and predict different types of waves

- design basic harbour structures
- analyse the coastal morphology
- conduct coastal erosion studies
- design coastal protection structure

Unit I - COASTAL GEOMORPHOLOGY: introduction to winds, waves and maritime structures; classification of waves; formation of waves;

Unit II - WAVE THEORIES: Linear wave theory -Cnoidal theory- SMB and energy based methods of wave prediction- Wave reflection- Wave refraction; Wave diffraction- coastal erosion and accretion processes- Wave run-up and overtopping

Unit III - COASTAL PROTECTION STRUCTURES: breakwaters and sea walls; consideration of hydrodynamics in the design of harbour structures- Harbour protection works- Wave forces on coastal structures- Breakwaters- Classification, Design and application in coastal protection and harbor planning

Unit IV - COASTAL EROSION: Planning and methods of coast protection works - Design of shore defense structures-Coastal Features - Beach Features - Beach cycles - Beach Stability - Beach profiles

Unit V - CASE STUDIES: case studies of Cochin, Chennai, Vishakhapatnam harbours; Case studies on erosion and accretion – Malabar and Coromandel coasts.

References:

1. Robert M. Sorensen, “Basic Coastal Engineering”, 2nd edition, Springer Science+ Business Media, Inc, 1997.
2. A. Vallega, “Fundamentals of Integrated Coastal Management”, Kluwer Academic Publishers, Netherlands, 1999.
3. Timothy Beatley, David Brower, Anna K. Schwab, “An Introduction to Coastal Zone Management”, 2nd edition, Island Press, 2002.
4. J. W. Kamphuis, “Introduction to Coastal Engineering and Management”, 2nd edition, World Scientific Publishing Co. Pte.Ltd.,2010
5. A. M Muir Wood, “Coastal hydraulics”.New York, Gordon and Breach, 1969.
6. Dominic Reeve, Andrew Chadwick, Christopher Fleming, “Coastal Engineering: Processes, Theory and Design Practice”, Spon press, 2004.
7. Shore Protection Manual Vol 1, Coastal Engineering Research Centre, Department of the Army, Wachrieays Experiment Station, Corps of Engineering, Wichsbarg, Mississippi, the US, 1984.

17CE3077 FOREST, URBAN AND AGRICULTURAL WATERSHED MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To impart knowledge on underlying hydrologic processes associated with the flow of water through forested watersheds
- To give exposure about nutrient budget and agricultural management practices
- To familiarize the students with water conservation techniques in a watershed

Course Outcomes

At the end of the course, the student will be able to

- understand the hydrologic principles in forest, urban and agricultural management
- apply the techniques for soil erosion control, flood management and storm management
- develop an integrated watershed management plan
- calculate nutrient budget for a watershed
- develop stormwater management strategy for a watershed
- apply water conservation techniques in green buildings

Unit I - INTRODUCTION TO WATERSHED: Watershed development: definition and concepts, objectives and need- Integrated and multidisciplinary approach for watershed management- Characteristics of watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils - Watershed delineation.

Unit II - FOREST WATERSHED MANAGEMENT: Influence of forests on hydrologic processes - Causes of deterioration of watershed -Forests and water yield/lowflows - Forests and peakflows – Deforestation and accelerated erosion – Forests and snow.

Unit III - AGRICULTURAL WATERSHED MANAGEMENT: Global agricultural trends – Agricultural impacts on soil and water: non-point source pollution, erosion and sediment, drainage, storage and irrigation - Nutrient budget – Soil and water conservation – Watershed development projects – Indicators – Monitoring and evaluation.

Unit IV - URBAN WATERSHED MANAGEMENT: IMPACTS OF URBANIZATION ON HYDROLOGY: Urban site design – Landuse planning and conservation – Stormwater management- Flooding and floodplain management – Urban water supply – Water and green buildings.

Unit V - CASE STUDIES: Case study on forest hydrology of Western Ghats (MoEF) – Case study on cultivated watersheds (DST/CWRDM/JICA) – Case study on urban watershed (DST/UNDP/MATURE)

References:

1. Murthy, J.V.S., “Watershed Management”, New Age International Publishers, 1998.
2. Martin, M.K., Daniel T.R., and Kent, S.M., “Urban Watersheds: Geology, Contamination, and Sustainable Development”, CRC press, Taylor & Francis Group, 2011.
3. Bernier, P.Y., Woodard, P.D., “Forest Hydrology and Watershed Management”, IAHS Press, 1987,
4. Ghanshyam D., “Hydrology and Soil Conservation Engineering”, Prentice-Hall of India Pvt. Ltd., New Delhi. 2000.
5. Das Madan Mohan and Saikia Mimi Das, “Watershed Management”, PHI publishers, 2012.
6. Kenneth N. Brooks, Peter F.Folliott, Joseph A. Magner, “Hydrology and the Management of Watershed”, John Wiley & Sons, 2012.

17CE3078 WETLAND HYDROLOGY

Credits: 3:0:0

Course Objectives:

- To impart knowledge on hydrology of wetland ecosystems
- To introduce the students to the management and conservation of wetlands
- To impart the concepts of wise use of wetlands

Course Outcomes

At the end of the course, the student will be able to

- understand different aspects of wetland management
- conduct water balance studies in wetland
- apply the hydrological principles in wetland management
- estimate the exchange processes in coastal wetlands
- model sediment dynamics in wetland conservation
- develop suitable wetland management strategy in catchment and coastal hydrology

Unit I - DEFINITION OF WETLAND: classification of wetlands; wetlands types according to Ramsar Bureau; hydrologic features of aquatic ecosystems, terrestrial ecosystems and wetland ecosystem

Unit II - HYDROLOGY OF WETLANDS: hydroperiod-signature of a wetland; water balance of wetland, residence time, turnover time; conceptual model showing relationship between hydrologic, chemical and biological processes; chemical cycles in wetlands

Unit III - WATER MANAGEMENT AND CONSERVATION VALUES OF WETLANDS: recharging, flood containing, water purification, agriculture, aquatic tourism, drinking water, inland navigation, fisheries, biodiversity;

Unit IV - WISE USE OF WETLANDS: Integrated river basin management in relation to wise use of wetlands; sustainability concept in relation to wetland management

Unit V - ESTIMATION OF EXCHANGE PROCESSES: Exchange processes in estuaries-modified tidal prism method, coefficient of eddy diffusivity, flushing time; sediment dynamics; case studies: impact of manmade structures on downstream wetlands, Success stories in wetland conservation- Chilika and Loktak.

Reference:

1. William J. Mitsch, James G. Gosselink, “Wetlands”, John Wiley & Sons. Copyright. Inc, 2007.

2. W.J. Mitsch, M. Straškraba, S.E. Jorgensen, “Wetland Modelling”, Elsevier Science Publishers B.V, 1988.
3. Deanne Hickey, “The Role of Wetland Hydrology on Vegetative Structure in a Coastal Wetland Environment”, University of Sydney, 2009.
4. Jos T.A. Verhoeven, Boudewijn Beltman, Roland Bobbink, Dennis F. Whigham., “Wetlands and Natural Resource Management”, Springer-Verlag Berlin Heidelberg, 2006.

KITS

LIST OF COURSES

Sl. No.	Course Code	Name of the Course	Credits
1	15CE2004	Fluid Mechanics and Machinery Laboratory	0:0:1
2	15CE2005	Strength of Materials Laboratory	0:0:1
3	15CE3024	Cement and Concrete Chemistry	3:0:0
4	15CE3025	Seismic Design of Steel Structures	3:0:0
5	16CE1001	Evolution of Civil Infrastructure	3:0:0
6	16CE2001	Intelligent Buildings	3:0:0
7	16CE2002	Building Acoustics	3:0:0
8	16CE2003	Prestressed Concrete Structures	3:0:0
9	16CE2004	Strength of Materials and Fluid Mechanics & Machinery Laboratory	0:0:2
10	16CE3001	Applied Environmental Chemistry and Microbiology	3:0:0
11	16CE3002	Atmospheric Environmental Pollution and Control	3:0:0
12	16CE3003	Solid and Hazardous Waste Management	3:0:0
13	16CE3004	Elements of Hydrology	3:0:0
14	16CE3005	Design of hydraulic and conveyance structures	3:0:0
15	16CE3006	Water Resources Planning and Systems Engineering	3:0:0
16	16CE3007	Advanced Environmental Engineering Laboratory	0:0:2
17	16CE3008	GIS and Computational Laboratory	0:0:2
18	16CE3009	Cleaner Production and Sustainable Development	3:0:0
19	16CE3010	Environmental Geotechnology	3:0:0
20	16CE3011	Environmental Policies and Legislation	3:0:0
21	16CE3012	Noise Pollution and Control Techniques	3:0:0
22	16CE3013	Occupational Health and Safety	3:0:0
23	16CE3014	Nanotechnology for Water and Wastewater Treatment	3:0:0
24	16CE3015	Hydro Power Engineering	3:0:0
25	16CE3016	River Mechanics and Sediment Transport	3:0:0
26	16CE3017	Advanced Design of Precast Concrete Structures	3:0:0
27	16CE3018	Design of Prestressed Concrete Structures	3:0:0
28	16CE3019	Maintenance and Rehabilitation of Structures	3:0:0
29	16CE3020	Introduction to Structural Health Monitoring	3:0:0
REVISED VERSION COURSES			
Course Code	Version	Name of the Course	Credits
14CE1001	1.1	Basic Civil Engineering	3:0:0
14CE2001	1.1	Survey	3:0:0
14CE2002	1.1	Mechanics of Solids	3:1:0
14CE2003	1.1	Mechanics of Fluids	3:1:0
14CE2004	1.1	Building Materials and Geology	3:0:0
14CE2005	1.1	Applied Hydraulics and Hydraulic Machinery	3:0:0
14CE2006	1.1	Strength of Materials	3:1:0
14CE2007	1.1	Soil Mechanics	3:0:0
14CE2008	1.1	Water and Waste water Engineering	3:0:0
14CE2009	1.1	Reinforced Concrete Structures	3:0:0
14CE2010	1.1	Structural Analysis	3:1:0

14CE2011	1.1	Water Resources Engineering	3:0:0
14CE2012	1.1	Foundation Engineering	3:0:0
14CE2013	1.1	Design of Steel Structures	3:0:0
14CE2014	1.1	Transportation Engineering	3:0:0
14CE2015	1.1	Construction Technology	3:0:0
14CE2016	1.1	Strength of Materials Lab	0:0:2
14CE2017	1.1	Fluid Mechanics and Machinery Lab	0:0:2
14CE2018	1.1	Survey Lab	0:0:2
14CE2019	1.1	Building Drawing Lab	0:0:2
14CE2020	1.1	Geotechnical Engineering Lab	0:0:2
14CE2021	1.1	Environmental Engineering Lab	0:0:2
14CE2022	1.1	Concrete and Highway Lab	0:0:2
14CE2023	1.1	Computer Application Lab	0:0:2
14CE2024	1.1	Design and Drawing (RCC & Steel) Lab	0:0:2
14CE2025	1.1	Estimation and Costing	0:0:2
14CE2026	1.1	Design and Drawing (Irrigation and Environment) Lab	0:0:2
14CE2027	1.1	Engineering Practices Lab	0:0:1
14CE2028	1.1	Construction Management	3:0:0
14CE2029	1.1	Advanced Reinforced Concrete Structure	3:0:0
14CE2030	1.1	Advanced Structural Analysis	3:0:0
14CE2031	1.1	Concrete Technology	3:0:0
14CE2032	1.1	Basics of Dynamics and Aseismic Design	3:0:0
14CE2033	1.1	Building Services	3:0:0
14CE2034	1.1	Advanced Structural Engineering Lab	0:0:1
14CE2035	1.1	Advanced Computer Application Lab	0:0:2
14CE2036	1.1	Prefabricated structures	3:0:0
14CE2037	1.1	Advanced Design of Steel Structures	3:0:0
14CE2038	1.1	Industrial Waste Treatment and Disposal	3:0:0
14CE2039	1.1	Solid waste Management	3:0:0
14CE2040	1.1	Environmental Chemistry and Micro-Biology	3:0:0
14CE2041	1.1	Air Pollution Management	3:0:0
14CE2042	1.1	Global Climate Change and its Impact	3:0:0
14CE2043	1.1	Disaster Management and Mitigation	3:0:0
14CE2044	1.1	Advanced Environmental Engineering Lab	0:0:2
14CE2045	1.1	GIS Lab	0:0:1
14CE2046	1.1	Smart Materials and Structures	3:0:0
14CE3001	1.1	Applied Elasticity and Plasticity	3:0:0
14CE3002	1.1	Advanced Concrete Technology	3:0:0
14CE3003	1.1	Structural Optimization	3:0:0
14CE3004	1.1	Advanced Design of Reinforced Concrete Structures	3:0:0
14CE3005	1.1	Structural Dynamics	3:0:0
14CE3006	1.1	Finite Element Methods in Engineering	3:0:0
14CE3007	1.1	Seismic Design of Structures	3:0:0
14CE3008	1.1	Experimental Techniques and Instrumentation	3:0:0
14CE3009	1.1	Advanced Design of Metal Structures	3:0:0
14CE3010	1.1	Advanced Bridge Engineering	3:0:0
14CE3011	1.1	Computer Aided Design Laboratory	0:0:1
14CE3012	1.1	Advanced Structural Testing Laboratory	0:0:1
14CE3013	1.1	Design of Structures for Dynamic load	3:0:0

14CE3014	1.1	Design of Space Structures	3:0:0
14CE3015	1.1	Design of Tall Buildings	3:0:0
14CE3016	1.1	Design of Offshore Structures	3:0:0
14CE3017	1.1	Geotechnical Earthquake Engineering	3:0:0
14CE3018	1.1	Design of Substructures	3:0:0
14CE3019	1.1	Design of Composite Structures	3:0:0
14CE3020	1.1	Stability of Structures	3:0:0
14CE3021	1.1	Prestressed Concrete Structures	3:0:0
14CE3022	1.1	Industrial Structures	3:0:0
14CE3023	1.1	Advanced Design of Prefabricated Structures	3:0:0
14CE3024	1.1	Analysis and Design of Plates and Shells	3:0:0
14CE3025	1.1	Energy Efficient Buildings	3:0:0
14CE3026	1.1	Introduction to IWRM	3:0:0
14CE3034	1.1	Fundamentals of MATLAB Programming	3:0:0
14CE3036	1.1	Hydrology Practicals	0:0:2
14CE3038	1.1	Environmental Impact Assessment	3:0:0
14CE3039	1.1	Isotope Techniques in Water Resource Management	3:0:0
14CE3040	1.1	Water and Wastewater Treatment	3:0:0
14CE3044	1.1	Remote Sensing and GIS	3:0:0
14CE3045	1.1	Forest, Urban and Agricultural Watershed Management	3:0:0
14CE3048	1.1	Electrochemical Water Processing and Water Treatment	3:0:0
14CE3053	1.1	Wetland Hydrology	3:0:0
14CE3054	1.1	Fundamentals of Coastal Engineering	3:0:0

15CE2004 - FLUID MECHANICS AND MACHINERY LABORATORY

Credits: 0:0:1

Co-requisite: 14CE2003 - Mechanics of Fluids

Course Objective:

- To give hands on training on the principle and working of different types of turbines
- To impart knowledge on open channel flow profiles

Course Outcome:

At the end of the course students will be able to

- Identify various forms of flows and flow measurement
- Select and operate pumps and turbines

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Modi, P.N and Seth, S.M., "Fluid Mechanics & Fluid Machines", Standard Book House, New Delhi, 2007.
2. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 2002.

15CE2005 – STRENGTH OF MATERIALS LABORATORY

Credits: 0:0:1

Co-requisite: 14CE2002 - Mechanics of Solids

Course Objective:

- To apply the theory of mechanics of solids on real specimens
- To give hands on training on testing of real specimens

Course Outcome:

At the end of the course the student will be able to

- Demonstrate the application of theories
- Determine various strength of the materials by experiments

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Jindal, U.C, “Strength of Materials”, Asian Books Pvt. Ltd, 2007.

15CE3024 - CEMENT AND CONCRETE CHEMISTRY

Credits 3:0:0

Course Objective:

- To study the properties of cement paste
- To impart knowledge in the behaviour of the microstructure of concrete

Course Outcome:

At the end of the course the student will be able to

- Understand the microstructure and strength of cement paste
- Analyse the properties of cement paste and concrete
- Assess the hydration of cement with mineral admixtures

Description:

Principles of Cement Classification - Different Phase Systems of Cement Chemistry ($\text{CaO-SiO}_2\text{-Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$) system - Phase Composition of Portland Cements - Effect of constituents of cement on Hydration – Properties of Cement Paste - Rheological Properties of Concrete - Relationship Between the Microstructure and Strength of Cement Paste - Volume Changes of the Plastic Paste - Permeability of Paste - Interfacial Transition Zone (ITZ)- Chemical Structure of C-S-H Phases- Ettringite Formation- Effect of carbonation - Corrosion of Concrete in Cl_2 solutions - Bond characteristics – Microstructure of the Aggregate phase - Mineral Admixtures for Cement Production and its Properties – Application of XRD, SEM, EDAX, TEM, FTIR in concrete microstructure studies.

References:

1. Kurdowski & Wieslaw, “Cement and Concrete Chemistry” Springer Publications 2014.
2. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, 2005.
3. Santhakumar A.R, “Concrete Technology” Oxford University press, New Delhi, 2006.

15CE3025 - SEISMIC DESIGN OF STEEL STRUCTURES

Credits 3:0:0

Course Objective:

- To understand the basic concepts of seismic design of structures
- To learn the basics of behavior of bracing systems
- To study the dynamic behavior of steel structures

Course Outcome:

At the end of the course the student will be able to

- Design the steel structures for earthquake forces
- Choose suitable system to resist dynamic loads
- Improve the existing structures for earth quake forces

Description:

Steel Material Properties and Design-Behavioral characteristics – Ductility under cyclic loading – Hysteresis. Behavior of Bracing Systems - Cantilever and portal methods of analysis – Concepts of drift assessment and Design of framed structures – Post yield deflection consideration-Dynamic Behavior of Steel Building – Ductile Moment Resisting frames. Use of response spectra- Post Yield behavior – Connection design. New generation steel structures- Improving existing structures - Dog bone systems - Buckling restrained braces -Buckling inhibited shear panels –Retrofitting - Solution for connections.

References:

1. Robert E. Englekirk, “Controlling Behaviour Through Design”, John Wiley & Sons,1994.
2. Victor Gionc and Federico Mazzolani, “Seismic Design of Steel Structures”, CRC Press,2013.
3. Michel Bruneau, Chia-Ming Uang , and Rafael Sabelli S.E. , “Ductile Design of Steel Structures”, 2nd Edition,McGraw Hill Professional Publishers,2011.
4. IS1893: 2002 Criteria for Earthquake Resistant Design of Structures

16CE1001 EVOLUTION OF CIVIL INFRASTRUCTURE

Credits: 3:0:0

Course objectives:

- To enlighten the students with the various construction practices over the years
- To impart knowledge on the various materials used in the ancient and modern construction
- To enable the students to appraise on the scope of infrastructure development for the next generation

Course Outcomes

At the end of the course the student will be able to

- Demonstrate the various construction practices during various ages
- Classify the materials used for construction with respect to technology development
- Discover the technology of the Civil Engineering construction marvels
- Formulate technology for present / future construction for the individual and the society

Description

From Neolithic construction to sky scrapers- Evolution of building materials, construction methods and technology – Planning of a building - Structural and utility components of building - Construction practices in the present scenario: Pre-engineered buildings, fast track construction, Automation in

buildings, Green concepts in buildings - Intelligent transportation system: Roads, Railways, Airports and Harbours – Water retaining structures – Case studies on failure of structures.

References:

1. Palanichamy, M. S., “Basic Civil Engineering”, Tata McGraw Hill Publishing Co. Limited, New Delhi, 2008.
2. Ramesh Babu V., ‘Basic Civil Engineering’, Anuradha Agencies, Kumbakonam, 2001
3. Devadass. C.S.C., Jemimah Carmichael. M and Sheeba Ebenezer. J., “Basic Civil Engineering”, Shristi Publishers, Coimbatore, 2004.
4. Emani Siva Nagi Reddy, "Evolution of Building Technology: Early and medieveel in Andhradesa, Vol.2 1998
5. P K K lee, " Structures in the New Millenium" CRC press 2015
6. Shengwai Wang " Intelligent Buildings and Building Automation " Taylor and Francis, 2010

16CE2001 - INTELLIGENT BUILDINGS

Credits: 3:0:0

Course Objective:

- To introduce the basic concepts and principles of intelligent buildings
- To provide exposure to the working principles of building automation systems, office automation systems and communication systems
- To provide basic knowledge of the construction and installation of the structured cabling system enabling integrated system connections

Course Outcome:

At the end of the course the student will be able to

- Understand the concept of intelligent building
- Analyze the different HVAC and security systems
- Evaluate systems to automate buildings

Description:

Basic Concept - Intelligent buildings- Building automation –Cost Analysis- Introduction to Smart materials- Heating Ventilation and Air-conditioning systems- Electrical installation and illuminations – Electrical Power transmission in buildings-lighting systems-Fire protection systems – Security and safety systems – Health monitoring systems – Building Electronics—Communication principles

References:

1. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.
2. Derek Clements Croome “Intelligent Building Design, Management and Operations”, Thomas Telford Publishing, London, 2004.
3. Albert Ting –pat So wai Lok Chan, “Intelligent Building Systems”, Kluwer Academic Publisher, U.S.A, 1999.
4. Ehrlich, C., “Intelligent Building Dictionary: Terminology for Smart, Integrated, Green Building Design, Construction and Management”, San Francisco, Calif: Hands-on-Guide, 2007.
5. Michael Wigginton, Jude Harris, “Intelligent Skins”, Architectural Press, Burfington, 2003.
6. www.ieindia.org
7. www.koetterfire.com
8. www.informit.com

16CE2002 BUILDING ACOUSTICS

Credits:3:0:0

Course Objectives:

- To learn the basics of acoustics
- To learn to incorporate acoustic design in planning and design of buildings
- To know about the environmental and architectural aspects of acoustics

Course Outcomes:

At the end of the course the student will be able to

- Understand the requirements of acoustic design
- Apply the principles of acoustic in different types of buildings
- Assess architectural acoustics in buildings

Description:

Requirements for good acoustics - General principles of acoustic design -Fundamentals of Acoustics-Sound Absorbers and Room Acoustics- Planning and design against outdoor and indoor noise- Residential, Office, Hospital, Hotels and hostels, laboratories and test house, miscellaneous- Environmental Acoustics-Highway Noise- architectural design specification and measurement of some isolation design of portions- Architectural Acoustics-Building skin envelope-Interior space acoustics, Mechanical equipment noise - reverberation time - Sabine, sound absorption materials –acoustics factor in architectural design.

Text Books:

1. National Building Code-Part VIII Building Services- Section 4, Acoustics, Sound Insulation and Noise Control- Bureau of Indian Standards, New Delhi, 200.5
2. IS: 2526 – 1963 (reaffirmed 1996) Code of Practice for Acoustical Design of Auditoriums and Conference Hall- Ninth reprint December 1998.

16CE2003 PRESTRESSED CONCRETE STRUCTURES

Credits: 3:0:0

Course Objective:

- To understand the concepts of prestressing concrete structures and the design of various structural components.

Course outcomes:

At the end of the course the student will be able to

- Analyse and design prestressed concrete structural elements
- Understand the intricacies in the construction of prestressed concrete structures
- Evaluate the design of prestressed concrete structures using international code books

Description:

Prestressing systems - Analysis of prestress and bending stresses, concept of load balancing - losses of prestress, deflection, design for flexure, shear and torsion-Design of Anchorage Zone, Concordant cables -Analysis and Design of continuous beam, Circular prestressing, Partial prestressing, non-prestressed reinforcement-Tension Members-Poles and Sleepers-Application of prestressing in precast construction.

References:

1. Krishna Raju, N., "Prestressed Concrete", 4th Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
3. Perumalsamy Balaguru, Antonio Nanni, James Giancaspro, "FRP Composites for Reinforced and Prestressed Concrete Structures: A Guide to fundamentals and design for repair and retrofit", CRC Press. 2008
4. Loo/Chowdhury, "Reinforced and Prestressed Concrete: Analysis and Design with Emphasis on application of AS 3600 – 2009, Cambridge University Press., 2010
5. Rajagopalan N, "Prestressed Concrete", CRC Press. 2002

**16CE2004 STRENGTH OF MATERIALS AND FLUID MECHANICS & MACHINERY
LABORATORY****Credits: 0:0:2****Course Objective:**

- To give hands on training on testing of real specimens
- To train in operating pumps and turbines

Course Outcome:

At the end of the course, the student will be able to

- determine various strength of the materials
- identify various forms of flows and flow measurement
- select and operate pumps and turbines

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments from both categories and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Jindal, U.C, "Strength of Materials", Asian Books Pvt. Ltd, 2007.
2. Modi, P.N and Seth, S.M., "Fluid Mechanics & Fluid Machines", Standard Book House, New Delhi, 2007.
3. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S.Chand and Co., New Delhi, 2002.

16CE3001 - APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY**Credits 3:0:0****Course Objectives:**

- To impart knowledge on various aspects of chemistry and microbiology and their relevance in environmental engineering.

Course Outcomes:

At the end of the course the student will be able to

- understand the principles of chemistry and microbiology in controlling pollution
- analyse and characterize the samples for chemical and biological parameters
- develop innovative and cost effective treatment methods

Description:

Significance of environmental chemistry in environmental engineering - stoichiometry and mass balance- beer- lambert's law- the carbonate system- principles of optical and chromatographic methods- aquatic chemistry- concept of colloidal and quantitative chemistry, complex chemistry, solubility chemistry, biochemistry in water, photocatalysis, amphoteric hydroxides, buffer index; soil chemistry: environmental properties of soil, salt affected soils and its remediation - atmospheric chemistry - photochemical and chemical reactions in the atmosphere, ozone chemistry, aerosols and radiations - diversity of microorganisms - growth kinetics of microorganisms - measurement techniques - microbes of public health importance - metabolic pathways – ecotoxicology – enzymes: Michaelis-Menten equation.

References:

1. C.N. Sawyer, P.L. MacCarty and G.F. Parkin, “Chemistry for Environmental Engineering and Science”, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
2. G.W. Vanloon and S.J. Duffy ‘Environmental chemistry – a global perspective,, Oxford University press, New York., 2000.
3. Buell P. and Girard J. “Chemistry Fundamentals: An Environmental Perspective (2nd edition)”, Jones & Bartlett Publishers, 2000.
4. Harrison R.M. (Edited) “Understanding our Environment: An Introduction to Environmental Chemistry and Pollution”, Royal Society of Chemistry, 1999.
5. Tortora. G.J, B.R. Furke, and C.L. Case, “Microbiology-An Introduction” (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.
6. Pelczar, M.J., Chan E.C.S. and Krieg, N.R., “Microbiology”, Tata McGraw Hill, New Delhi, 1993.

16CE3002 ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL

Credits 3:0:0

Course Objectives:

- To impart knowledge about atmospheric pollution
- To introduce various measurement techniques and control measures

Course Outcomes:

At the end of the course the student will be able to

- understand the principles of atmospheric chemistry in air pollution
- classify, characterize and quantify different types of air pollutants
- apply suitable measures in controlling air pollution

Description:

Basic Concepts: sources and types of air pollutants - effects on environment - sampling and measurement of particle and gaseous pollutants - dispersion of air pollutants: atmospheric stability and inversion-plume rise estimation, dispersion theories - particulate and gaseous pollutant control: control methods, selection of control equipment, principle and design aspects of settling chambers, cyclone separators, scrubbers, filters, electrostatic precipitators- absorption, adsorption and precipitation, engineering control concept - air pollution emission standards and legislation - Control measures for industrial application - introduction to air pollution models: CALINE, SCREEN 3, ISCST3 - basics of AERONET - case studies.

References:

1. Rao C S, “Environmental Pollution Control Engineering”, New Age International (p) Limited, 2006.
2. M. N. Rao et al., “Air Pollution”, Tata McGraw Hill Publication, 1989.

3. Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York, 1999.
4. Lawrence K.Wang, Norman C Perelra, Yung-Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
5. David H.F Liu, Bela G.Liptak "Air Pollution", Lewis Publishers, 2000.
6. Anjaneyulu.Y, "Air Pollution & Control Technologies", Allied Publishers (P) Ltd, India, 2002.
7. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis", IK International, 2010.

16CE3003 SOLID AND HAZARDOUS WASTE MANAGEMENT

Credits 3:0:0

Course Objectives:

- To impart knowledge on solid and hazardous waste management
- To introduce the principles involved in the effective management of municipal solid and hazardous waste from source identification up to disposal.

Course Outcomes:

At the end of the course the student will be able to

- understand the various sources of solid and hazardous waste and their impacts
- analyse the composition of the waste and its characteristics
- develop an effective and efficient layout for solid and hazardous waste management

Description:

Types and sources of solid and hazardous wastes - need for solid and hazardous waste management - salient features of Indian legislations: legislations on management and handling of municipal solid wastes, hazardous wastes, management and handling of biomedical wastes - elements of integrated waste management and roles of stakeholders: waste generation rates, waste sampling, waste characterization, TCLP tests, source reduction of wastes, recycling and reuse - handling and segregation of wastes at source: lead acid batteries, E-waste - storage and collection of municipal solid wastes: analysis of collection systems, need for transfer and transport, transfer stations, labeling and handling of hazardous wastes - waste processing: processing technologies, biological and chemical conversion technologies, composting, thermal conversion technologies, energy recovery, incineration - solidification and stabilization of hazardous wastes: treatment of biomedical wastes, disposal in landfills - site selection: design and operation of sanitary landfills, secure landfills and landfill bioreactors, leachate and landfill gas management, landfill closure and environmental monitoring, landfill remediation, bioreactors, ocean dumping, elements of integrated waste management - Case studies

References:

1. CPHEEO, Manual on "Municipal Solid waste management", Central Public Health and Environmental Engineering Organization, Government of India," New Delhi, 2010.
2. George Tchobanoglous et.al., "Integrated Solid Waste Management", MCGraw-Hill Publishers, 2003.
3. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 2004.
4. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 2002.
5. Bhide A.D. and Sundaresan, B.B., "Solid Waste Management in Developing Countries", INSDOC, 2003.
6. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management", "Hazardous waste Management", McGraw-Hill International edition, New York, 2001.

16CE3004 ELEMENTS OF HYDROLOGY

Credits 3:0:0

Course Objectives:

- To introduce hydrological processes in water balance studies
- To develop the ability in hydrological data acquisition, analysis and interpretation

Course Outcomes:

At the end of the course the student will be able to

- understand the components of hydrologic cycle
- predict hydrologic extreme events for hydrologic design
- interpret groundwater field data and compute hydrologic mass balance in a river basin

Description:

Introduction: description of hydrologic cycle - precipitation: rain gauge network, test for consistency and continuity of data, analysis of rainfall data, intensity-duration-frequency analysis and depth-area-duration analysis; abstractions from precipitations: evaporation, estimation using Thornthwaite and Penman-Monteith methods, evapotranspiration, infiltration process, infiltration indices and effective rainfall - stream flow measurement: stream flow measurement, stage-discharge relationship and rating curve, runoff characteristics - hydrograph theory: direct runoff hydrograph, unit hydrograph, hyetograph - occurrence and movement of groundwater - groundwater budget - classification of aquifers - physical properties: Darcy's law, hydraulic head, permeability, hydraulic conductivity, porosity, void ratio, transmissivity, storativity, steady state flow and transient flow - groundwater hydraulics: uniform and radial flow, Theis, Dupit and Theim methods for estimation of drawdown - pumping test.

References:

1. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Wiley & Sons Inc., 2007.
4. Bear, J., "Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 2008.
6. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 2010.
7. Maidment, D.R. (editor), "Handbook of Hydrology". McGraw-Hill, New York, 1993.
8. Singh V.P., "Elementary Hydrology", Prentice Hall of India, New Delhi, 1994.

16CE3005 DESIGN OF HYDRAULIC AND CONVEYANCE STRUCTURES

Credits 3:0:0

Course Objectives:

- To impart knowledge about various types of hydraulic structures
- To introduce the planning and design concepts of hydraulic structures.
- To inculcate the importance of basic water supply and drainage systems in society

Course Outcomes:

At the end of the course the student will be able to

- understand the types of dams and diversion structures, canals and cross drainage works
- analyse and design various hydraulic structures
- design water supply and drainage systems

Description:

Dams: types and classification, selection of site for dams, choice of dams, dam safety, Design and construction of gravity and earth dams, flow nets - spillways: principles and classification, design of ogee and open channel spillways, energy dissipation devices, basins, buckets and gates - canals: types, components, selection, design of irrigation canals, maintenance of canals - cross drainage works: types and selection, design principles - water distribution networks: flow through pipes, solving pipe network flow problems, use of computer software for network analysis - cross country pipeline - hydraulic transient analysis; basic approaches to urban drainage – runoff quantity and quality – wastewater and stormwater reuse – major and minor systems

References:

1. Punmia & Pandey, “Irrigation & Water Power Engg.”, Laxmi Publications (P) Ltd., New Delhi, 2016.
2. M.M.Dandekar and K.N.Sharma, “Water Power Engineering”, 2nd edition Vikas publishers, 2013.
3. Asawa G.L., “Irrigation and Water Resources Engineering”, New Age International (P) Ltd. Publishers, 1st edition, 2005.
4. Garg S.K, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers N.D. 13th edition, 1998.
5. Modi, P.N., “Irrigation, Water Resources and Water Power Engineering”, Standard Book House, New Delhi, 2nd edition, 1990.
6. Design of small dams, United States Bureau of Reclamation, Third Edition, 1987.

16CE3006 WATER RESOURCES PLANNING AND SYSTEMS ENGINEERING

Credits 3:0:0

Course Objectives:

- To introduce application of systems concepts to water resources planning
- To make the students learn the optimization techniques in modeling water resources systems

Course Outcomes:

At the end of the course the student will be able to

- understand the steps involved in planning a water resources project in an integrated way
- develop reservoir operation policy and analyse the economic cost of the projects
- make use of few of optimization tools and techniques to optimize water resources problems

Description:

Concepts of systems analysis: definition, approach to water resources planning and management - objectives and constraints - overview of optimization techniques - linear programming: graphical method, simplex method, sensitivity analysis, duality - dynamic programming: concepts, formulation of recursive equation - water resources planning: concepts, functions, phases, data requirement - National Water Policy: objectives, planning strategies and implementation of water resources projects, constitutional provisions - economic policy: shadow pricing on project cost - calculation of shadow pricing of water supply - international funding agencies - water resources management: reservoir operation and water allocation policy

References:

1. Vedula, P.P., and Mujumdar, S., “Water Resources Systems: Modelling Techniques and Analysis”, Tata-McGraw Hill, 2005.

- Leonard Douglas James and Robert Rue Lee, “Water Resources Economics” Oxford Publishers, 2005.
- Bhave, P. R., “Optimal Design of Water Distribution Networks”, Narosa Publishing house, 2003.
- Loucks, Daniel P., van Beek, Eelco - Stedinger, Jery R., Dijkman, Jozef P.M., Villars, Monique T., “ Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications” , UNESCO publishing, 2005.
- Quentin Grafton R., and Karen Hussey, “ Water Resources Planning and Management”, Cambridge University Press, 2011.

16CE3007 - ADVANCED ENVIRONMENTAL ENGINEERING LABORATORY

Credits: 0:0:2

Course Objectives:

- To demonstrate the sampling techniques and analytical methods in assessing air and water quality in the laboratory
- To introduce the principles of instrumentation in air and water quality analysis

Course Outcomes:

At the end of the course, the student will be able to

- monitor and assess air and water quality of samples from various sources
- design suitable treatment method and control measures for water and air pollution problems

Experiments:

- The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

- “Standard Methods for the Examination of Water and Wastewater”, 14th ed, American Public Health Association, Washington, DC, 1999.
- http://cpcb.nic.in/upload/NewItems/NewItem_171_guidemanualw&wwanalysis.pdf.
- CPHEEO, Manual on “Municipal Solid waste management”, Central Public Health and Environmental Engineering Organization, Government of India,” New Delhi, 2010.
- C.N. Sawyer, P.L. MacCarty and G.F. Parkin, “Chemistry for Environmental Engineering and Science”, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.

16CE3008 GIS AND COMPUTATIONAL LABORATORY

Credits: 0:0:2

Course Objectives:

- To demonstrate the application of different components of GIS and computational techniques in environmental and water resources systems

Course Outcomes:

At the end of the course the student will be able to

- understand and analyse numerical solutions for linear and nonlinear systems
- apply GIS for temporal and spatial data acquisition and analysis
- develop forecasting and prediction models using statistical methods and artificial intelligence techniques

References:

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. John, E. G., "Introduction to Hydraulics and Hydrology with Applications for Stormwater Management", DELMAR, Thomson Learning, USA, 2002.
3. Ian Heywood Sarah, Cornelius and Steve Carver, "An Introduction to Geographical Information Systems", Pearson Education, New Delhi, 2002

16CE3009 - CLEANER PRODUCTION AND SUSTAINABLE DEVELOPMENT**Credits: 3:0:0****Course Objectives:**

- To introduce the concept of sustainable development and principles of environmental management
- To develop an understanding in long-term mitigation to promote eco-sustainable developments
- To emphasize the integrative approaches for cleaner production, Life Cycle Assessment (LCA) and sustainable management.

Course Outcomes:

At the end of the course the student will be able to

- explain the philosophy and art of environmental management systems
- work as a professional member of a team in conducting Life Cycle Assessments
- identify policy options for addressing the political and economic sources of technology controversies

Description:

Principles of cleaner production: cleaner production project development and implementation, assesment steps and skills, material balance, cleaner production financing, measuring progress, waste audit - life cycle assessment and environmental management systems - life cycle costing, design for the environment - international environmental standards - ISO14001 - environmental audit - concept of sustainable management - millenium development goals, - environment and development linkages - resource degradation - sustainability and the tripple bottom line - components of sustainability, - ecosystem integrity - structural and functional linking of developmental dimensions - sustainability development and international response - international summits - sustainable livelihoods - framework for achieving sustainability - operational guidelines -science and technology for sustainable development - performance indicator of sustainability and indicator mechanism - case studies - industrial applications of CP, LCA, EMS and environmental audits - green energy - green process management - case studies

References:

1. World Bank Group " Pollution Prevention and Abatement Handbook - Towards Cleaner Production ", World Bank and UNEP, Washington D.C, 1998.
2. Paul L Bishop, 'Pollution Prevention : Fundamentals and Practice', McGraw Hill International, 2000 .
3. Prasad Modak, C.Visvanathan and Mandar Parasnis, 'Cleaner Production Audit',Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok, 1995.
4. Sayer, J. and Campbell, B., The Science of Sustainable Development : Local Livelihoods and the Global Environment (Biological Conservation, Restoration & Sustainability), Cambridge University Press, London, 2003.
5. Bowers, J., Sustainability and Environmental Economics – An Alternative Text, Longman, London, 1997.

6. Kirkby, J., O'Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London, 1993.

16CE3010 - ENVIRONMENTAL GEOTECHNOLOGY

Credits 3:0:0

Course Objectives:

- To introduce the fundamentals of geotechnology in environmental planning and analysis of systems
- To impart knowledge on fundamental behavior of soil and its relevance to environmental engineering operations and applications

Course Outcomes:

At the end of the course the student will be able to

- understand the principles of soil treatment techniques
- identify suitable site investigation techniques and explore the contaminant transport mechanisms
- analyse the engineering properties of soil for selected geotechnical engineering problems.

Description:

Soil as a multiphase system; soil-environment interaction; properties of water in relation to the porous media; water cycle with special reference to soil medium; soil mineralogy: significance of mineralogy in determining soil behavior, mineralogical characterization, mechanisms of soil-water interaction; diffuse double layer models; force of attraction and repulsion; soil-water-contaminant interaction; theories of ion exchange; influence of organic and inorganic chemical interaction; introduction to unsaturated soil mechanics; water retention property and soil-water characteristic curve; flow of water in unsaturated soil; concepts of waste containment facilities; desirable properties of soil; contaminant transport and retention; contaminated site remediation; introduction to advanced soil characterization techniques: volumetric water content, gas permeation in soil, electrical and thermal properties, pore-size distribution, contaminant analysis; applications

Reference:

1. Mitchell, J. K and Soga, "Fundamentals of Soil Behavior", John Wiley and Sons Inc., 2005.
2. Fang, H-Y, "Introduction to Environmental Geotechnology", CRC Press, 1997.
3. Daniel, D. E, "Geotechnical Practice for Waste Disposal", Chapman and Hall, 1993.
4. Rowe, R. K., Quigley, R. M. and Booker, "Clay Barrier Systems for Waste Disposal Facilities", J. R., E & FN Spon, 1995.
5. Rowe, R. K, "Geotechnical and Geoenvironmental Engineering Handbook", Kluwer Academic Publishers, 2001.
6. Reddi, L. N. and Inyang, H. F, "Geoenvironmental Engineering - Principles and Applications", Marcel Dekker, Inc, 2000.
7. Sharma, H. D. and Lewis, S. P, "Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation", John Wiley & Sons Inc., 1994.

16CE3011 ENVIRONMENTAL POLICIES AND LEGISLATION

Credits 3:0:0

Course Objectives:

- To educate the students on Indian Constitution, administrative regime and laws of pollution control

- To equip the students with the skills needed for interpreting laws, policies and judicial decisions

Course Outcomes:

At the end of the course the student will be able to

- understand the laws, policies and institutions in the field of environment
- acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective
- to evaluate the role of law and policy in conservation and management of natural resources and pollution prevention

Description:

Basics of jurisprudence - criminal law - common Law - relevant sections of the code of civil procedure - Indian Penal Code: introduction, fundamental rights, directive principles of state policy, article 48 (A) and 51-A(g) Judicial enforceability, constitution and resources management and pollution control, Indian Environmental Policy (1992): administrative regulations, constitution of Pollution Control Boards powers, functions, accounts, audit - constitutional remedies writ jurisdiction Article 32, 226 136 special reference to Mandamus and Certiorari for pollution abatement, Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988 - Water (prevention and control of pollution) Rules 1975 Water (prevention & control or Pollution) Cess Act. 1977 as amended by Amendment Act 1987 and relevant notifications - relevant notifications in connection with hazardous Wastes (management and handling) biomedical wastes (management and handling - noise pollution, eco-labelling.

References:

1. "Constitution of India", Eastern Book Company Lucknow, 12th Edn. 2007.
2. Pandey J.N., "Constitutional Law of India", (31st Edn.) Central Law Agency Allahabad, 2007.
3. Kesari U.P.D., "Administrative Law 12008", Universal Book Trade Delhi.
4. Tiwari H.N., "Environmental Law", Allahabad Law Agency 2007.
5. Divan A., and Noble M., "Environmental Law and Policy in India (cases, Materials and Statutes)", Tripathi Bombay, 2001.
6. "Environmental Policy, Forest Policy", Bare Acts - Government Gazette Notificaiton.

16CE3012 - NOISE POLLUTION AND CONTROL TECHNIQUES

Credits 3:0:0

Course Objectives:

- To impart knowledge on the sources, effects and control techniques of noise pollution.

Course Outcomes:

At the end of the course the student will be able to

- understand the nature and the characteristics of noise pollution
- identify the sources of noise pollution
- adopt suitable control measure in abating noise pollution

Description:

Noise: various sources, basics of sound waves and specification of sound, acoustic energy and sound intensity;; acoustic wave equation - characterization of noise - measurement and analysis of sound - psycho-acoustic effects, noise menace - special noise environments - noise control and abatement measures : resonators and filters, acoustic impedance, exchange chamber type of filters - noise instrumentation and measuring procedure - noise indices - architectural acoustics. - indoor noise pollution - case studies

References:

1. Handbook of Noise Measurement – APG Peterson & EE Gross PH, Englewood cliffs New Jersey, latest edition.
2. Environmental Noise Pollution – PE Cunniff, McGraw Hill, New York, 1987.
3. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 1979.

16CE3013 - OCCUPATIONAL HEALTH AND SAFETY**Credits 3:0:0****Course Objectives:**

- To enable the students to learn about the occupational hazards
- To impart knowledge on occupational health, safety and standards

Course Outcomes:

At the end of the course the student will be able to

- acquire knowledge on the occupational standards and nature of occupational hazards
- investigate existing occupational safety issues
- develop suitable occupational safety measures in the working place.

Description:

Introduction: occupational health and safety - acts - National Occupational Standards (NOS) - ergonomics: task Analysis, preventing ergonomics hazard, ergonomics program - occupational hazard and control: hazard analysis and control - occupational safety: fire prevention and protection, electrical safety, product safety - occupational health: health consideration, personal safety equipments, accidents, causation - investigation methods and models - occupational health problems in various types of industries - construction; textile, chemical, food and pharmaceutical.

References:

1. Goetsch D. I., “Occupational safety and Health for technologist”, Engineers and managers, Prentice Hall Publications, 1999.
2. Heinrich H. W., “Industrial Accident Preventions”, McGraw Hill Publications, New York, 1980.
3. Colling D.A., “Industrial Safety Management and Technology”, Prentice Hall Publications, New Delhi, 1979.
4. Della D.E. & Giustina, “Safety and Environmental Management”, Van Nostrand reinhold international Thomson publishing inc., 1996.
5. CPHEEO, Manual on sewage treatment.
6. Industrial Safety and Pollution Control Handbook, National Safety Council and Associate (Data) Publisher Pvt. Ltd., 1991.
7. Dr. K.C. Arora, “ISO 9000 to OHSAS 18001”, S.K. Kataria & Sons, Delhi.

16CE3014 NANOTECHNOLOGY FOR WATER AND WASTEWATER TREATMENT**Credits: 3:0: 0****Course Objectives:**

- To impart the knowledge about the application of nanomaterials and nanoparticles in water and wastewater treatment

- To introduce the methods of synthesis of nanoparticles in the laboratory and characterization of nanomaterials

Course Outcomes:

At the end of the course the student will be able to

- understand the principles of nanotechnology in removal of pollutants from water and wastewater
- synthesis different types of nanoparticles for various applications
- develop nano composites, nanomembranes and nanosensors for treatment of water and wastewater

Description:

Introduction to nanoscience and nanotechnology - overview of existing application of nanomaterials in water and wastewater treatment - synthesis of nanoparticles and nanomaterials: magnetic nanoparticles - carbonaceous nanoparticles - nanocomposites - clay supported nanoparticles - physical and chemical analysis of nanoparticles: separation techniques - morphology studies: scanning electron microscopy - surface charge and optical properties of nanoparticles: zeta potential, UV-Vis spectrometry - elemental composition of single nanoparticles: x-ray diffraction - elemental composition of bulk nanoparticles - nanotechnology in water treatment: carbon based nano adsorbent, regenerable polymeric nanoadsorbents, nanoclays, silver nanoparticles for water disinfection, electrospun nanofibrous membrane filtration - nanotechnology in wastewater treatment: activated carbon based palladized iron nanoparticles for site remediation, $Mg(OH)_2$ nanoadsorbent, phosphate removal, site remediation, desalination, molecularly imprinted polymers for removal of micropollutants - fate and toxicity of nanoparticles and nanomaterials - processes determining the fate of NMs /NPs in environment - processes determining the fate of NMs /NPs in environment: aggregation, reaction, adsorption, sedimentation - ecotoxicity of NMs/NPs - effect on human health and environment - introduction to nanosensors - case studies

References:

1. Lens P., Virkutyte J., Jegatheesan V., and Al-Abed S., “Nanotechnology for Water and Wastewater Treatment”, IWA Publishing, 2013
2. Ajay Kumar Mishra, “Application of Nanotechnology in Water Research”, Scrivener Publishing LLC. 2014
3. Eugene T, Michele De Kwaadsteniest, “ Nanotechnology in Water Treatment Applications”, Caister Academic Press, 2010

16CE3015 - HYDRO POWER ENGINEERING

Credits 3:0:0

Course Objectives:

- To understand the working principles of different power plants
- To design power canals, silting basin, types of dams
- To explain about transmission system, financial implications etc.,

Course Outcomes:

At the end of the course the student will be able to

- estimate the hydropower potential
- analyse the financial implications and maintenance of hydropower systems
- design various components of hydropower system, construction of power plant

Description:

Introduction: development of water power - estimation of hydropower potential - comparison of hydro, thermal and nuclear power - firm power - secondary power - load and load duration curves - load factor

etc. types of hydropower plants: classification of hydropower plants - run-of-river plants - valley dam plants, high head diversion plants, diversion canal plants, pumped storage plants, tidal power plants. water conveyance system: power canals - alignment - design of power canals - flumes - covered conduits and tunnels - drainage and ventilation in tunnels. penstocks: alignment - types of penstocks - anchor blocks - spillways: types - spillway gates - design of stilling basins. types of turbines and their utility - power house details: fore bay - intakes - balancing reservoir - escape surge shafts/ inclined shafts - underground power stations - general transmission system: general introduction - basic principles of design and construction - financial implications of hydropower plants - maintenance of hydro power plant.

References:

1. Birdoi – DAS, “Irrigation Engineering (including Water Power Engineering)” – Dhanpat Rai Publishing Company, New Delhi – 110002, 2012.
2. Dr. P.N. Modi, “Irrigation Water Resources and Water Power Engineering”, Standard Book House- Rajsons Publication Private Limited, New Delhi- 110002, 2012.
3. Santosh Kumar Garg, “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, Delhi – 110 006 – 28th Revised Edition – 2014.
4. Nigam P.S., Handbook of Hydroelectric Engineering, Nem Chand Publisher, 1985
5. Warnick, C.C., “Hydropower Engineering”, Prentice Hall, 1984.
6. Manual on planning and design of small hydroelectric scheme, publication no. 280, Central Board of Irrigation and Power, 2001.
7. “Guidelines for Hydraulic Design of Small Hydro Plants”, Alternate Hydro Energy Research Centre, 2011.

16CE3016 RIVER MECHANICS AND SEDIMENT TRANSPORT

Credits: 3:0:0

Course objectives:

- To introduce the concepts of flow through rivers and the theoretical and empirical formulation of energy and momentum principles
- To demonstrate the sediment transport in terms of first principles
- To make the students understand the causes of river channel change and river training

Course outcomes:

At the end of the course the student will be able to

- identify the various types of flow
- analyze the transport of sediments
- develop strategies for sediment routing

Description:

Free surface flow, uniform flow, gradually varied flow, flow profiles, prismatic channels energy and momentum principles – basic equations of various flows, velocity of flood wave discharge, flood routing, origin and properties of sediments, incipient movement of sediments – shields analysis, bed formation and flow regimes, sampling and measurement techniques of sediment load, forms of sediment transport, estimation of bed load transport, suspended load transport and total transport, application of RS in estimating sediment load, settling, deposition, consolidation, attrition, erosion, Rouse profile, reservoir sedimentation, aggradation and degradation, design of stable channels, river training methods, bank protection, Groynes or spurs, deflectors, cut offs; sedimentation basin

References:

1. Garde, R.J. and Ranga Raju, K.G. "Mechanics of Sediment Transport and Alluvial Stream Problems", New Age International (P) Ltd. Publications, New Delhi, 2006.
2. Subramanya. K, "Open channel flow", Tata McGraw Hill, 3rd Edition, 2010.
3. Yang, C.T. "Sediment transport theory and Practice", McGraw-Hill, New York, 1996.
4. Graf, W.H. "Hydraulics of sediment transport", McGraw-Hill, New York, 1971.
5. Garde, R.J. "History of Fluvial Hydraulics", New Age International (P) Ltd. Publishers, New Delhi, 1995.
6. Garde, R.J. "River Morphology", New Age International (P) Ltd. Publishers, New Delhi, 2006.

16CE3017 ADVANCED DESIGN OF PRECAST CONCRETE STRUCTURES**Credit: 3:0:0****Course Objective:**

- To design precast structural components and its joints
- To design of precast structures subjected to dynamic forces

Course Outcome:

At the end of the course the student will be able to

- Understand the production, transportation and erection process of precast elements
- Design the precast structural members
- Analyse and design the different types of joints and its behaviour

Description:

Introduction – Precast concrete structural elements - Prefabricated systems - Advantages – Materials – Production – Transportation – Erection – Quality control - Design considerations and requirements — Bearing for precast units - Design of members – Slab - Beam – Wall – Joints and connections – Requirements of structural joints – Types of joints – Detailing of joints - Diaphragm connection – Beam/Column/Wall connections – Joint fillers - Design requirements for safety against progressive collapse – Design of ties - Case studies on precast construction and failures.

References:

1. Kim S Elliott, Colin Jolly., "Multi-Storey Precast Concrete Framed structures", Wiley, 2013.
2. IS 15916 (2011): Building Design and Erection Using Prefabricated Concrete - Code of Practice.
3. Code of Practice for Precast concrete construction 2003, PCI Design hand book.

16CE3018 DESIGN OF PRESTRESSED CONCRETE STRUCTURES**Credits:3:0:0****Course Objectives:**

- To introduce the fundamental principles about the structural behaviour and design criteria of prestressed concrete structures
- To review the current technology available to prestressed concrete structures.
- To extend knowledge in the design using international code books

Course outcomes:

At the end of the course the student will be able to

- Analyse and design prestressed concrete structural elements
- Understand the intricacies in the construction of prestressed concrete structures
- Evaluate the design of prestressed concrete structures using international code books

Description:

Prestressing systems – analysis and design of members for bending, shear, torsion and combined bending and torsion - creep and shrinkage effects - detailing requirement – deflection and crack width – Design of continuous beams, composite beams, one way slab, two way slab and flat slabs - Box girders - Piles - sleepers – Construction and failure of prestressed concrete structures – case studies – studies using IS, ACI and BS codes.

References:

1. Krishna Raju, N., "Prestressed Concrete", 4th Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2. Rajagopalan, N., "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
3. T.Y. Lin & Ned H. Burns, "Design of Prestressed Concrete Structures", John Wiley & Sons, 3rd edition, 1981.
4. IS 1343:2012, BS 8110 & ACI 318-08, TR 43 Hand Book.

16CE3019 MAINTENANCE AND REHABILITATION OF STRUCTURES

Credits 3:0:0

Course Objectives:

- To get exposed to the repair and rehabilitation of structures and structural elements
- To know the materials used for repair.
- To have a knowledge about the repair techniques

Course outcomes:

At the end of the course the student will be able to

- Identify different types of defects in structures
- Analyse and formulate suitable rehabilitation, retrofitting and demolition procedures
- Recommend suitable solutions for existing structures

Description:

Maintenance: Facets and Importance - Quality Assurance and control - Structural appraisal : concrete, steel and masonry structures – Strength evaluation of existing structures - Assessment procedure for evaluating a damaged structure – Non destructive testing methods - classification of cracks - nonstructural cracks: causes, repair and rehabilitation methods – structural cracks: causes, preventive measures, repair and rehabilitation methods for Masonry, Concrete and Steel Structures – Materials used for rehabilitation- Retrofitting: Methods of retrofitting viz., global and local - Techniques of retrofitting. Demolition of structures: Engineered demolition techniques for structures - case studies: monument, bridge and multistory building.

References:

1. Johnson, S.M., "Deterioration, Maintenance and Repair of Structures", McGraw-Hill book company, New York, 1965.
2. Allen, R.T., and Edwards, S.C., "Repair of concrete structures", Blake and Sons, UK, 1987.
3. Denison Campbell, Allen and Harold Roper, "Concrete structures - Materials, Maintenance and Repair", Longman Scientific and technical, UK, 1991.
4. Deofferey, P. Sims, "The Rehabilitation of Dams and Reservoirs", Brown & Root Services, UK.
5. Shetty, M.S., "Concrete Technology- Theory and Practice", S. Chand and Company, New Delhi, 1992.
6. Gambhir, M.L., "Concrete Technology", Tata McGraw Hill Publishing Company, New Delhi, 2004.

16CE3020- INTRODUCTION TO STRUCTURAL HEALTH MONITORING

Credits 3:0:0

Course Objective:

- To implement fundamental concepts in structural health monitoring.
- To demonstrate the working principles of sensors and actuators made from smart materials.
- To describe the current real-world applications of damage identification in the aerospace, civil, and mechanical engineering fields.

Course Outcome:

At the end of the course, the student will be able to

- Identify various health monitoring techniques.
- Interpret the acquired data using diagnostic methods.
- Formulate appropriate SHM system for structures.

Description:

Motivation and objectives of structural health monitoring - State-of-the-art in damage monitoring –A statistical pattern recognition paradigm for SHM- Sensing Techniques: Fibre optic (FBG), Piezo electric sensors, Electrical impedance based methods, electric waves and magnetostrictive sensors – Data Acquisition Systems: Lab view – Damage diagnostic methods: Vibrational Response, Electrical Impedance and Wave propagation- Advanced signal processing methods - Applications using hands on training in laboratory.

References:

1. Keith Worden, “Structural Health Monitoring: A Machine Learning Perspective”,Wiley-Blackwell ,November 2012.
2. Dr Charles R. Farrar and HoonSohn, “Structural Health Monitoring: A Statistical Pattern Recognition Approach”, John Wiley & Sons, 1994.
3. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, “Structural Health Monitoring”,John Wiley & Sons, 2010.

14CE1001 - BASIC CIVIL ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To understand the selection of building materials and site
- To apply the purified water and treat the sewage eater
- To produce general layouts on transportation systems

Course Outcome:

At the end of the course the student will be able to

- Demonstrate the principles of surveying and basic functions of buildings
- Select appropriate construction materials for structures
- Justify the need of water purification, transportation and irrigation engineering

Description:

Engineering – Civil Engineering – Characteristics of good building materials such as stones, bricks, timber, cement, concrete and steel sections – Basic principles of surveying - Field measurement - Area of a plot - Basic functions of buildings – site selection - Major components of buildings and its construction methods - Valuation of a building by plinth area method - Sources of water supply –water requirements –

Purification of water by sedimentation, filtration and disinfection - Rainwater harvesting - Sewerage systems – Working principle of Septic tanks and oxidation ponds – Collection and disposal of solid wastes – transportation engineering - Classification and Cross sections of water bound macadam, bituminous and cement concrete roads - Importance of railways – Gauges – Components of a permanent way - General layout of an airport and harbour – Bridges and its types – Dams, its purpose and its types – Selection of site for a dam - Irrigation and its types.

References:

1. Palanichamy, M. S., “Basic Civil Engineering”, Tata McGraw Hill Publishing Co. Limited, New Delhi, 2008.
2. Ramesh Babu V., ‘Basic Civil Engineering’, Anuradha Agencies, Kumbakonam, 2001.
3. Devadass. C.S.C., Jemimah Carmichael. M and Sheeba Ebenezer. J., “Basic Civil Engineering”, Shristi Publishers, Coimbatore, 2004.

14CE2001 SURVEY

Credits: 3:0:0

(Version 1.1)

Co-requisite: 14CE2018 - Survey Lab

Course Objective:

- To understand the principles of land and hydrographic surveying
- To know the application of surveying in civil engineering projects

Course Outcome:

At the end of the course students will be able to

- Illustrate various conventional instruments involved in surveying with respect to utility and precision
- Develop the ability and analyse to solve survey and survey related problems
- Adapt control surveying for field applications.

Description:

Principle and practices of leveling, contouring, calculation of areas and volumes - Principle and practices of theodolite surveying, omitted measurements, closing error and distribution, heights and distances - Principle of tacheometric surveying, curve surveying – simple curves, transition curves - Triangulation systems, intervisibility of stations, base line corrections, satellite stations : reduction to centre.

References:

1. Duggal, S.K., “Surveying”, Volume I and II, McGrawHill & Co., New Delhi 2009.
2. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Parts 1 and 2, Pune Vidyarthi Griha Prakashan, 2012.
3. Basak, N., “Surveying and Levelling”, McGrawHill & Co., New Delhi 2011.
4. Arthur Bannister, Stanley Raymond, Raymond Baker, ”Surveying”, Pearson, 2009.
5. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2010.

14CE2002 - MECHANICS OF SOLIDS

Credits: 3:1:0

(Version 1.1)

Co-requisite: 14CE2016 - Strength of Materials Lab

Course Objective:

- To learn the state of stress and principal stresses and strains

- To study the bending moment and shear force of determinate beams
- To study the different types of stresses on structural elements

Course Outcome:

At the end of the course students will be able to

- Demonstrate the fundamental concepts of mechanics
- Analyse the behavior of structural members under different loading conditions.
- Categorise suitable method for analysis of structures

Description:

Axial, shear and thermal stresses and strains in solids- Elastic constants and relationship between them - Analytical and graphical methods for determination of principal stresses and strains - Bending moment and shear force of determinate beams – Theory of pure bending and elastic torsion -Stresses in beams due to bending, shear and torsion- strength of section- power transmitted by shafts

References:

1. Egor, P.Popov, “Engineering Mechanics of Solids” ,Prentice Hall of India, New Delhi, 2003.
2. Rajput, R.K., “Strength of Materials”, S. Chand & Co. Ltd., New Delhi, 2010.
3. Bansal, R.K ., “Strength of Materials”, Laxmi Publications, New Delh, 2007.
4. Subramanian R., ”Strength of Materials”, Oxford University Press, 2005.
5. Srinath L S., “Advanced Mechanics of Solids”, Tata McGraw Hill Publishing 2003.

14CE2003 - MECHANICS OF FLUIDS

Credits: 3:1:0

(Version 1.1)

Course Objective:

- To introduce the fundamental concepts of fluid statics, kinematics and dynamics
- To introduce the concepts of flow measurements, flow through pipes

Course Outcome:

At the end of the course the student will be able to

- Understand the various types of flow and flow profiles
- Carry out flow measurements
- Design pipe networks

Description:

Fluid Properties and Fluid Statics :Viscosity, Density, Perfect gas, vapour pressure and surface tension- Basic equation of fluid statics- Pascal’s Law- Basic Concepts of Fluid Flow: Classification of flows- streamline, Streak line and pathlines- Flownets- Dynamics- Concepts of system and control volume- Application of control volume to continuity, energy and Momentum- Euler’s equation and Euler’s equation of motion and Bernoulli’s equation- Flow through Pipes: Reynold’s number- Laminar flow- Turbulent flow –Energy Loss in pipes – Hydraulic gradient – Energy gradient- Flow Measurement: Venturimeter- orifice meter- pitot tube- mouthpiece and orifice- Open channel flow-Weirs and notches.

References:

1. Bansal, R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi, 9th edition,2011.
2. Modi, P.N. & Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi, 2007.
3. Som, S.R, & Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, 2nd edition,2007.

4. Hubert Chanson, “Hydraulics of Open Channel flow”, Butterworth-Heinemann Ltd., 2nd Edition, 2004.
5. Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines” , S. Chand and Co., New Delhi, 2008.
6. Agarwal, S.K., “Fluid Mechanics and Machinery”, Tata Mc Graw Hill Co. New Delhi, 2006.

14CE2004 BUILDING MATERIALS AND GEOLOGY

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To impart the knowledge of geology
- To study the basics of seismology

Course Outcome:

At the end of the course the student will be able to

- Identify the quality of building materials for construction
- Incorporate geological concepts in Civil Engineering structures
- Investigate the geological formations and their contributions.

Description:

Building materials: bricks, cement, timber, steel, concrete, water proofing materials, miscellaneous building materials - Properties, tests, applications - General geology- geology for engineers- branches - geological formations: action of water and wind on rocks- Mineralogy- Study of rock forming minerals – Petrology: Classification - engineering properties and description- Structural geology: geological maps- folds, faults and joints, hydro geology, study of structural models- Geophysical methods and investigations- Investigation of landslides and subsidence- causes and mitigation.

References:

1. Parbin Singh, “Engineering and general Geology”, Katson publication House, 2010.
2. Gokhale K.V.G.K. “Principles of Engineering Geology”. BS Publications, 2010.
3. Bell F G., “Fundamentals of Engineering Geology”, Butterworth-Heinemann, 2007.
4. Michael H. De Freitas , “Engineering Geology” Springer-Verlag Berlin Heidelberg, 2009.
5. Chenna Kesavulu., “Textbook of Engineering Geology” 2nd Edition, Macmillan Publishers India Ltd. 2009.
6. Varghese P.C., “Building materials“, Prentice Hall, 2005.

14CE2005 - APPLIED HYDRAULICS AND HYDRAULIC MACHINERY

Credits: 3:0:0

(Version 1.1)

Pre-requisite: 14CE2003 - Mechanics of Fluids

Course Objective:

- To learn the fundamental flow in open channels
- To introduce the concepts of boundary layer theory and flow around submerged objects
- To impart the knowledge on pumps and turbines

Course Outcome:

At the end of the course the student will be able to

- Design channels with different flow conditions
- Determine the forces on submerged bodies and its impact moving and stationary objects

- Capable to and select operate pumps and turbines

Description:

Open Channel Flow : Types of flow- Chezy's and Manning's equation- Specific energy- critical flow- Varied flow: Hydraulic jump- Gradually varied flow- Backwater and drawdown curves- Boundary Layer and Dimensional Analysis: Displacement, Momentum and energy thickness- laminar and turbulent boundary layers- forces on submerged bodies –drag- Momentum Principle: Impulse momentum equation- Application of linear momentum principle- Impact of Jet- Turbines : Typical layout and components of Hydro- electric project- working principles of Pelton wheel, Francis and Kaplan turbine- Draft tube - Specific Speed –Inlet and outlet velocity triangles- Headlosses and efficiency – Specific Speed – Positive Displacement pump: Reciprocating pump- Types and components , working principle- miscellaneous pumps.

References:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, Edition 9. 2011.
2. Modi, P.N. & Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 19th Edition, 2011.
3. Som, S.R, & Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, Edition 3. 2011.
4. Hubert Chanson, "Hydraulics of Open Channel flow", Butterworth-Heinemann Ltd., 2nd Edition, 2004.
5. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S. Chand and Co., New Delhi, 2006.
6. Agarwal, S.K., "Fluid Mechanics and Machinery", Tata Mc Graw Hill Co., Edition 1. 2002.

14CE2006 STRENGTH OF MATERIALS

Credits: 3:1:0

(Version 1.1)

Pre-requisite: 14CE2002: Mechanics of Solids

Course Objective:

- To understand the concepts of deflection, stability criteria, theories of failure
- To study the analysis of indeterminate beams

Course Outcome:

At the end of the course the student will be able to

- Perform basic calculation and determine the stresses
- Develop the relation between material properties and strength
- Adapt the concept failure theories in structural members

Description:

Biaxial bending- Deflection of Determinate beams- Double integration, Macaulay's method - Moment area method - Conjugate beam method - Bending moment and Shear force of Indeterminate beams - Columns and struts - behaviour of axially loaded short, medium and long members - Critical loads with different end conditions - Euler's method, Analysis of thin and thick cylinders, Failure theories, Concept of Shear Center

References:

1. Egor, P.Popov , " Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2006.
2. Rajput, R.K., "Strength of Materials", S. Chand & Co. Ltd., New Delhi, 2006.
3. Bansal, R.K., "Strength of Materials", Laxmi Publications Ltd., New Delhi, 2010.

4. Bedi, D.S., “Strength of Materials”, Khanna Book Publishing Co. (P) Ltd., Delhi, 2003.
5. Bhavikatti S.S., “Strength of Materials, 3E”, Vikas Publishing House Pvt Ltd, 2009.

14CE2007 SOIL MECHANICS

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To gain knowledge about index and engineering properties of soil
- To study about stress distribution and settlement behaviour of soil
- To gain knowledge about stability of slopes

Course Outcome:

At the end of the course the student will be able to

- Determine the describe the index and engineering properties of soils from tests and basic theories
- Describe and classify the soil according to standards
- Apply the knowledge in the selection of appropriate substructures.

Description:

Index properties of soil such as water content, specific gravity & classification of soil according to BIS, Phase relations and plasticity characteristics - Engineering properties of soil such as permeability, compaction and consolidation- Stress Distribution analysis by Boussinesq equation & Westergaard's analysis and Causes & methods of minimizing settlement - Determination of Shear Strength by lab and field methods & Stability of Slopes and analysis by slip circle and friction circle method

References:

1. Punmia, B.C., “Soil Mechanics and Foundations”, Punmia B.C., Suara & Co., Madras 2005.
2. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers, New Delhi, 2011.
3. Gopal Ranjan, A S R Rao, “Basic and Applied Soil Mechanics”, New Age International (P) Limited, 2005.
4. Purushothama Raj. P., “Soil Mechanics and Foundation Engineering” Pearson Education, 2008.
5. Murthy V N S, “Geotechnical Engineering”, Library of Congress Cataloging-in-Publication Data, 2002.
6. IS 2720 (Parts 1 to 10, 13, 14, 30, 36).

14CE2008 WATER AND WASTEWATER ENGINEERING

Credits: 3:0:0

(Version 1.1)

Co-requisite: 14CE2021 - Environmental Engineering Lab

Course Objective:

- To educate the students in planning and design concepts related to water storage and distribution
- To impart knowledge on the design concepts related to waste water collection, treatment and disposal

Course Outcome:

At the end of the course students will be able to

- Estimate the quantity of water and waste water
- Design and develop appropriate sewerage system
- Recommend house connections in civil engineering works

Description:

Water Supply System: water demand - population forecast – water quality – water treatment: screening, sedimentation, filtration, disinfection – water distribution: pipe materials, laying and jointing, analysis of pipe network. Sewerage System: wastewater and storm water quantity – wastewater characteristics – wastewater treatment: flotation, primary sedimentation, suspended and attached growth process. House service connection: septic tank – one pipe and two pipe system – sanitary fixtures and fittings.

References:

1. Arceivala, S. J., “Wastewater Treatment for Pollution Control”, Tata McGraw Hill, 3rd edition 2006.
2. Bajwa G. S., “Practical Handbook on Public Health Engineering”, Deep Publishers, Shimla, 2003.
3. “Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
4. "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP, Washington, 1998.
5. Barbara Hauser A., “Practical Hydraulics Handbook”, Lewis Publishers, New York, 2nd edition, 1995.

14CE2009 REINFORCED CONCRETE STRUCTURES**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To study the behavior and design of RCC structural elements
- To study the design of supporting components of the buildings

Course Outcome:

At the end of the course the student will be able to

- Examine the design concept of various structural elements
- Analyze and design structural elements of building
- Interpret the concepts in design of buildings

Description:

Design philosophies – limit state design of one way, two-way, continuous slab and circular slabs – rectangular and flanged beams – axial and eccentrically loaded columns, straight, dog legged and open well staircases, Deep and Shallow foundations – resting on ground and underground water tanks – cantilever and counterfort retaining wall.

References:

1. Unnikrishna Pillai and Devdass Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd., latest edition 2003.
2. Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi, latest edition. 2007.
3. Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, latest edition. 2002.
4. Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., latest edition 2006.
5. Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi latest edition 2005.
6. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
7. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.

8. IS 3370 (Part I) - 1975 - Code of Practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi.

14CE2010 STRUCTURAL ANALYSIS

Credits: 3:1:0

(Version 1.1)

Pre-requisite: 14CE2006 - Strength of Materials

Course Objective:

- To understand the deflection and force methods for the analysis of structures
- To learn the concepts of moving loads and influence lines
- To study the analysis of indeterminate beams and frames

Course Outcome:

At the end of the course student will be able to

- Interpret the behaviour of structures using appropriate methods
- Analyze statically determinate and indeterminate structures
- Recommend suitable methods for analyzing the structures.

Description:

Work energy principles – Principle of virtual work-Castigliano's first, second theorem- Williot diagram- Rolling loads and Influence lines- reaction, shear force and bending moment- Muller Breslau's principle -Slope Deflection- Analysis of continuous beams and rigid frames with and without sway, Moment Distribution method – short cut methods – Multistoried frame analysis by substitute frame method, portal and cantilever method.

References:

1. Bhavikatti, S., "Structural Analysis", Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
2. Devadas Menon, "Advanced Structural Analysis", Alpha Science International, 2009.
3. Norris and Wilber, "Elementary Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
4. Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
5. Vaidyanathan, R. and Perumal,P., "Structural Analysis" Vol.1 & 2, Laxmi Publications, New Delhi, 2004.
6. Pandit, G.S. and Gupta, S.P., "Structural Analysis – A Matrix Approach", Tata McGraw Hill Publishing Co. Ltd., 2006.

14CE2011 - WATER RESOURCES ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To introduce the concepts of surface and ground water hydrology
- To enable the student to develop skills to appreciate water resources systems

Course Outcome:

At the end of the course the student will be able to

- Recognise the concepts to manage water resources and apply for hydrological modelling
- Decide and plan basic water resources projects
- Solve water related environment problems

Description:

Surface water hydrology : Hydrologic cycle and hydrological data-forms of precipitation- Hydrologic abstractions- Run-off – flood estimation by empirical formulae-Groundwater Hydrology – types of aquifers- steady flow towards well in confined and unconfined aquifer- pumping test- artificial recharge-conjunctive use of surface and groundwater - Potable Water - Water for Energy and other uses:Basic components of Hydro-electric project , Conservation of water: Reservoir- Single and multi purpose – Flood levees and flood walls.

References:

1. Linsley, R. K. and Franzini, J.B., “Water Resources Engineering”, McGraw Hill Inc, 4th edition 2013.
2. Subramanya, K., “Engineering Hydrology”, Tata McGraw Hill, 4th edition, 2013.
3. Sahasrabudhe, S.R., “Irrigation Engineering and Hydraulic Structures”, Katson Publishers, 3rd edition, 2011.
4. Garg S. K., “Irrigation Engineering and Hydraulic Structures”, Khanna Publishers, 2009.
5. Michael, A.M., “Irrigation – Theory and Practices”, Vikas Publishing House, New Delhi, 2004.

14CE2012 - FOUNDATION ENGINEERING**Credits: 3:0:0****(Version 1.1)****Pre-requisite:** 14CE2007 - Soil Mechanics**Course Objective:**

- To gain knowledge about exploration and bearing capacity of soil
- To study about types, selection and design of foundation
- To gain knowledge about pile and shallow foundation in detail

Course Outcome:

At the end of the course the student will be able to

- Apply the basic theories in determining suitable soil parameters
- Perform geotechnical design of various types of foundation
- Develop an appreciation of the modes of failure

Description:

Objectives of Soil Exploration, Sampling & methods and Requirement, Choices & factors governing selection of Foundation- Bearing Capacity of soil analysis by Terzaghi & Skempton, Determination & methods of improving - Earth Pressure analysis by Rankine, Coulomb, Culmann & Rehmann's methods, Design of shallow foundations such as rectangular combined footing & trapezoidal combined footing and types, functions and designing of deep foundations, Sheet Pile Walls.

References:

1. Punmia, B.C., “Soil Mechanics and Foundations”, Punmia B.C., Suara & Co., Madras 2005.
2. Kasmalkar, B.J., “Foundation Engineering”, Pune, Vidyarthi Griha Prabakar, Pune, 2002.
3. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers, New Delhi, 2011.
4. Purushothama Raj. P., “Soil Mechanics and Foundation Engineering” Pearson Education, 2008.
5. Murthy V NS., “Geotechnical Engineering” Library of Congress Cataloging-in-Publication Data, 2002

14CE2013 - DESIGN OF STEEL STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To study the design of connections
- To study the design of axial and flexural members
- To study design of roof truss

Course Outcome:

At the end of the course student will be able to

- Classify the various structural connections
- Analyze and design the structural elements
- Interpret the concepts in design of structures.

Description:

Concepts of steel design – Design of Bolted and Welded connections - Design of Members for Axial forces –Tension splices-lug angle - Design of Lacings, battens and Column bases - Design of Flexural Members - beams, rolled and built-up section- laterally restrained and unrestrained beams, welded plate girder and Beam Columns - Design of Industrial Roof Truss and Gantry Girder .

References:

1. Jayagopal.L.S and Tensing.D., “Design of Steel Structures”, Vikas Publishing, New Delhi 2015
2. Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi 2008.
3. Duggal S.K, “Limit State Design of Steel Structures”, Tata Mc Graw Hill Education Private Limited, New Delhi, 2010.
4. “Teaching Resources for Structural Steel Design – Vol. I & II”, INSDAG, Kolkatta.
5. Bhavikatti S.S., “Design of Steel Structures(By limit state method as per IS 800:2007)”, I K International Publiishing house pvt ltd, 2010.
6. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.

14CE2014 TRANSPORTATION ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To impart knowledge in planning, geometric design, construction and operation of highways and railways
- To understand the layouts and operation of airport and harbours

Course Outcome:

At the end of the course the student will be able to

- Classify and design highways as per standards
- Apply supply methodology in the design of railways
- Plan and design airports and harbours

Description:

Introduction to Transportation Engineering - Planning and Geometric design of highways - super elevation – design principles of flexible and rigid pavements – Defects in pavements - Planning, Geometric design and construction of Railways – Maintenance and materials- Conventional and modern methods (GIS &GPS), Airport planning, wind rose diagram, runway design and airport terminal buildings - Planning of harbor terminal buildings – Navigational aids and coastal structures – Dredging methods

References:

1. Saxena S.C & Arora S.P., “A Text book of Railway Engineering”, Dhanpat Rai Publishers, 2001.
2. Khanna, S.K., and Justo C.E.G., “Highway Engineering”, Nem Chand and Bros, 2005.
3. Oza H. P. and Oza G. H., “Dock and Harbour Engineering”, Charotar Publishing House, New Delhi, 2013.
4. Rangwala, S. C., “Airport Engineering”, Charotar Publishing House, New Delhi, 2013.
5. Narasimha Murthy A.S, Henry R. Mohle., “Transportation Engineering Basics” ASCE press 2000.

14CE2015 CONSTRUCTION TECHNOLOGY**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To impart knowledge about site planning and construction of foundations.
- To study the various methods of constructions and service requirements
- To understand the usage of equipments for construction

Course Outcome:

At the end of the course the student will be able to

- Understand the principles of planning the building.
- Choose the construction methodology and its sequences
- Adopt the appropriate construction equipment for the construction.

Description:

Planning of Building –setting of foundation- Methods of Construction – Concrete, Steel, Brick and stone Masonry, Hollow block masonry, pre-cast, roofs, Expansion joints, damp proof course, Composite-Formwork, shoring, underpinning and scaffolding – Service and safety Requirements - Construction Equipment.

References:

1. Varghese P.C, “Building Constructions “, Prentice Hall, 2007.
2. Rangwala S.C., Building Construction, Charotar Book Stall, Anand, 2003.
3. Punmia, B.C., “Building Construction”, Laxmi Publications (P) Ltd., 2008.
4. Relevant IS Codes and National Building Code of India.
5. Sushil Kumar, “Building Construction”, Standard Publishers, New Delhi, 2003.
6. Arora, S.P. and Bindra, S.P., “Building Construction”, Dhanpat Rai and Sons, 2003.

14CE2016 STRENGTH OF MATERIALS LAB**Credits: 0:0:2****(Version 1.1)****Co-requisite:** 14CE2002 - Mechanics of Solids**Course Objective**

- To apply the theory of mechanics of solids on real specimens
- To give hands on training on testing of real specimens

Course Outcome

At the end of the course the student will be able to

- Determine the various mechanical properties and strength of materials
- Study the behaviour of various structural elements

Description:

Test on mechanical properties of materials – Verification of theorems- Deflection studies

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Jindal, U.C, “Strength of Materials”, Asian Books Pvt. Ltd, 2007.

14CE2017 FLUID MECHANICS AND MACHINERY LAB

Credits: 0:0:2

(Version 1.1)

Co-requisite: 14CE2005 - Applied Hydraulics and Hydraulic Machinery

Course Objective:

- To give hands on training on the principle and working of different types of turbines
- To impart knowledge on open channel flow profiles

Course Outcome:

At the end of the course students will be able to

- Identify various forms of flows and flow measurement
- Select and operate pumps and turbines

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Modi, P.N and Seth, S.M., “Fluid Mechanics & Fluid Machines”, Standard Book House, New Delhi, 2007.
2. Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines”, S.Chand and Co., New Delhi, 2002.

14CE2018 - SURVEY LAB

Credits: 0:0:2

(Version 1.1)

Co-requisite: 14CE2001- Survey

Course Objective:

- To train the students to operate various survey instruments effectively
- To give hands on training on the use of conventional and modern tools of surveying

Course Outcome:

At the end of the course the student will be able to

- Acquire skill in operation of various survey instruments
- Develop an understanding on the use of conventional and modern tools of surveying
- Demonstrate various types of surveying

Description: Measurements of distance and area using different survey equipments- Measurement of reduced levels - estimation of height of elevated objects - setting out curves.

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Kanetkar, T.P and Kulkarni, S.V., “Surveying and Levelling”, Part 1 and 2, Pune Vidyarthi Griha Prakashan 2010.
2. Basak, N., “Surveying and Levelling”, McGrawHill & Co. 2011.

14CE2019 BUILDING DRAWING LAB**Credits: 0:0:2****(Version 1.1)****Course objectives:**

- To understand the principles of planning and byelaws
- To draw plan, elevation and section of load bearing and framed structures
- To draw plan, elevation and section of public and industrial structures
- To prepare detailed working drawing for doors, windows, etc.

Course outcomes:

At the end of the course students will be able to

- Understand the principles of civil engineering drawing
- Apply the knowledge to plan commercial and residential buildings

Description:

Building planning - Building bye-laws- Building Information model (BIM) - Detailed drawings using AutoCAD

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Shah M.G. Kalec. M. & Patki SY Building Drawing, Tata Mcgraw Hill, New Delhi, 2000.
2. AUTO CAD Tutorials and Manual- Autodesk Work Book on AUTO CAD Level I and II CAD/CAM centre, Coimbatore.
3. Gurucharan Singh & Jagdish Singh, “Building Planning, Designing and scheduling”, Standard Publishers, New Delhi, 2001.
4. IS: 962 – 1967, Code of Practice for Architectural and Building Drawing, Bureau of Indian Standards, New Delhi.
5. IS: 3021 – 1983, Specification for Timber Door, Window and Ventilator Frames, Bureau of Indian Standards, New Delhi.
6. IS: 1003 – 1977, Part I, II Specification for Timber Panelled and Glazed Shutters, Bureau of Indian Standards, New Delhi Revit Package Manual.

14CE2020 GEOTECHNICAL ENGINEERING LAB**Credits: 0:0:2****(Version 1.1)****Co-requisite:** 14CE2007 - Soil Mechanics**Course Objective:**

- To determine the index and engineering properties of soil
- To classify the soil according to standards

Course Outcome:

At the end of the course the student will be able to

- Determine the index and engineering properties of soil
- Determine the describe and classify soil according to standards

Description: Determination of various index and engineering properties of soil

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Lambe, T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1990.
2. IS 2720-1983, “Indian Standard Code of Practice: Methods of tests for Soil”, , Bureau of Indian Standards, New Delhi.

14CE2021 - ENVIRONMENTAL ENGINEERING LAB

Credits: 0:0:2

(Version 1.1)

Co-requisite: 14CE2008 - Water and Wastewater Engineering

Course Objective:

- To make the students conversant with the experimental procedures for quantitative estimation of water quality parameters
- To give hands on training on the testing of wastewater quality

Course Outcome:

At the end of the course the student will be able to

- Examine the characteristics of water and waste water
- Categorise the water according to standards
- Recommend for necessary water and waste water treatment

Description: Analysis of physical – chemical properties of water and waste water

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References

1. Sawyer, N.C., and McCarty, P.L., “Chemistry for Environmental Engineering”, McGraw-Hill Book Co., New York, 2003.
2. “Standard Methods for the Examination of Water and Waste Water”, APHA- AWWAWPCF, latest Edn., Washington (D.C). 1995.

14CE2022 CONCRETE AND HIGHWAY LAB

Credits: 0:0:2

(Version 1.1)

Course Objective:

- To give hands on training in testing of cement and aggregates
- To give hands on training in testing of concrete and highway materials
- To impart knowledge on mix design procedures

Course Outcome:

At the end of the course students will be able to

- understand the field problems through experimentation
- check the quality of material used in the construction of building and highway
- carry out concrete mix design

Description:

Destructive and non destructive tests on constituents of concrete - Tests on aggregates, bitumen and bituminous mixes

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Shetty, M. S., "Concrete Technology", S. Chand and Co., New Delhi, 2005.
2. Gambhir, M.L., "Concrete Technology – Theory and Practice", Tata McGraw Hill Publishing Ltd, New Delhi, 2009.
3. IS 2386 – 1963 Part I, III, "Methods of test for aggregate for concrete", Bureau of Indian Standards, New Delhi.
4. IS 516 – 1959, "Method of test for strength of concrete", Bureau of Indian Standards, New Delhi.
5. IS 10262-2009, "IS standard for recommended guidelines for concrete mix design", Bureau of Indian Standards, New Delhi.

14CE2023 - COMPUTER APPLICATION LAB

Credits: 0:0:2

(Version 1.1)

Pre-requisite: 14CE2011 - Water Resources Engineering

Course Objective:

- To give hands on training on Matlab Programming
- To analyze and design various structural elements using STAAD Pro

Course Outcome:

At the end of the course the student will be able to

- Write programmes for design and project management
- Analyse the design problems analytically.
- Develop matlab program for real time structures

Description:

Developing Matlab program for the design of structural elements – Project management software - Analysis of structures using STAAD Pro software

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Rudra Pratap Getting Started with MATLAB Oxford University Press, 2002.
2. STAAD Package Manual.

14CE2024 DESIGN AND DRAWING (RCC & STEEL) LAB

Credits: 0:0:2

(Version 1.1)

Pre-requisite: 14CE2009 - Reinforced Concrete Structures
14CE2013 - Design of Steel Structures

Course objectives:

- To design and detail RCC structures
- To design and detail steel structures

Course outcomes:

At the end of the course the student will be able to

- Summarise the reinforcement detailing in the field
- Design various structures for the requirements for the society
- Develop the reinforcement detailing for various structures

Description:

Detailed design of the reinforced concrete structures and drawing using software - Detailed design of the steel structures and drawing using software

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Dayaratnam P., "Design of Reinforced Concrete Structures", Oxford & IBH Publishers & Co., New Delhi, 2011
2. Victor, D.J., "Essentials of Bridge Engineering", Oxford & IBH Publishers Co., New Delhi, 2009
3. IS456-2006 Code of practice for Plain and reinforced concrete code of practice.
4. SP-34-1987, Handbook on Reinforcement and Detailing.
5. SP 6: Part 1: 1964, Handbook for Structural Engineers - Structural steel sections.
6. IS 800-2007, "General Construction in Steel - Code of Practice", Bureau of Indian Standards, New Delhi.

14CE2025 - ESTIMATION AND COSTING

Credits: 0:0:2

(Version 1.1)

Course Objective:

- To impart techniques of estimation of buildings, roads, and irrigation structures
- To introduce the concepts of rate analysis

Course Outcome:

At the end of the course students will be able to

- Execute rate analysis of various works in construction,
- Estimate the total construction cost of structures

Description:

Estimate of buildings - Estimate of road, sanitary and retaining structures - Specification and tenders – Valuation - Report preparation.

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Dutta.B.N, “Estimating and Costing”, UBS Publications, 2005.
2. Rangawala.S.C., “Estimating and Costing”, Charotar Anand, 2002.
3. IS 1200-1 (1992): Methods of measurement of building and civil engineering works, Part - 1: Earthwork [CED 44: Methods of Measurement of Works of Civil Engineering].
4. IS: 1200 - 1974- Parts 1 to 25, Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards, New Delhi.

**14CE2026 DESIGN AND DRAWING (IRRIGATION AND ENVIRONMENT)
LAB****Credits: 0:0:2****(Version 1.1)****Pre-requisite:** 14CE2008 - Water and Waste Water Engineering
14CE2011 - Water Resources Engineering**Course Objective:**

- To impart the knowledge about the design of irrigation and environmental engineering structures
- To give hands-on experience in drawing of irrigation and environmental engineering structures

Course Outcome:

At the end of the course students will be able to

- Design and draw irrigation structures
- Design and draw environmental engineering structures

Description:

Design of major irrigation works to be worked out and detailed drawings using software- Design of major environmental engineering works to be worked out and detailed drawings using software.

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Ellis, W.M., “College of Engineering Manual: Irrigation”, The Textile Institute Publishers, 2012.
2. Santosh Kumar Garg., “A Text Book of water supply Engineering”, Khanna Publishers, 2010.

14CE2027 ENGINEERING PRACTICES LAB**Credits: 0:0:1****(Version 1.1)****Course Objective:**

- To study the basic practices in civil engineering construction

Course Outcome:

At the end of the course the student will be able to

- Inspect electrical and plumbing works for buildings
- Explain the bar bending schedule

Description:

Plumbing and electrical services - Welding joints - Bar bending - Brickwork –plastering- floor finishing

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Saravanapandian M, Pranitha S, Jeyapoovan T., "Engineering Practices Laboratory Manual", VRB Publishers Private Ltd 2009.
2. Jeyachandran.K., Natarajan.S. and Balasubramanian.S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Bawa.H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad.A. and Sarma.P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.

14CE2028 CONSTRUCTION MANAGEMENT**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To introduce the concepts of management, resources and construction planning
- To introduce the labour laws, principle of accounting
- To introduce fundamentals concepts of computer applications in construction management

Course Outcome:

At the end of the course the student will be able to

- Manage resources and labours in construction
- Plan construction projects
- Estimate the cost of the project and evaluate tenders

Description:

Management Principles –Functions – Construction Management - Quantity method of management- management by network analysis and control – CPM/PERT - control by graphical representation, by bill of quantities and by network analysis - Tender and tender documents- Definition - calling of tenders - tender documents - submission of tenders - processing of tenders - negotiations and settlement of contracts – Contracts –Arbitration- Software applications in Recording and Operations – Environment health and safety (EHS).

References:

1. Seetharaman, S., "Construction Engineering and Management", Umesh Publications, 2007.
2. Sengupta, B., and Guha, H., "Construction Management and Planning", Tata McGraw-Hill Book Co., 2000.
3. Rana,V.K., "Construction Management Practice", Tata McGraw-Hill publishing Co.,2000.
4. Chitkara, K.K., "Construction Project Management", Tata McGraw-Hill publishing Co., 2000.
5. Sharma, J.L., "Construction Management and Accounts", Sathya Prakashan, New Delhi, 2011.

14CE2029 ADVANCED REINFORCED CONCRETE STRUCTURES**Credits: 3:0:0****(Version 1.1)****Pre-requisite:** 14CE2009 - Reinforced Concrete Structures**Course Objective:**

- To introduce the fundamental design concepts of advanced structural elements
- To design the bridges as per IRC loading conditions
- To emphasize the importance of grid flooring

Course Outcome:

At the end of the course the student will be able to

- Elaborate the design concepts of complex structural elements.
- Analyze and design the structural elements as per standards.

- Prepare detailing in appropriate professional formats.

Description:

Design of flat slab- components, BIS codal recommendations, direct tension method, Equivalent frame method – Design of box culverts and road bridges (slab and T beam) as per IRC codal provisions – Design of Corbels: brackets and nips – Design of deep beam, grid floor – Design of RCC domes

References:

1. Unnikrishna Pillai and Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd. 2003.
2. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India Pvt. Ltd. 2000.
3. Punmia.B.C., Ashok, K. Jain., Arun.K.Jain , “Limit State Design of Reinforced concrete”, Laxmi Publications (P). 2007.
4. Krishna Raju, N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi. 2005.
5. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
6. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.
7. IRC Bridge Codes and Pigeaud's charts.

14CE2030 ADVANCED STRUCTURAL ANALYSIS

Credits: 3:0:0

(Version 1.1)

Pre-requisite: 14CE2010 - Structural Analysis

Course Objective:

- To impart knowledge about arches, suspension bridges and space trusses
- To analyze indeterminate structures using flexibility and stiffness method
- To determine shear centre and analyze curved
- To analyse structural elements

Course Outcome:

At the end of the course the student will be able to

- Identify the degrees of freedom and formulate flexibility and stiffness matrix
- Interpret the concept of structural stability in structural design
- Apply the theoretical concepts in computer applications for structural analysis

Description:

Arches-parabolic and semi circular arches- cables and suspension bridges - Analysis of space trusses – Matrix flexibility method – Determinate and indeterminate trusses, beams and frames-Matrix Stiffness method- Determinate and indeterminate trusses, beams and frames - curved beams.

References:

1. Norris and Wilber, “Elementary Structural Analysis”, Tata McGraw Hill Publishing Co., 2005.
2. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, “Theory of structures”, Laxmi Publications, New Delhi, 2004.
3. Reddy, C.S., “Basic Structural Analysis”, Tata McGraw Hill Publishing Co., 2005.
4. Vaidyanathan, R. and Perumal, P., “Structural Analysis”, Vol.1 & 2, Laxmi Publications New Delhi, 2004.

5. Pandit, G.S. and Gupta, S.P., “Structural Analysis – A Matrix Approach”, Tata McGraw Hill Publishing Co. Ltd., 2006.
6. Wang, C.K., “Intermediate Structural Analysis”, Tata McGraw-Hill Publishing Co., 2010.

14CE2031 - CONCRETE TECHNOLOGY

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To study about the constituents of concrete
- To study the properties of fresh and hardened concrete
- To understand the concepts of mix design methods

Course Outcome:

At the end of the course the student will be able to

- Examine the properties of concrete and its constituents
- Design concrete mixes by various mix design methods
- Evaluate special concretes for construction field

Description:

Concrete- Constituents: cement, fine aggregates and coarse aggregates, Admixtures: chemical and mineral, Properties, Compositions and Tests - Properties of Fresh Concrete- workability, segregation, bleeding, mixing compaction and curing - strength and durability studies on Hardened Concrete - Mix Design: BIS, ACI and BS method - special concrete: light weight concrete, ready mix concrete, fiber reinforced concrete, Aerated concrete, No fines concrete, high strength concrete, ferrocement, high performance concrete, shotcrete, pumped concrete, preplaced concrete - repair and rehabilitation.

References:

1. Neville, A.M., “Concrete Technology”, Longman Scientific & Technical, 2005.
2. Gambhir, M.L., Concrete Technology, Tata Mc Graw Hill Publishing Company limited, New Delhi, 2004.
3. Shetty, M.S., “Concrete Technology”, S.Chand & Co., New Delhi, 2013.
4. Santhakumar A.R, “Concrete Technology”, Oxford University press, Jai Singh road, Delhi, 2006.
5. Adam Neville, “Concrete: Neville’s insights and issues”, Thomas Telford Books, 2006.

14CE2032 BASICS OF DYNAMICS AND ASEISMIC DESIGN

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To introduce the phenomena of earthquakes, the process, measurements and the factors that affects the design of structures in seismic areas.
- To introduce the concepts of seismic design of buildings
- To understand codal provisions and the aseismic design methodology.

Course Outcome:

At the end of the course the student will be able to

- Adopt the basic concepts of dynamics in seismic design
- Analyse the structures for seismic forces
- Apply the concepts to strengthen the existing buildings

Description:

Theory of vibrations – One degree, two degree of freedom system with and without damping- free and forced vibration-Response spectrum- Seismology-Plate tectonics- lessons from past earthquakes-seismic zone map of India- Seismic analysis of RCC and steel building using codal provision- improving seismic resistance of masonry buildings-strong column-weak beam concept- Ductile detailing - Seismic strengthening and Structural control methods –Base isolation, bracings, dampers.

References:

1. Pankaj Aggarwal, Manish Shrikande, “Earthquake resistant design of structures”, Prentice Hall of India, Delhi, 2006.
2. Anil K. Chopra, “Dynamics of structures- Theory and applications to earthquake engineering”, Prentice hall of India, New Delhi, 2007.
3. Mario Paz, M., “Structural Dynamics – Theory & Computation”, CSB Publishers & Distributors, Shahdara, Delhi, 2004.
4. NPEEE Publications, 2005.
5. Roy R Craig Jr, Andrew J Kurdila., ”Fundamentals of Structural Dynamics”, John Wiley and Sons, 2011.
6. IS1893:2002, Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi
7. IS 13920:1993, Ductile detailing of Reinforced Concrete Structures subjected to seismic forces, Bureau of Indian Standards, New Delhi.

14CE2033 BUILDING SERVICES**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To learn about water supply and sanitation arrangements in a building
- To understand the essentials of electrical installations in a building
- To get an exposure to air conditioning and fire safety arrangement
- To pioneer the concepts of intelligent building

Course Outcome:

At the end of the course the student will be able to

- Identify the byelaws for building services
- Design the service and safety systems for buildings
- Recommend suitable building services for various applications

Description:

Building Sanitation and Byelaws- septic and sewage treatment plant-Rain water harvesting - Electrical Installations in Buildings-wiring system-main and distribution boards, transformers, switch gears-lighting design - Air Conditioning System and Applications- Natural and artificial ventilation - Fire Safety control measures and Regulations - Introduction to Intelligent buildings- building automation- green buildings, Smart buildings.

References:

1. Arceivala, S. J., "Wastewater Treatment for Pollution Control", Tata McGraw Hill, 3rd edition 2006.
2. Bajwa G. S., “Practical Handbook on Public Health Engineering”, Deep Publishers, Shimla, 2003.
3. National Building Code-Part VIII Building Services- Section 4, Acoustics, Sound Insulation and Noise Control- Bureau of Indian Standards, New Delhi, 2005.

4. IS: 2526 – 1963 (reaffirmed 1996) Code of Practice for Acoustical Design of auditoriums and Conference Hall- Ninth reprint December 1998 (incorporating Amendment No: 1) New Delhi.
5. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.

14CE2034 ADVANCED STRUCTURAL ENGINEERING LAB

Credits: 0:0:2

(Version 1.1)

Pre-requisite: 14CE2031- Concrete Technology
14CE2009 - Reinforced Concrete Structures

Course Objective:

- To learn the concepts of mix design
- To understand the flexural behaviour of RCC and steel beam by experimental Investigation
- To get an exposure on NDT methods

Course Outcome:

At the end of the course the student will be able to

- Design various concrete mixes
- Investigate the flexural behaviour of RCC and steel beam
- Conduct the NDT tests in the field

Description:

Mix Design - High performance concrete – behavior of beams, columns, slabs – NDT Tests – Steel beam, column test – joints test - frame test.

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Kukreja C.B, Kishore K and Ravi Chawla, “Material Testing Laboratory Manual”, Standard Publishers, New Delhi, 2001.
2. IS 10262 Indian Standard code for Concrete Mix Design, Bureau of Indian Standards, New Delhi.

14CE2035 ADVANCED COMPUTER APPLICATION LAB

Credits: 0:0:2

(Version 1.1)

Pre-requisite: 14CE2010 - Structural Analysis
14CE2009 - Reinforced Concrete structures
14CE2013 - Design of Steel Structures

Course Objective:

- To analyze and design various structural elements using SAP/ETABs and Matlab
- To impart knowledge in analysing the structural elements using ANSYS Software

Course Outcome:

At the end of the course the student will be able to

- Model 2D and 3D building using STAAD
- Analyse the RCC and Steel Building Frame
- Design structural elements

Description:

Analysis of structures using SAP/ETABs, Matlab

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. SAP / ETABS Package Manual.
2. ANSYS Package Manual.
3. Matlab Manual.

14CE2036 PREFABRICATED STRUCTURES**Credits: 3:0:0****(Version 1.1)****Pre-requisite:** 14CE2009 - Reinforced Concrete structures**Course Objective:**

- To study the design of prefabricated structural components and its joints
- To study the design of prefabricated structures subjected to dynamic forces

Course Outcome:

At the end of the course the student will be able to

- Adopt prefabrication techniques and methods for residential buildings
- Adopt prefabrication techniques for industrial structures

Description:

Prefabrication and its components Modular co-ordination- standardization systems- production- transportation- erection- Behaviour of structural components- construction of roof and floor slabs-wall panels-columns-shear walls - Design Principles- Disuniting of structures- Design of cross section based on efficiency of material used - Joints in Structural members - Design for dynamic forces – Progressive collapse-Equivalent design loads for considering abnormal effects such as earthquake, cyclones, explosions and fire

References:

1. John D. Quale., “Sustainable, Affordable, Prefab: The EcoMOD Project”, University of Virginia Press, 2012.
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc., 2012.
3. Koncz T., “Manual of precast concrete construction”, Vols. I, II and III, Bauverlag, GMBH, 1971.
4. Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013.
5. Colin Davies., “The Prefabricated Home”, Reaktion Books, 2005.

14CE2037 ADVANCED DESIGN OF STEEL STRUCTURES**Credits: 3:0:0****(Version 1.1)****Course Objectives:**

- To study the design of advanced types of framed connections
- To study the concepts and design of pre-engineered buildings
- To study the analysis and design of towers and chimneys
- To understand the behaviour of Composite members and design the composite slab, beam and column

Course outcomes:

At the end of the course student will be able to

- Classify different types of bolted and welded joints
- Design steel beams and columns
- Assess the resistance of shear connectors in composite sections

Description:

Design of Bolted and Welded connections for framed structures and Advanced connections – stiffened and unstiffened seat connections - Design of Industrial bents, sway and non-sway frames, Gable column, purlins and Bracings – Analysis and design of Towers and Chimneys - Design of steel concrete composite beams and columns – IS and Euro codal provisions – ultimate load theory – design of shear connectors – Composite deck slab.

References:

1. Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2008.
2. Duggal S.K, “Limit State Design of Steel Structures”, Tata Mc Graw Hill Education Private Limited, New Delhi, 2010.
3. “Teaching Resources for Structural Steel Design – Vol. I & II”, INSDAG, Kolkatta, 2003.
4. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.
5. Johnson R.P., "Composite Structures of Steel and Concrete", Blackwell Scientific Publications, 2004.

14CE2038 INDUSTRIAL WASTE TREATMENT AND DISPOSAL**Credits: 3:0:0****(Version 1.1)****Pre-requisite:** 14CE2009 Water and Wastewater engineering**Course Objective:**

- To know the effects, importance and fundamental methods in Industrial waste treatment
- To impart knowledge about disposal of effluents and the standards for disposal

Course Outcome:

At the end of the course the student will be able to

- Identify the impacts of waste on environment
- Select suitable method for industrial waste treatment and disposal

Description:

Effects of industrial wastes on environment, waste minimization techniques: volume and strength reduction - Physical, chemical and biological treatment of industrial sewage, advanced wastewater treatment – manufacturing process, wastewater characteristics and treatment processes of major industries - Effluent standards and legislations, zero discharge concepts - environmental protection act – Air Act – Water Act – Wetland Regulatory Notification and Coastal Zone Regulation.

References:

1. Rao, M.N. and Dutta, “Waste Water Treatment”, Oxford and IBH Publishing Ltd. Calcutta, 2008.
2. Eckenfelder, W.W., “Industrial Waste Pollution Control”, McGraw Hill Book Co., New Delhi 2003.
3. Nemerow, N.L., “Theory and Principles of Industrial Waste Treatment”, Addison Wesley, Reading Mass, 2003.
4. Water Environment Federation., “Industrial Waste water Management Treatment and Disposal 3E”, Mc Graw Hill, 2008.
5. Frank Woodard., “Industrial Waste Treatment Handbook”, Butterworth-Heinemann, 2001.

14CE2039 SOLID WASTE MANAGEMENT

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To educate the students on the principles involved in the management of municipal solid and hazardous wastes
- To impart knowledge on various solid waste treatment strategies

Course Outcome:

At the end of the course the student will be able to

- Use the principles in the management of solid waste
- Select appropriate solid waste collection and treatment methods
- Develop skills to undertake major projects related to municipal solid waste management

Description:

Types and sources of solid waste, integrated waste management, legislations on municipal solid waste, hazardous wastes, biomedical wastes - Composition, physical, chemical and biological properties of solid waste, Source reduction, recycling and reuse - Storage, collection and transport of solid waste, handling of hazardous waste and its transport - Material separation and processing technologies - biological, chemical and thermal conversion and disposal – treatment of biomedical wastes.

References:

1. George Tchobanoglous, Hilary Theisen and Samuel, A. Vigil, "Integrated Solid Waste Management", McGraw- Hill International edition, New York, 2012.
2. "CPHEEO Manual on Municipal Solid waste management", Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Micheael, D. LaGrega, Philip, L. Buckingham, Jeffrey, C. E., "Environmental Resources Management, Hazardous waste Management", McGraw-Hill International edition, New York, 2001.
4. Vesilind, P.A., Worrell, W and Reinhart, "Solid waste Engineering", Thomson Learning Inc., Singapore, 2002.
5. Jagbir Singh, A. L Ramanathan, "Solid Waste Management Present and future Challenges", IK International, 2010.

14CE2040 ENVIRONMENTAL CHEMISTRY AND MICRO-BIOLOGY

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To educate on the chemistry of water, air and soil
- To impart knowledge on the role and impact of microorganisms on the environment

Course Outcome:

At the of the course the student will be able to

- Assess the chemical reaction in the environment
- Relate chemical reactions with the causes of environmental changes
- Investigate the metabolism, distribution and isolation of microorganisms

Description:

Chemical reactions, Chemical equilibrium and thermodynamics, Instrumental methods - chromatographic and spectroscopic techniques - Complex formation, oxidation, reduction and sorption in aquatic environment - Chemical and photochemical reactions in the atmosphere, photochemical smog, green

house gases and global warming - Distribution of microorganisms in water, air and soil, indicator organisms, metabolism of microorganisms, isolation of microorganisms.

References:

1. Sawyer C.N, MacCarty P.L and Parkin G.F, "Chemistry for Environmental Engineering and Science", Tata McGraw-Hill, Fifth edition, New Delhi, 2002.
2. Vanloon G.W and Duffy S.J "Environmental chemistry – a global perspective", Oxford University press, New York., 2000..
3. Pradipta K Mohapatra., "Environmental Microbiology", I K International, 2008.
4. Anita Rajor., "Practical Methods for Environmental Microbiology and Biotechnology", Krishna Prakashan Ltd. Meerut, 2002.
5. Mehrotra And Sumbali, "Principles of Microbiology", Tata McGraw-Hill Education, 2009.

14CE2041AIR POLLUTION MANAGEMENT

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To educate the students on various sources of air pollution and their effects on environment
- To expose the students on the different strategies of air pollution management

Course Outcome:

At the end of the course the student will be able to

- Classify the different types of air pollutants
- Select suitable air pollution control methods

Description:

Sources and classification of pollutants and their effects on human health vegetation and property, emission standards, atmospheric stability, atmospheric diffusion theories - plume rise – Methods for the control of particulate and gaseous contaminants - operational considerations and monitoring - Process modification for the minimization of automobile pollution, Technical and Economic Feasibility of emerging technologies for air pollution control , indoor air quality, noise measurements and standards – Radioactive pollution and its control.

References:

1. Rao C S, "Environmental Pollution Control Engineering", New Age International (p) Limited, 2006.
2. Lawrence K.Wang, "Norman C Perelra, Yung-Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
3. David H.F Liu, Bela G.Liptak, "Air Pollution", Lewis Publishers, 2000.
4. Anjaneyulu.Y, "Air Pollution & Control Technologies", Allied Publishers (P) Ltd, India, 2002.
5. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis" IK International, 2010.

14CE2042 GLOBAL CLIMATE CHANGE AND ITS IMPACT

Credits: 3:0:0

(Version 1.1)

Pre-requisite: 14CE2012 - Water Resources Engineering

Course Objective:

- To appreciate the global climate change scenario, causes and consequences
- To learn about climate change modelling

Course Outcome:

At the end of the course the student will be able to

- List the factors affecting global climate change
- Analyse the impacts of climate change across the globe
- Develop strategies to adapt climate change

Description:

Concept of Global Climate: climate in the spot light- the earth's natural green house effect- Green house gases- vital importance of monsoon rains, clouds, storms and climate - Causes for climate change: Patterns of large-scale variability - Influences and feedbacks of hydrological changes on climate - Climate modelling - Potential consequences and impacts of climate change- Water-related adaptation to climate change in the fields of ecosystems and biodiversity- Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and economy (insurance, tourism, industry and transportation) -Adaptation, vulnerability and sustainable development.

References:

1. Olav Slaymaker, Thomas Spencer Christine Embleton, "Geomorphology and Global Environmental change", Cambridge University Press, 2011.
2. Thomas R Karl, Jerry Melillo., "Global Climate Change Impacts in the United States", U S Global Change Research. 2009.
3. Syed M. H., "Climate Change". Daya Publishing House, 2009.
4. Syed M.H, Encyclopaedia of SAARC Nations, Gyan Publishing House, 2003.
5. Alper Baba, Gökmen Tayfur, "Climate Change and Its Effects on Water Resources" Springer Publishers, 2010.

14CE2043 DISASTER MANAGEMENT AND MITIGATION

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To expose the students to the natural and manmade disasters
- To train the students the effect of disasters and methods for mitigation

Course Outcome:

At the end of the course the student will be to

- Examine the effects of natural and man - made disasters
- Develop mitigation methods for various disasters
- Adopt disaster management strategies

Description:

Types and effects of natural disasters, climate change: sea level rise and global warming, ozone layer depletion - Types of man-made disasters, effects on the environment, types of accidents - Mitigation of natural disaster, national disaster management framework, financial arrangements, community based organizations, role of central, state, district and armed forces in disaster response, police and other organizations - Skills and strategies for disaster preparedness, reconstruction and rehabilitation, risk-time charts

References

1. Iyengar, C.B.R.I., "Natural Hazards in the Urban Habitat", Tata McGraw Hill Co., 2001.
2. Jon Ingleton, "Natural Disaster management", Tulor Rose, 1999.
3. Singh, R.B., "Disaster Management", Rawat Publications, 2000.
4. Sachindra Narayan, "Anthropology of Disaster management", Gyan Publishing House, 2000.

5. Damon P. Coppola Introduction to International Disaster Management”, Elsevier Publication, 2011.

14CE2044 ADVANCED ENVIRONMENTAL ENGINEERING LAB

Credits: 0:0:2

(Version 1.1)

Pre-requisite: 14CE2021 Environmental Engineering Lab

Course Objective:

- To give hands-on training on the site as well as laboratory methods of water and wastewater analysis
- To educate the students on the analysis of chemical and biological parameters of water and wastewater

Course Outcome:

At the end of the course the student will be able to

- Examine the physio-chemical and biological characteristics of water and waste water
- Analyse the heavy metals in water and waste water

Description:

Physical, chemical and bacteriological analysis of industrial and municipal wastewater - Analysis of heavy metals in water and waste water – air quality parameters.

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Sawyer, N.C., and McCarty, P.L., “Chemistry for Environmental Engineering”, McGraw-Hill Book Co., New York, 2002.
2. “Standard Methods for the Examination of Water and Waste Water”, APHA-AWWAPCF, Washington (D.C), 2012.

14CE2045 GIS LAB

Credits: 0:0:1

(Version 1.1)

Course Objectives:

- To give hands-on training on the applications of GIS in the context of water resources

Course Outcome:

At the end of the course the student will be able to

- Analyse the geo- spatial maps and related data
- Model geographical information systems
- Manage land and water resources

Description:

Map processing - Spatial analysis – Overlay analysis - land use – land cover changes

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Lillesand, T. M. and Kiefer, R. W. “Remote Sensing and Image Interpretation”, Third Edition. John Wiley and Sons, New York, Fifth Edition 2003.
2. Basudeb Bhatta. “Remote Sensing and GIS”. Oxford University Press. 2nd Edition 2011.

3. Lo C P Yeung, K W Albert, Concepts and Techniques of GIS, Prentice Hall of India, 2002.
4. Michael N. Demers, "Fundamentals of GIS with Lab Manual Set", John Wiley & Sons, 2000.

14CE2046 SMART MATERIALS AND STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective

- To give an in-depth knowledge on properties of smart materials and their use in structures.

Course Outcome

At the end of the course the student will be able to

- Examine the properties of smart materials
- Choose various measuring techniques suitable for building elements' characteristics
- Recommend appropriate smart materials for structures

Description:

Properties of smart materials- mechanisms and properties - fiber optic strain sensors, vibration absorbers- vibration characteristics of mistuned systems strain measuring techniques control systems: classical control, modern control, optimal control and digital control - active structures in practice, Application of smart materials in bridges, high rise structures – structural health monitoring - concept of smart concrete.

References

1. Srinivasan, A.V., and Michael McFarland. D., "Smart Structures – Analysis and Design", Cambridge University Press, 2001.
2. Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996.
3. Donald J. Leo, "Engineering Analysis of Smart Material Systems" John Wiley & Sons. 2007.
4. Hartmut Janocha, "Adaptronics and Smart Structures: Basics, Materials, Design, and Applications", Springer, 2007.
5. Brebbia C. A, Samartin A., "Computational methods for smart structures and materials II", WIT Press/Computational Mechanics Publications, 2000.

14CE3001 APPLIED ELASTICITY AND PLASTICITY

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To study the stress and strain analysis of 2D and 3D problems and torsion
- To have a brief introduction to failure criteria and elasto-plastic problems of beams in bending, pressure vessels and torsion

Course Outcome:

At the end of the course student will be able to

- Describe the stress distribution in two and three dimensional problems of elasticity
- Apply failure criteria for complex state of stress
- To predict the yield strength of structural elements

Description:

Analysis of stress and strain in three dimensional Cartesian coordinates, generalized Hook's law, formulation of elasticity problems, two dimensional problems in rectangular and polar co-ordinates ,torsion of non-prismatic bars and thin walled open and closed sections, Yield criteria, elasto-plastic problems –Beams in bending, cylinders subjected to internal pressure and torsion of bars.

References:

1. Sadhu Singh., "Theory of Elasticity", Khanna Publishers, N.Delhi, 2013.
2. Sadhu Singh., "Theory of Plasticity and Metal forming", Khanna Publishers, New Delhi, 1999.
3. Timoshenko, S and James M Gere, "Theory of Elasticity Stability", Dover Publication, 2009.
4. Chakrabarthy, J., "Theory of Plasticity", BH publishers, 2006.

14CE3002 ADVANCED CONCRETE TECHNOLOGY**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To study about the constituents of concrete
- To study the properties of fresh and hardened concrete
- To apply new theories and testing techniques

Course Outcome:

At the end of the course the student will be able to

- Examine the properties of concrete and its constituents
- Analyse the behaviour and formation of cracks in concrete.
- Predict the behaviour of concrete structures by destructive and non-destructive methods.

Description:

Concrete- Constituents: cement, fine aggregates and coarse aggregates, - use of various additives, production techniques and chemical processes, degree of control over the properties of specific concretes for a wide range of applications - New theories, models and testing techniques, Fracture mechanics of hardened concrete, advanced cementitious composites, production of durable, economical and sustainable concrete – Non destructive testing of concrete.

References:

1. Advanced Concrete Technology 2: Concrete Properties, "John Newman, B S Choo,. Butterworth-Heinemann". 2003.
2. Murari Lal Gambhir, "Concrete Technology: Theory and Practice" Tata McGraw-Hill Education. , 2013.
3. Nayak N. V., Jain A. K., "Handbook on Advanced Concrete Technology", Alpha Science International, Limited, 2012.
4. Zongjin Li. "Advanced Concrete Technology", John Wiley & Sons. 2011.

14CE3003 STRUCTURAL OPTIMIZATION**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To enable the student to understand the concept of optimization
- To enable them apply optimization concept to different civil engineering problems

Course Outcome:

At the end of the course student will be able to

- Describe conventional and non-conventional optimization technique
- Analyse and optimize the structural element.
- Apply the knowledge in designing real time problems

Description:

Concepts of minimum weight - minimum cost design, constrained and unconstrained optimization techniques, linear and non-linear programming- simplex algorithm, geometric programming, dynamic programming, Non- conventional optimization techniques-genetic algorithm, ant colony algorithm, artificial neural networks, fuzzy logic in civil engineering. Optimal design of beams, frames and trusses.

References:

1. Rao, S.S., "Engineering Optimization, Theory and Practice", New Age International (p) Ltd., New Delhi, 2002.
2. David. W. A Rees., "Mechanics of Optimal Structural Design: Minimum Weight Structures", John Wiley and Sons, 2009
3. Rajasekaran,S. and Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and GeneticAlgorithm", Prentice Hall of India Pvt. Ltd, Delhi, 2003.
4. Kalyanmoy Deb., "Multi-Objective Optimization using Evolutionary Algorithm", John Wiley and Sons, 2001.

**14CE3004 ADVANCED DESIGN OF REINFORCED CONCRETE
STRUCTURES**

Credits: 3:0:0**(Version 1.1)****Course Objective:**

- To understand the behavior of structural elements
- To study the design of special structures

Course Outcome:

At the end of the course student will be able to

- Examine the design concepts of special structural elements
- Analyze and design structural elements
- Evaluate the intricacies in construction and maintenance of structures

Description:

Limit State Design of Beams for Shear, Torsion and Bond, Composite column and Tubular column, Design of Bunkers and Silos, design of RCC chimney, cooling tower and nuclear structures. Limit state analysis and design of isotropically and orthotropically reinforced slabs of various shapes, Design of flat slabs, Limit state analysis and design of Statically Indeterminate Structures, Check on rotation capacity, Grid floors, Shells and folded plates of simple configuration.

References:

1. Bhavikatti S.S " Advanced RCC Design" New age International Pvt. Ltd.2006.
2. Varghese, P.C., "Advanced Reinforced concrete structures ", Prentice – Hall of India Ltd, New Delhi 2003.
3. Krishnaraju,N., "Advanced Reinforced Concrete Design "CBS publications, New Delhi 2005.
4. Punmia B.C "Advanced RCC Design" Laxmi Publications Pvt Ltd", 2006.
5. James K. Wright, James Grierson MacGregor, "Reinforced Concrete: Mechanics and Design (4th Edition), Pearson Education, Limited, 2012.

14CE3005 STRUCTURAL DYNAMICS

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To impart knowledge free and forced vibration SDOF, MDOF and distributed parameter

Course Outcome:

At the end of the course student will be able to

- Create the mathematical model of vibrating system
- Explain the dynamic properties of vibrating structure
- Evaluate the displacement-time history of vibrating structures

Description:

Principles of dynamics, single degree of freedom- damped and undamped free and forced vibration – transmissibility - response to general dynamic loading (blast or earthquake), two degrees of freedom systems, normal modes of vibration –vibration absorber, mathematical modeling of multiple degree of freedom system- shear building, free vibration of undamped system- orthogonality of normal modes, solution of eigen value problem, distributed parameter system, solution for equilibrium equations in dynamics

References:

1. Clough, R.,W., and Penzien, "Dynamics of Structures", McGraw Hill Book Co Ltd, 1986.
2. Paz Mario," Structural Dynamics - Theory and Computation", CBS publishers, US, 1999.
3. Anil K. Chopra, "Dynamics of Structures" (4th Edition), Prentice Hall - 2011.
4. Roy R. Craig, Andrew J. Kurdila., "Fundamentals Structural Dynamics ", John Wiley and Sons, UK, 2011.
5. Thomson, W.T., "Theory of Vibrations with applications", Prentice Hall of India, 2008.
6. Humar J. "Dynamics of Structures", Third Edition, CRC Press. 2012

14CE3006 FINITE ELEMENT METHODS IN ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To understand the basic concept of finite element for one, two, and three dimensional finite elements
- To study the various finite element procedures and solution techniques for linear and nonlinear structures.

Course Outcome:

At the end of the course student will be able to

- Identify the appropriate finite element techniques to be used for different types of problems
- Understand the limitations and errors in solution using finite element methods
- Analyse complex problems not amenable for closed form solutions

Description

Concept of finite element, variational and weighted residual methods, convergence and compatibility requirements , elements for trusses, beams and frames, stress and strain analysis of two dimensional planar problems, concept of shape functions - triangular elements - rectangular elements, iso-parametric elements stress analysis (three dimensional elements): numerical integration techniques plate and shell elements- finite strip method nonlinear, vibration and thermal problems, meshing and solution problems- auto and adaptive mesh generation techniques .

References:

1. Robert D.Cook, et al, " Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc. Singapore, 2007.
2. Bathe. K.J., "Finite Element Procedure", Prentice Hall of India, New Delhi, 2006.
3. Zienkiewicz O. C., Robert Leroy Taylor., "The Finite Element Method Vol. 1 & 2", McGraw Hill Book Company, New York, 2005.
4. Tirupathi, R.Chandrupatla and Ashok, D. Belegundu., "Introduction to Finite Elements in Engineering", Prentice Hall of India Private Limited., New Delhi, 2004.
5. Rajasekaran, S., "Finite Element Methods in Engineering Design", S.Chand& Co Ltd., NewDelhi, 2003.
5. Mukhopadhyay, M., "Matrix, Finite Element Computer and Structural Analysis", Oxford & IBH publishing Co., Pvt. Ltd. New Delhi, 1993.

14CE3007 SEISMIC DESIGN OF STRUCTURES**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To introduce to the student to seismology
- To introduce the concepts of seismic design of buildings

Course Outcome:

At the end of the course the student will be able to

- Identify suitable methods of seismic analysis
- Design the buildings for seismic loads
- Recommend suitable retrofitting method for buildings

Description:

Engineering seismology, lessons learnt from past earthquakes , conceptual design considerations, seismic methods of analysis, lateral load analysis using codal provisions , principles of earthquake resistant design, ductility consideration of earthquake design of rc buildings - capacity based design , behavior and design of shear wall in earthquake, seismic design of masonry buildings, seismic behaviour of steel structures - design of steel structures ,response control concepts, methods of retrofitting.

References:

1. Pankaj Agarwal and Manish Shrinkhande., "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2. Duggal, S.K., "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi, 2007.
3. Chopra, A.K., "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Prentice Hall of India private limited, New Delhi, 2002.
4. Steven, L.Kramer., "Geotechnical Earthquake Engineering", Prentice Hall of India PvtLtd., New Delhi, 2004.
5. Naeim, F., "The Seismic Design Hand Book", 2nd Edition, Kluwer academic publishers, London, 2001.

14CE3008 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To study the various techniques for experimentation
- To study the Modeling of different structures
- To understand the various non destructive tests

Course Outcome:

At the end of the course student will be able to

- Summarise the data acquisition systems and its measurements.
- Analyse complex structures for static and dynamic load
- Adapt suitable load test on wind tunnel, bridges and dams.

Description:

Forces and strain measurement, principles and operation , vibration measurements- velocity and acceleration measurements,digital data acquisition systems, acoustics and wind flow measurement, structural modeling, Model analysis for concrete structures, wind tunnel, load tests on actual structures-bridges and dams ,distress measurements and control tests on beams and structures, , non-destructive testing methods.

References:

1. Arthur P. Boresi, Ken Chong, James D. Lee “Elasticity in Engineering Mechanics” , John Wiley & Sons. 2012
2. Dalley, J.W and Riley, W.F, “Experimental Stress Analysis”, Mc Graw Hill Book Company, New York, 2004
3. GanesanT.P., “Model Analysis of Structures”, University Press, India, 2005.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.
5. William N. Sharpe, Jr., William N. Sharpe, “Springer Handbook of Experimental Solid Mechanics”, Springer, 2008

14CE3009 ADVANCED DESIGN OF METAL STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To study the design of framed connections, pre-engineered buildings and towers and chimneys.
- To understand the behaviour of composite members and design

Course outcomes:

At the end of the course student will be able to

- Classify the structural steel joints and connections
- Analyse and Design the Steel structural members
- Examine the failure of structural members and their connections

Description:

Design for simple and moment resistant connections- welded and bolted seat connections, Limit state design of Beams and Beam columns, lateral torsional buckling, modes of failure, Design of Industrial steel buildings, pre-engineered buildings, Wind load analysis and Design of Towers & Stacks, Design of light gauge steel sections, Concepts of Plastic analysis, continuous beams and portal frames.

References:

1. N. Subramanian, “Design of Steel Structures”, Oxford University Press, USA, 2008

- Dayaratnam, P., "Design of Steel Structures", A.H.Wheeler& Co. Ltd., Allahabad, 2008
- Arya and Ajmani, "Design of Steel Structures", NemChand Brothers, Roorkee, 2007
- Punmia B.C., Ashok kumar Jain and Arunkumar Jain, "Design of Steel Structures", ArihantPublications, Bombay, 2008
- Gray, C. S. Kent L.E Mitchell, W.A., and Godfey, W.B., "Steel Designer's manual", English Language Book Society and Granade Publishing, London, 2003
- Teaching Resource Materials on Steel – SERC, INS DAG, Anna University and IIT Madras

14CE3010 ADVANCED BRIDGE ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To get exposed to the design aspects of various types of bridges using IRC specifications and railways
- To learn the concept of design of substructure for the bridges
- To learn the construction and maintenance of bridges

Course Outcome:

At the end of the course the student will be able to

- Design various types of bridges and substructures
- Examine the possibilities of failures in RCC and Steel bridges

Description:

Design of Concrete Bridges-slab, T-beam and- slab, arch, bow string girder types, Prestressed Concrete Bridges- simple spans, continuous decks, Steel Bridges- Plate girder, box girder, truss and arch types - Cable stayed bridges and suspension bridges - principles of design, aerodynamic stability and vibrations, Substructure design: piers and abutments and Foundations, River draining works, Design of bearings, Erection techniques, Bridge maintenance management: inventory, inspection and rehabilitation. Failures – case studies.

References:

- Johnson Victor, D., "Essentials of Bridge Engineering", Oxford & IBH Publishing Co.,New Delhi, Fourth Edition, 2007.
- Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, New Delhi, 2007.
- Krishna Raju, N., "Design of Bridges", Oxford & IBH Publishing Co., New Delhi, Third Edition, 2007.
- Jagadeesh T.R., Jayaram M.A., "Design of Bridge Structures", Prentice Hall of India Private Limited, New Delhi, 2007.

14CE3011 COMPUTER AIDED DESIGN LAB

Credits: 0:0:1

(Version 1.1)

Course Objective:

- To introduce the application of FEM in Software Packages
- To enable the students to analyze and design various structural elements using software packages

Course Outcome:

At the end of the course the student will be able to

- Model the structures with appropriate loading as per the standards
- Analyse and design the structures for static and dynamic loads

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD and notify it at the beginning of each semester.

References:

1. STAAD Pro 2007 V8i Analysis Reference Manual.
2. ANSYS 11.0 Analysis Reference Manual.
3. SAP Analysis Reference Manual – “Computers and structures”.
4. Rudra Pratap Getting Started with MATLAB Oxford University Press, 2002

14CE3012 ADVANCED STRUCTURAL TESTING LAB**Credits: 0:0:1****(Version 1.1)****Course Objective:**

- To impart basic knowledge on properties of building materials
- To impart knowledge on concrete mix design for low strength and high strength concrete
- To study the behaviour of fresh and hardened concrete, high performance concrete
- To impart knowledge on non-destructive testing

Course Outcome:

At the end of the course student will be able to

- Determine the properties of concrete in fresh and hardened state
- Analyse the behaviour of structural elements for various loading

Experiments:

The faculty conducting the Laboratory will prepare a list of 6 experiments on static and dynamic loading tests and get the approval of HoD and notify it at the beginning of the semester.

References:

1. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, England, 2008.
2. Gambir, M.L., “Concrete Technology”, Tata McGraw Hill, New Delhi, 2004.
3. Shetty, M.S., "Concrete Technology", S.Chand & Co., New Delhi, 2005.
4. Krishnaraju, N., “Design of concrete mixes”, Sehgal Educational Consultants & Publishers Pvt.Ltd., Faridabad, 2007.

14CE3013 DESIGN OF STRUCTURES FOR DYNAMIC LOAD**Credits: 3:0:0****(Version 1.1)****Course Objective:**

- To study the basic principles of dynamic loads
- To study the behaviour of structures subjected to dynamic loads

Course Outcome:

At the end of the course student will be able to

- Identify the behaviour of structures subjected to earthquake forces
- Analyse the response of structures subjected to various dynamic forces
- Evaluate suitable strategies for vibration control of structures

Description:

Dynamic loads, behavior under impact and cyclic loads: concrete, steel, masonry and soil – design against earthquakes: hydraulic structures, life line structures, terminal buildings, towers, tunnels. Inelastic

earthquake analysis of multi-storey building frames, Pushover Analysis, Design against blast and impact, design against wind and cyclone– aero elastic and aerodynamic effect - design as per BIS code of practice including gust factor approach – tall buildings, stacks and chimneys, Passive and active control of vibrations, new and favorable materials., Stability of nonlinear and time varying Systems, Inverse Problems in Vibrations: System identification approaches.

References:

1. Paulay, T and Priestly, M.N.J “Aseismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley and Sons, 1991.
2. Alan G. Davenport, “Wind Effects on Buildings and Structures”, Proceedings of the Jubileum Conference on Wind effects on Structures, Port Alegre, Brazil, pp 25-29, Balkema A.A. Publishers, 1998.
3. Viridi K. S., Matthews R, Clarke J. L, Fikry Garas, “Abnormal Loading on Structures: Experimental and Numerical Modelling”, CRC Press. 2000
4. Theodor Krauthammer, “Modern Protective Structures”, CRC Press. 2008
5. Graham, M.L. Gladwell, “Inverse Problems in Vibration”, Springer Verlag. 2004
6. Datta T. K, “Seismic Analysis of Structures”, John Wiley & Sons (Asia). 2010

14CE3014 DESIGN OF SPACE STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To understand the concept of space structures
- To understand the behaviour of space structures

Course Outcome:

At the end of the course student will be able to

- Understand the knowledge of space structures
- Analyse and design the space structural systems
- Construct and maintain space structures.

Description:

Space structures - Single and multi-layer grids - Barrel vaults – Domes - Towers - Tension structures - Pneumatic structures - Material- Protection coats for the members. Practical Construction Methods– Drainage - Transportation problem - Lifting technique corrosion protection - Maintenance and fire protection. forms of space structures - Tensegrity frame work – Tensile structures- Pneumatic structures Prefabricated Space Structural Systems: Mero, Space deck, Nodus, Unistrut, Triodetic, Unibat and NS truss. Node Connectors: Mero - Octatube - Nodus system – Triodetic - Modular system – Tomo unit truss. Finite element method - Linear – Nonlinear - Collapse - Dynamic and Stability analysis. Design of Members: Joints - Support systems – Foundations. Configuration Processing: Formian Algebra - Case Studies - Failures.

References:

1. Ramaswamy G. S, Mick Eekhout, Suresh G. R “Analysis, Design and Construction of Steel Space Frames” Thomas Telford 2002.
2. Subramanian, N.” Space Structures: principles and Practice I” Multi Science Publishing Company 2006.
3. Timoshenko S, S. Woinowsky-Kriege “ Theory of plates and shells” Mc Graw Hill 2003.
4. Reinhold Kienzler, Holm Altenbach, Ingrid Ott “Theories of Plates and Shells: Critical Review and New Applications” Springer 2013.

14CE3015 DESIGN OF TALL BUILDINGS

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To provide an insight into the techniques for the analysis tall buildings.

Course Outcome:

At the end of the course student will be able to

- Classify various structural forms for tall buildings
- Analyse the response of structural systems
- Evaluate the second order effects of the structures

Description:

Design principles and loading: methods of live load reduction ,Behaviour of various structural systems: factors affecting growth, height and structural form - high rise behavior: rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger braced and hybrid mega systems, modeling for approximate analysis , computerized general three dimensional analysis, stability of tall buildings, p-delta analysis

References:

1. Bungale S Taranath, "Structural Analysis and Design of Tall Buildings", McGraw Hill, 2011.
2. Bungale S. Taranath, "Reinforced Concrete Design of Tall Buildings", CRC Press, 2009
3. Bungale S. Taranth , "Wind and Earthquake Resistant Buildings: Structural Analysis and Design", CRC Press, 2005
4. Guy Nordenson, "Tall Buildings", Museum of Modern Art. , Delhi, 2003.
5. Mark P Sarkisian, "Designing Tall Buildings: Structure as Architecture", Routledge, 2012.

14CE3016 DESIGN OF OFFSHORE STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective

- To learn the theories on wave motion
- To understand the behavior and design aspects of offshore structures

Course Outcome

At the end of the course student will be able to

- Understand the wave motion and its effect on structures.
- Analyse the shore protection works
- Design offshore structures

Description:

Theories of periodic wave motion - mathematical formulation of wave problem - forces due to ocean waves on structures: wave forces on breakwaters and sea walls due to non-breaking and broken waves - wave forces on piles. Shore protection works: natural and artificial, design of breakwaters, Functional aspects and design of piers, wharf , quay walls, gravity dry docks - floating dry docks - dolphins - fenders - offshore mooring buoys - offshore marine platform.

References:

1. Mohamed A. El-Reedy, "Offshore Structures: Design, Construction and Maintenance Gulf Professional Publishing, 2012
2. Gudmestad O.T, Holand I., Jersin E., "Design of Offshore Concrete Structures", CRC Press. 2002

3. Ben C. Gerwick, Jr, "Construction of Marine and Offshore Structures, Third Edition, CRC Press, 2007
4. API Recommended Practice, "Planning, Designing and Constructing Fixed Offshore Platforms", American Petroleum Institute Publication, RPZA, Dallas, 1999.

14CE3017 GEOTECHNICAL EARTHQUAKE ENGINEERING

Credits: 3:0:0

(Version 1.1)

Pre-requisite: 14CE3007 Seismic Design of Structures

Course Objective:

- To provide fundamental knowledge of soil-dynamics and seismic behavior of soils.

Course Outcome:

At the end of the course the student will be able to

- Classify the types of waves through various media
- Analyse the behaviour of soil under dynamic loads
- Evaluate procedures for strengthening the soil characteristics

Description:

Wave Propagation, Attenuation of stress waves, Dispersion, waves in a layered medium. Static and dynamic characteristics of soils. Ground Response Analysis: Equivalent and nonlinear finite element approaches; soil-structure interaction. Liquefaction, Earth Pressure: Active and passive earth pressures; Terzaghi's passive wedge theory, numerical methods, earth pressure measurements. Seismic design of retaining walls, Types of earthquake induced landslides; Evaluation of slope stability Ground Improvement Techniques- Applications.

References:

1. Prasad Bharat Bhushan, "Advanced Soil Dynamics and Earthquake Engineering", PHI Learning Pvt. Ltd..2011.
2. Ranjan, G. and Rao A.S.R., "Basic and Applied Soil Mechanics", New AgeInt. Ltd.2000.
3. Kameshwara, Rao, N.S.V, "Dynamic Soil Tests & Applications", Wheeler Publications. 2000.
4. Day Robert, W., "Geotechnical Earthquake Engineering Handbook", McGraw-Hill.2001.
5. Kramer, S.L., "Geotechnical-Earthquake Engineering", Pearson Education –Indian Low Price Edition.2004.
6. Saran, S. "Soil Dynamics & Machine Foundation", Galgotia Publication. 2006.

14CE3018 DESIGN OF SUBSTRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To study the design of various types of foundation.

Course Outcome:

At the end of the course the student will be able to

- Summarise soil investigation methods and selection of foundation
- Analyse and design various types of foundation
- Design various types of foundations for real time structures on different soils.

Description:

Soil Investigation and Selection of foundation, Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation, pile foundations , pile load test – structural design of straight piles,

structural design of pile cap. Types and design of well foundation – lateral stability - principles of design of machine foundation design for reciprocating machines and impact machines, vibration isolation. Foundation on expansive soils, under-reamed pile foundation, foundation for concrete towers, chimneys, anchors- reinforced earth retaining walls.

References:

1. Swamy Saran, “Analysis and Design of substructures”, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
2. Varghese.P.C, “Design of Reinforced Concrete Foundations” – PHI learning private limited, New Delhi – 2009
3. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 2001.
4. Kameswara Rao N. S. V., “Foundation Design: Theory and Practice”, John Wiley & Sons, 2010

14CE3019 DESIGN OF COMPOSITE STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To understand the behavior of steel concrete composite structures
- To design composite elements and structures and their connections

Course Outcome:

At the end of the course the student will be able to

- Examine the elastic behaviour of Composite structural members
- Analyze and Design the Steel concrete composite sections
- Evaluate the usage of shear connectors in composite sections

Description:

Steel - concrete composite construction -IS, BS and Euro code provisions, elastic and ultimate load behavior, Design of simply supported and continuous steel – concrete composite beams with solid deck slabs and profiled deck slabs. Design of composite trusses and columns, Design of Connections, typical shear connectors and interaction with concrete, Seismic behaviour of composite structures – case studies on steel-concrete composite construction in buildings and bridges.

References:

1. Johnson, R.P., “Composite Structures of Steel and Concrete”, Blackwell Scientific Publications, UK, 2008.
2. Narayanan R., “Steel-Concrete Composite Structures”, CRC Press. 2005.
3. Alain Nussbaumer, Luis Borges, Laurence Davaine, “Fatigue Design of Steel and Composite Structures: Eurocode 3: Design of steel structures”, John Wiley & Sons. 2012.
4. INSDAG, “Design of Composite Truss for Building”, Institute for Steel Development and Growth Publishers, Calcutta.
5. IS: 11384-1985., “Code of Practice for Composite Construction in Structural Steel and Concrete”, Bureau of Indian Standards, New Delhi.
6. Appropriate IS, British and Euro Codes.

14CE3020 STABILITY OF STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To understand the basic principles of stability
- To understand the buckling behaviour of columns, plates and shells

Course Outcome:

At the end of the course the student will be able to

- List the criteria for stability of structures
- Interpret the different buckling behavior of structures
- Evaluate the buckling strength of structures

Description:

Concept of stability, stability criteria, static and dynamic approach stability of columns - large deflection of columns, effect of shear on buckling, Inelastic buckling theories, beam columns: stability of frames, stability functions, lateral stability of beams, buckling of thin-walled open sections, stability of plates, post-buckling strength, buckling of shells, Donnel's equation, sensitive and insensitive systems - symmetric and asymmetric bifurcation

References:

1. Stephen P. Timoshenko, James M. Gere., "Theory of Elastic Stability", 2nd Ed. McGraw-Hill, 2012.
2. Iyengar, N.G.R., "Elastic Stability of Structural Elements", Macmillan India Ltd., New Delhi, 2007
3. Murali, L. Gambir, "Stability Analysis and Design of Structures", Springer-Verlog, Berlin, 2004.
4. Robert Millard Jones, "Buckling of Bars, Plates and Shells", Mc Graw Hill, 2006.
5. George J. Simitses, Dewey H. Hodges, "Fundamentals of Structural Stability", Butterworth-Heinemann. 2006.
6. Chen W.F., Lui E.M, "Principles of Structural Design" CRC Press, 2005.
7. Iyengar NGR, "Elastic Stability of Structural Elements", Macmillan, 2007.

14CE3021 PRESTRESSED CONCRETE STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective

- To introduce the fundamental principles about Prestressed Concrete Structures
- To impart the design concepts as per limit state of collapse and serviceability
- To interpret the concepts in the design of different structural elements

Course Outcome

At the end of the course the student will be able to

- Understand the systems of prestressing and behaviour of structural elements
- Analyse and design prestressed concrete structural elements
- Interpret the design concepts in designing structural members

Description:

Prestressing systems - Analysis of prestress and bending stresses, concept of load balancing - losses of prestress, deflection, design for flexure, shear and torsion-Design of Anchorage Zone, Concordant cables -Analysis and Design of continuous beam, Circular prestressing, Partial prestressing, non-prestressed reinforcement-Tension Members-Poles and Sleepers-Application of prestressing in precast Construction.

References

1. Krishna Raju, N., "Prestressed Concrete", 4th Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
3. Perumalsamy Balaguru, Antonio Nanni, James Giancaspro, "FRP Composites for Reinforced and Prestressed Concrete Structures: A Guide to fundamentals and design for repair and retrofit, CRC Press. 2008.
4. Loo/Chowdhury, "Reinforced and Prestressed Concrete: Analysis and Design with Emphasis on application of AS 3600 – 2009, Cambridge University Press., 2010.
5. Rajagopalan N, "Prestressed Concrete", CRC Press. 2002.

14CE3022 INDUSTRIAL STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To provide an insight to the techniques for the analysis and design of industrial buildings

Course Outcome:

At the end of the course the student will be able to

- Identify the requirements of industrial buildings
- Analyse and design the components of industrial buildings
- Recommend suitable foundations for industrial buildings

Description:

Functional Requirements of industrial buildings, Design and detailing of R.C. gable frames, corbels, bunkers, silos and chimneys - North light roofs - Cooling towers -Application of prefabrication techniques, gantry girders, steel bunkers, silos and chimneys - High pressure boilers and piping design. Design of nuclear containment structures, power transmission structures: cables, transmission line towers - Substation structures - Tower foundations – Design of machine foundations.

References:

1. Mohamed A. El-Reedy, "Construction Management and Design of Industrial Concrete and Steel Structures, CRC Press, 2010.
2. Bhavikatti S.S, "Design Of Steel Structures" (By Limit State Method As Per Is: 800 2007), I. K. International Pvt Ltd, 2009.
3. Handbook on Fundamental Requirements of Industrial Buildings (Lighting and Ventilation), BIS.
4. Dayaratnam, P., "Design of Steel Structures", A.H. Wheeler & Co., Ltd., Allahabad, 1999.
5. Duggal, "Design of Steel Structure" - 3E, Tata McGraw-Hill Education., 2009.
6. Somerville G., "The Design Life of Structures", CRC Press.2003.

14CE3023 ADVANCED DESIGN OF PREFABRICATED STRUCTURES

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To know the prefabrication technique of various structural components

Course Outcome:

At the end of the course the student will be able to

- Understand the principles of prefabrication

- Adopt prefabrication techniques for residential buildings and industrial structures
- Design various Prefabricated buildings

Description:

Principles of prefabrication, Transportation, Erection, Analysis and design of prefabricated floors, stairs, roofs and joints, walls: leak prevention, joint sealant and sandwich wall panels. materials, erection and joining techniques used in precast construction, design for handling and erection stresses, prefabricated roof for industrial sheds precast roof trusses, roof panels, crane-gantry girders, corbels, columns and wind bracing - joints between columns and foundations

References:

1. Maurice Levitt, "Precast Concrete: Materials, Manufacture, Properties and Usage", Taylor and Francis Group, 2007.
2. Lasslo Mokka, "Prefabricated concrete for Industrial and Public sectors", Akademiai Kiado, Budapest, 2004.
3. Seismic Design of Precast Concrete Building Structures: State-of-art Report edited by International Federation for Structural Concrete, FIB - Féd. Int. du Béton. 2003.
4. Kim Elliott, "Prefabricated concrete structures", Butterworth-Heinemann, 2002.

14CE3024 ANALYSIS AND DESIGN OF PLATES AND SHELLS

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To enable the student to understand the structural behavior of plates and shells
- To enable the student to analyze and design different types of shells and folded plates

Course Outcome:

At the end of the course the student will be able to

- Identify the structural behavior of plates and shells
- Analyse and design different structural components
- Evaluate the structural response of plates and shells

Description:

Classical theory of plates, Levy and Navier's solution of plates - small deflection theory of plates - analysis of laterally loaded (concentrically loaded) plates: circular thin plates with simply supported or clamped edges. Design of folded plate roof, design of shells: spherical shell, conical shell, paraboloid, ellipsoid. R.C. Cylindrical shell, prestressed Cylindrical shells, hyperbolic paraboloid shell, design of R C north-light shells

References:

1. Timoshenko S, S. Woinowsky-Krieger "Theory of plates and shells" Mc Graw Hill 2003.
2. Reinhold Kienzler, Holm Altenbach, Ingrid Ott "Theories of Plates and Shells: Critical Review and New Applications" Springer 2013
3. Farshad M, "Design and Analysis of Shell Structures" Springer 2010
4. "Design of Cylindrical concrete shell roofs", Manual of Engineering Practice No.31 ASCE, New York, 1952.
5. Varghese PC, "Design of Reinforced Concrete Shells and Folded Plates", PHI Learning Pvt Ltd, 2010.

14CE3025 ENERGY EFFICIENT BUILDING

Credits: 3:0:0

(Version 1.1)

Course Objective:

- To give the concept of Energy efficient buildings with the holistic approach
- To acquaint the students with the international assessment systems and documentation procedure
- To be aware of the economic benefits of High performance buildings

Course Outcome:

At the end of the course students will be able to

- Explain the concepts of green building
- Assess energy efficient buildings
- Evaluate the economic performance of buildings as related to their resource-consumption and environmental performance.

Description:

Energy efficient building concepts and materials - the integrated design process - documentation requirements - Sustainable sites and landscaping- Indoor environment quality – building water and waste management - Green building implementation and assessment (IGBC and LEED standards) of residential building, Industrial building and commercial building – Planning - Site protection- health and safety- waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - Evaluation of existing buildings and recommendations for improvement- Managing initial costs- cost barrier in project management- long-term environmental benefits.

References:

1. Jerry Yudelson, “Green building A to Z, Understanding the Language of Green Building”, New Society Publishers, Canada, 2007.
2. Jerry Yudelson, “Green Building through Integrated Design”, McGraw Hill, USA, 2009.
3. Means, R.S., “Green Building: Project Planning & Cost Estimating”, Wiley, Kingston, 2006.
4. Charles J. Kibert, “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, Wiley, New Jersey, 2007.
5. Green building guidelines: Meeting the Demand for Low-energy, Resource-Efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.

14CE3026 INTRODUCTION TO IWRM

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To introduce the concepts of IWRM and highlight the inter-disciplinary nature
- To expose to sustainable water resources management, water security and public-private partnership issues
- To brief about integrated multi-sectoral and multi-dimensional issues in developing water resource management plans

Course Outcomes:

At the end of the course the student will be able to

- understand IWRM principles in sustainable water management
- plan integrated water resources development projects considering sustainability aspects
- involve in water management projects from a multi-objective and multi-purpose perspective

Description:

IWRM: definition and principles; water crisis-national and global - concepts of 'blue' and 'green' water; holistic or ecosystem approach - impact of global climate change on water resources - sustainable water resources development: Dublin conference and national water policy, river basin and small watershed approach, water allocation, environmental flows - water related environmental problems: introduction to risk analysis - floods, droughts, sedimentation, water logging, groundwater depletion, pollution due to urban sewage and industrial effluents as well as agro-chemicals - water borne and related diseases - water conservation and development: rainwater harvesting, artificial recharge, conjunctive use, interbasin transfer - sanitation and health care; water economics: virtual water and water security, PPP, conflict resolution, private water market - awareness creation and participatory approach.

References:

1. Negi S.S., "Integrated Watershed Management", Oriental Enterprises, 2001
2. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", John Wiley and Sons Inc., New York, 2003.
3. Cap-Net, Tutorial on Basic Principles of Integrated Water Resources Management, Cap-Net, IRC, IWMI, HRWallingford, IUCN, WSS, UNDP (www.cap.net.org).
4. Integrated Water Resources Management Plans, Training Manual and Operational Guide, CIDA, 2005.
5. Training Course Report in Water Assessment in Sub-Saharan Africa: Prediction in Ungauged and Data Scarce Basins, 21-25 January 2008, Cap – Net
6. Vinita Bhati. "India's Water Resources: Planning and Management", Universal Scientific, 2003
7. Technical Advisory Committee, "Integrated Water Resources Management", Technical Advisory Committee Background Paper 4. Global Water Partnership, Stockholm, Sweden. 2002.
8. Technical Advisory Committee, "Poverty Reduction and IWRM" Technical Advisory Committee, Background paper 8. Global Water Partnership, Stockholm, Sweden, 2003.

14CE3034 FUNDAMENTALS OF MATLAB PROGRAMMING**Credits: 3:0:0****(Version 1.1)****Course Objectives:**

- To introduce the elements and application of computer programming through MATLAB

Course Outcomes:

At the end of the course the student will be able to

- understand the programming concepts in MATLAB
- develop procedural languages for computing
- solve engineering problems using MATLAB

Description:

Basic Matlab programming: algorithm, pseudo-code, flowchart, interface, data types -expressions, constants, variables, assignment statement, arrays - control statements: if,else, then, while, for loop, nested loop, switch/case; functions and scripts - formatted input and output statements - reading from and writing to a text file - sorting; basic plotting: 2D and 3D plots, figures and sub plots - introduction to GUI: graphics handling, objects, uicontrol - application examples in environmental and water resources engineering

References:

1. Holly M., "MATLAB for Engineers", Prentice Hall, 3rd Edition, 2012.

2. Rudra P., "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
3. Duane, C.H., "Mastering MATLAB", Pearson Education Inc., 2012
4. Amos, G., "MATLAB: An Introduction with Applications", 4th Edition, 2011.

14CE3036 HYDROLOGY PRACTICALS

Credits: 0:0:2

(Version 1.1)

Course Objectives:

- To impart practical knowledge in hydrologic processes
- To help the students in understanding the practical implications of aquifer parameters

Course Outcomes:

At the end of the course, the student will be able to

- gain better understanding of physical processes and phenomena involved in the evaluation and prediction of water movement in all phases of the hydrologic cycle
- solve the groundwater problems using groundwater flow and transport models

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

References:

1. Fetter C. W., "Applied Hydrogeology", Merrill Publishing Co., Columbus, OH, 2001.
2. Hiscock K., "Hydrogeology, Principles and Practice", Blackwell Publishing, Oxford, UK, 2005.
3. Todd D. K., "Groundwater Hydrology", John Willey & Sons Inc., 2007.
4. Bear, J., "Hydraulics of Groundwater", McGraw Hill, New York, 1979.
5. Subramanya K., "Engineering Hydrology", Tata McGraw Hill, New Delhi, 2008
6. Chow V.T., Maidment D.R., Mays L.W., "Applied Hydrology", McGraw Hill Publications, New York, 2010.

14CE3038 ENVIRONMENTAL IMPACT ASSESSMENT

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To enable students to acquire necessary skills to assess the impact of environmental and water resources projects
- To help students in taking necessary steps to bring down the adverse environmental impacts during inception of new projects

Course Outcomes:

At the end of the course the student will be able to

- identify environmental attributes to be considered for the EIA study
- specify methods for prediction of the impacts
- formulate environmental management plan

Description:

Introduction to EIA: elements of EIA, factors affecting - preparation of base map - methods of EIA: criteria selection - Ad-hoc methods, matrix and network method, overlay method - cost benefit analysis - hydrological, ecological, social, cultural and human health impacts - soil, landscape and ecosystem

changes - environmental auditing: objectives, types, protocol, stages of environmental audit, evaluation of audit data and preparation of report - case studies and EIA statement.

References:

1. John, G., Riki, T., Andrew, C., "Introduction to Environmental Impact Assessment", Routledge Taylor& Francis Group, III Edition, 2005.
2. Prabhakar, V.K., "Environmental Impact Assessment", Anmol Publications, 2001.
3. Marriott, Betty B., "Environmental Impact Assessment: a Practical Guide", McGraw-Hill, 1997.
4. Richard, K.M., "Environmental Impact Assessment- a Methodological Perspective", Kluwer Academic Publishers, 2002

14CE3039 ISOTOPE TECHNIQUES IN WATER RESOURCE MANAGEMENT

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To introduce fundamentals of isotope hydrology
- To demonstrate the application of this tool to solve simple practical problems in hydrology and water resources engineering

Course Outcomes:

At the end of the course the student will be able to

- understand the chemistry involved in isotope hydrology
- estimate isotope footprints of water samples from various sources
- apply environmental isotopes in identifying the recharge sources, pollution source, salt water intrusion

Description:

Introduction to isotopes: elements, stable and radioactive isotopes, isotopic characteristics, isotopic fractionation; Isotope measurement techniques: mass spectrometer, isotopic footprints - partitioning of isotopes - Deuterium excess and source identification - tracing the hydrologic cycle - Rayleigh distillation - application of isotopes in surface and groundwater hydrology: streamflow measurement, lake dynamics, groundwater recharge process, saltwater intrusion, migration of pollutants, groundwater velocity - paleo hydrology

References:

1. Rao, S.M., "Practical Isotope Hydrology", New India Publishing Agency, 2006.
2. Mook W.G. (Editor), "Environmental Isotopes in Hydrological Cycle, Principles and Applications", IHP-V, Technical Documents in Hydrology, No 39, Vol 1, UNESCO, Paris, 2000.
3. "Use of Artificial Tracers in Hydrology", Proc. Adv. Group Meeting, Vienna, IAEA, 1990.
4. Kendall, C., and McDonnell J.J., "Isotopes in Catchment Hydrology", Elsevier, 1998.

14CE3040 WATER AND WASTEWATER TREATMENT

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To introduce physical, chemical and biological aspects of water and wastewater quality
- To elaborate the aspects of design and management of water and wastewater plant

Course Outcomes:

At the end of the course the student will be able to

- understand the water quality standards, physico-chemical processes, design and operational parameters involved in treatment of water and wastewater
- analyse and characterize the wastewater samples from different unit operations
- plan and design the water and waste water treatment plant

Description:

Physical, chemical and biological characteristics of water and wastewater - population forecast - water demand analysis - quantity estimation of wastewater - wastewater collection systems - introduction to primary, secondary and tertiary treatment units - principles and design of physical unit operations: screening, commutation, grit chamber, sedimentation tank - secondary treatment units: aerobic and anaerobic processes, activated sludge process, trickling filter, rotating biological contactor, fluidized bed - tertiary treatment system: coagulation, flocculation, filtration, disinfection, aeration, precipitation, softening, adsorption, ion exchange, membrane technology - membrane bioreactor - in-situ and ex-situ bioremediation - characterization of treated effluent and sludge: SEM, XRD, EDAX and FTIR - case studies of wastewater treatment plants

References:

1. Metcalf and Eddy, "Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995.
2. Casey T.J., "Unit Treatment Processes in Water and Wastewater Engineering", John Wiley & Sons England 1993.
3. Stuetz R., T Stephenson, "Principles of Water and Wastewater Treatment Processes", IWA Publications, 2009
4. Kuruvilla M., Stewart D., Goen Ho, "Decentralized Water and Wastewater Systems", IWA Publications, 2008.

14CE3044 REMOTE SENSING AND GIS

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To familiarize the principles of Remote Sensing and GIS
- To demonstrate temporal and spatial data acquisition and analysis

Course Outcomes:

At the end of the course the student will be able to

- understand the principles and components of Remote Sensing and GIS
- analyse and interpret satellite images and create thematic maps for various applications.
- apply GIS and RS tool in environmental and water resources projects

Description:

Basics of remote sensing: concepts, EMR and its interaction with atmosphere, soil, surface, water and vegetation - remote sensing platforms: LANDSAT, SPOT, ERS, IKONOS, scanners, radiometers - digital image processing: preprocessing, enhancement, classification, merging - introduction to GIS: components, map projections, raster and vector data, topology - hierarchical, network, relational models - data types, quality and meta data - spatial analysis: thematic layers, query analysis, measurement, reclassification, buffering, interpolation - raster and vector overlay - network analysis, DEM, TEM - case studies

References:

1. Lillesand T.M. and Kiefer, R.W., “Remote Sensing and Image interpretation”, VI edition of John Wiley & Sons-2000.
2. John R. Jensen, “Introductory Digital Image Processing: A Remote Sensing Perspective”, 2nd Edition, 1995.
3. John A. Richards, “Remote Sensing Digital Image Analysis”, Springer –Verlag, 1999.
4. Ian Heywood Sarah, Cornelius and Steve Carver, “An Introduction to Geographical Information Systems”, Pearson Education, New Delhi, 2002.
5. Charles Elachi and Jakob J. van Zyl, “Introduction to the Physics and Techniques of Remote Sensing”, Wiley Series in Remote Sensing and Image Processing, 2006.

14CE3045 FOREST, URBAN AND AGRICULTURAL WATERSHED MANAGEMENT**Credits: 3:0:0****(Version 1.1)****Course Objectives:**

- To impart knowledge on underlying hydrologic processes associated with the flow of water through forested watersheds
- To give exposure about nutrient budget and agricultural management practices

Course Outcomes:

At the end of the course the student will be able to

- understand the hydrologic principles in forest, urban and agricultural management
- apply the techniques for soil erosion control, flood management and storm management
- develop an integrated watershed management plan

Description:

Watershed development: definitions, integrated and multidisciplinary approach - watershed characteristics: size, slope, shape, physiography - watershed delineation - forest watershed management: forests and hydrologic processes, forests and water flows - agricultural watershed management: impacts of agricultural activities on soil and water, nutrient budget - soil and water conservation - monitoring and evaluation of water development projects - urban watershed management: urbanization and hydrology, water supply and stormwater management, land use planning - water and green building.

References:

1. Murthy, J.V.S., “Watershed Management “New Age International Publishers, 1998.
2. Martin, M.K., Daniel T.R., and Kent, S.M., “Urban Watersheds: Geology, Contamination, and Sustainable Development”, CRC press, Taylor & Francis Group, 2011.
3. Bernier, P.Y., Woodard, P.D., “Forest Hydrology and Watershed Management”, IAHS Press, 1987,
4. Ghanshyam D., “Hydrology and Soil Conservation Engineering”, Prentice-Hall of India Pvt. Ltd., New Delhi. 2000.
5. Das Madan Mohan and Saikia Mimi Das, “Watershed Management”, PHI publishers, 2012.
6. Kenneth N. Brooks, Peter F. Folliott, Joseph A. Magner, “Hydrology and the Management of Watershed”, John Wiley & Sons, 2012.

14CE3048 ELECTROCHEMICAL WATER PROCESSING AND WATER TREATMENT

Credits: 3:0:0

(Version 1.1)

Course objectives:

- To introduce the basic concepts of electrochemistry
- To help the students understand the electrochemical methods in wastewater treatment

Course Outcomes:

At the end of the course the student will be able to

- understand the basic concepts of electrochemistry
- analyse the characteristics of the effluent and sludge produced
- develop cost effective treatment method using electrochemical methods

Description:

Basic aspects of electrochemistry - chemistry and electricity: electrochemical cells - transport of charge potentials and the electromotive series - biociding technology - electrolytic production of free halogens-chlorination - metal ion removal and metal recovery - electrochemical process for the removal of iron in acid baths - electrodialysis (ED): performance characteristics, applications - chemical coagulation and electrocoagulation (EC) in water treatment - electroflotation: electrochemical reactions and gas generating rate - electrodes arrangement - typical cell design combination of ED with EC.

References:

1. Ralph Zito, "Electrochemical Water Processing", Wiley 2011.
2. Derek Pletcher, "Industrial Electrochemistry", Chapman and Hall Ltd 1982.
3. Stephen K. Lower, "Electrochemistry- Chemical reactions at an electrode, galvanic and electrolytic cells", 2004.
4. C. Comninellis and G. Chen, "Electrochemistry for the environment" Springer 2010.

14CE3053 WETLAND HYDROLOGY

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To impart knowledge on hydrology of wetland ecosystems
- To introduce the students to the management and conservation of wetlands

Course Outcomes:

At the end of the course the student will be able to

- understand the aspects of wetland management and conservation
- develop suitable wetland management strategy in catchment and coastal hydrology

Description:

Definition of wetland - classification of wetlands - wetlands types according to Ramsar Bureau - hydrologic features of aquatic ecosystems, terrestrial ecosystems and wetland ecosystem - significance of hydrology in wetland studies - hydroperiod-signature of a wetland - water balance of wetland, residence time, turnover time - conceptual model showing relationship between hydrologic, chemical and biological processes - chemical cycles in wetlands - water management and conservation values of wetlands – recharging, flood containing, water purification, agriculture, aquatic tourism, drinking water, inland navigation, fisheries, biodiversity - concept of wise use of wetlands - integrated river basin management in relation to wise use of wetlands - sustainability concept in relation to wetland management - estimation of exchange processes in estuaries-modified tidal prism method, coefficient of eddy diffusivity, flushing

time - sediment dynamics - case studies: impact of manmade structures on downstream wetlands, Success stories in wetland conservation- Chilika and Loktak.

Reference:

1. William J. Mitsch, James G. Gosselink, "Wetlands", John Wiley & Sons. Copyright. Inc, 2007.
2. W.J. Mitsch, M. Straškraba, S.E. Jorgensen, "Wetland Modelling", Elsevier Science Publishers B.V, 1988.
3. Deanne Hickey, 'The Role of Wetland Hydrology on Vegetative Structure in a Coastal Wetland Environment', University of Sydney, 2009.
4. Jos T.A. Verhoeven, Boudewijn Beltman, Roland Bobbink, Dennis F. Whigham., 'Wetlands and Natural Resource Management', Springer-Verlag Berlin Heidelberg, 2006.

14CE3054 FUNDAMENTALS OF COASTAL ENGINEERING

Credits: 3:0:0

(Version 1.1)

Course Objectives:

- To introduce the basics of coastal engineering
- To enable students to appreciate coastal management problems

Course Outcomes:

At the end of the course the student will be able to

- understand the principles of wave theory and hydrodynamics in coastal engineering management
- analyse and predict different types of waves
- design basic harbour structures

Description:

Coastal geomorphology - introduction to winds, waves and maritime structures - classification of waves - formation of waves - simple wave theories-Cnoidal theory - SMB and energy based methods of wave prediction - wave reflection - wave refraction - wave diffraction - coastal erosion and accretion processes - coastal protection structures – breakwaters and sea walls - consideration of hydrodynamics in the design of harbour structures - harbour protection works- breakwaters and jetties - case studies of Cochin, Madras, Vishakhapatnam harbours - Case studies on erosion and accretion – Malabar and Coromandel coasts.

References:

1. Robert M. Sorensen, "Basic Coastal Engineering", 2nd edition, Springer Science+ Business Media, Inc, 1997.
2. A. Vallega, "Fundamentals of Integrated Coastal Management", Kluwer Academic Publishers, Netherlands, 1999.
3. Timothy Beatley, David Brower, Anna K. Schwab, "An Introduction to Coastal Zone Management", 2nd edition, Island Press, 2002.
4. J. W. Kamphuis, "Introduction to Coastal Engineering and Management", 2nd edition, World Scientific Publishing Co. Pte.Ltd., 2010
5. A. M Muir Wood, "Coastal hydraulics". New York, Gordon and Breach, 1969.
6. Dominic Reeve, Andrew Chadwick, Christopher Fleming, "Coastal Engineering: Processes, Theory and Design Practice", Spon press, 2004.
7. Shore Protection Manual Vol 1, Coastal Engineering Research Centre, Department of the Army, Wachriays Experiment Station, Corps of Engineering, Wicksburg, Mississippi, the US, 1984.

LIST OF SUBJECTS

Sub. Code	Program Core –36 credits, a full and a Part Semester project		Credits
	Name of the Subject		
14CE3049	Computational Techniques in Transportation Engineering		3:0:0
14CE3050	Intelligent Transportation Systems		3:0:0
14CE3051	Principles of Highway Traffic		3:0:0
14CE3052	Urban Transportation Infrastructure Planning and Design		3:0:0
15CE2001	Irrigation Engineering		3:0:0
15CE2002	Watershed Management		3:0:0
15CE2003	Introduction to Water Quality Analysis and Modeling		3:0:0
15CE3001	Statistical Methods for Engineers		3:0:0
15CE3002	Building Bye laws		3:0:0
15CE3003	Construction Equipment		3:0:0
15CE3004	Project Formulation and Appraisal		3:0:0
15CE3005	Quantitative Techniques in Management		3:0:0
15CE3006	Construction Project Management		3:0:0
15CE3007	Advanced Construction Techniques		3:0:0
15CE3008	Contract Laws and Regulations		3:0:0
15CE3009	Construction Planning, Scheduling and Control		3:0:0
15CE3010	Energy Efficient Buildings		3:0:0
15CE3011	Quality Control lab		0:0:2
15CE3012	Construction Personnel Management		3:0:0
15CE3013	Shoring, Scaffolding and Formwork		3:0:0
15CE3014	Resource Management and Control in Construction		3:0:0
15CE3015	Economics and Finance Management in Construction		3:0:0
15CE3016	Project Safety management		3:0:0
15CE3017	Management Information Systems		3:0:0
15CE3018	Urban Land economics		3:0:0
15CE3019	Principles of Rating and Insurance		3:0:0
15CE3020	Laws for acquisition and contract		3:0:0
15CE3021	Town and regional planning		3:0:0
15CE3022	Valuation of Real Estate		3:0:0
15CE3023	Property laws		3:0:0
	REVISED VERSION SUBJECTS		
Sub. Code	Version	Name of the Subject	Credits
14CE3013	1.1	Design of Structures for Dynamic load	3:0:0
14CE201	--	Prefabricated Structures	3:1:0

14CE3049 - COMPUTATIONAL TECHNIQUES IN TRANSPORTATION ENGINEERING

Credit: 3:0:0

Course Objective:

- Learn to develop mathematical models of phenomena involved in transportation engineering

Course Outcome:

At the end of the course student will be able to

- Understand the important physical phenomena from the problem statement
- Develop model equations for the given system
- Demonstrate the model solving ability for various processes/unit operations

Description:

Introduction to systems approach - Typical transportation systems - Mathematical models - Fundamentals of simulation - Monte Carlo method - Continuous and discrete models - Simulation languages - Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions – Manual simulation of simple queuing system Applications of GPSS - Simple queuing problems - Inventory problems - Simulation of ports - Railway platforms and level crossings - Traffic signals - Analysis of simulation results - Model validation - Replication of random conditions - Time series analysis - Genetic Algorithm - Terminology in GA – Strings, Structure, Parameter string - Data Structures – Operators - Algorithm - Fuzzy Logic - Artificial Neural Networks - Topology - Learning Processes - Supervised and unsupervised learning - Least mean square algorithm - Back propagation algorithm - Application in Transportation – Airport Traffic control modelling - Intermodal freight transportation - Artificial intelligence applications

References:

1. Gordon, G., “System Simulation”, Prentice-Hall of India, 2005
2. GPSS/PC, User Manual, Minuteman Software, USA, 2005
3. Zurada J.M., “Introduction to artificial neural systems”, Jaico Publishers, 2006
4. Kalyanmoy Deb, “Optimization for Engineering Design: Algorithms and Examples” PHI learning Pvt. Ltd., 2009.

14CE3050 - INTELLIGENT TRANSPORTATION SYSTEMS

Credit: 3:0:0

Course Objective:

- To study the concepts of ITS
- To understand the various methods used in different countries

Course Outcome:

At the end of the course student will be able to

- Understand and appreciate the concepts related to ITS technologies
- Design technologies for applications of the field

Description:

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS objectives - Historical background - Benefits of ITS - ITS Data collection techniques – Detectors - Automatic Vehicle Location (AVL) - Automatic Vehicle Identification (AVI) - Geographic Information Systems (GIS) - video data collection - Information management - Traffic Management Centres (TMC) - Vehicle road side communication – Vehicle positioning system - ITS functional areas – Advanced Traffic Management Systems (ATMS) - Advanced Traveler Information Systems (ATIS) - Commercial Vehicle Operations (CVO) - Advanced Vehicle Control Systems (AVCS) - Advanced Public Transportation Systems (APTS) - Advanced Rural Transportation Systems (ARTS) - ITS user needs and services – Travel and Traffic management - Public Transportation Management - Electronic Payment - Commercial Vehicle Operations - Emergency Management - Advanced Vehicle safety systems - Information Management - ITS for Pedestrians - ITS Programs in the world - Overview of ITS implementations in developed countries - ITS in developing countries

References:

1. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)”, ITS Hand Book 2000
2. Sussman J. M., “Perspective on ITS”, Artech House Publishers, 2005.
3. National ITS Architecture Documentation, US Department of Transportation, 2007

14CE3051- PRINCIPLES OF HIGHWAY TRAFFIC

Credit: 3:0:0

Course Objective:

- To learn Principle components and design of highways.

Course Outcome:

At the end of the course student will be able to

- Understand the important elements of traffic engineering
- Learn elements in highway design
- Learn principles and practices in highway

Description:

Road user - vehicle and roadway - vehicle characteristics - IRC standards - Design speed and volume - Highway capacity and level of service - capacity of urban and rural roads – PCU concepts and limitations - road user facilities - parking facilities - cycle tracks and cycle ways – Pedestrian facilities - Traffic volume studies - origin destination studies - speed studies - travel time and delay studies - Parking studies - Accident studies - Alignment - Cross sectional elements - stopping and passing sight distance - horizontal curves - vertical curves - Design problems - Hill roads - Signs and markings - Traffic System Management - Design of at-grade intersections - Principles of design - Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated - signal coordination - Design of signal setting - phase diagrams - timing diagram - Signal co-ordination - grade separated intersections - Geometric elements for divided and access controlled highways and expressways - Road furniture - street lighting - Traffic Safety - road safety programmes - Ramp metering - Design of parking - lighting and terminal facilities - Geometric Design - Sight distance requirements - Vehicle cornering - Horizontal and Vertical alignments - Traffic flow and queuing theory

References:

1. ITE Hand Book, “Highway Engineering Hand Book”, Mc Graw – Hill, 2009.
2. AASHTO, “A Policy on Geometric Design of Highway and Streets”.
3. Pignataro L.J., “Traffic Engineering – Theory & Practice”, John Wiley, 2012
4. Salter R. J and Hounsel N. B., “Highway Traffic Analysis and Design”, Macmillan Press Ltd, 2003.
5. Relevant IRC codes.

14CE3052 - URBAN TRANSPORTATION INFRASTRUCTURE PLANNING AND DESIGN

Credit: 3:0:0

Course Objective:

- Design of Intersections, Interchanges, Parking and Terminal Facilities to be provided in an urban area

Course Outcome:

At the end of the course student will be able to

- Understand the important elements in urban transportation
- Design different elements of transportation system

Description:

Basic considerations – simplicity – uniformity – Separation of conflict points – Design Elements – Design speed – Intersection curves – Superelevation for curves at Intersection – Intersection sight distance - capacity and LOS - Design of rotary and signalized intersections - Vehicle actuated signals - Signal co-ordination - Area Traffic Control System (ATCS) - Pedestrian planning at Grade intersections - Design of Grade separators – Principles - Design Criteria – Layout design - GAD preparation – Pedestrian foot over-bridge and subway design – pedestrian planning for Grade separated intersections - parking demand – characteristics – space inventory – Accumulation – duration – turn over index – Design of Multi Storeyed and surface parking facility - Bus Terminus – Design principles – Design elements – Design and case studies of Inter Modal Transfer facilities – Design and case studies of bus and rail terminals - Characteristics of interrupted traffic - Traffic characteristics at un-signalized intersections - Design of signalized intersections capacity and LOS of signalized intersections - Transportation system management - Guidelines for low cost traffic management techniques for urban areas - IRC Specifications - Advanced transit technologies - Bus route network planning and management

References:

1. Robert F Baker, “Hand Book of Highway Engineering”, Van Nostrand Reinhold Company, New York, 2003
2. New Jersey, “Transportation and Traffic Engineering Hand Book”, Institute of Transportation Engineers, Prentice Hall, INC, 2006
3. Kanna, S.K. and Justo, C.E.G. “Highway Engineering”, Nemchand and Brothers, Roorkee, 2002

15CE2001 - IRRIGATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- Impart knowledge about surface and groundwater irrigation methods
- Impart knowledge about irrigation structures

Course Outcome:

At the end of the course, students will be enabled to

- Plan the irrigation project
- Apply the concepts of irrigation methods
- Apply the irrigation management techniques

Description:

Irrigation engineering : definition, need and mode of irrigation, merits and demerits of irrigation; water requirement of crops: FAO methods, irrigation efficiency, crop ratio; Irrigation methods: canal irrigation, lift irrigation, tank irrigation, flooding methods, sprinkler irrigation, drip irrigation; impounding structures : weirs and barrage, percolation ponds, tanks, sluices, dams; crops drainage structures Irrigation water management: water logging and soil salinity, irrigation water losses, optimization of water use, participatory irrigation management, land reclamation; major irrigation projects in India

References:

1. Sharma R.K., "Irrigation Engineering", S. Chand and Co. 2007.
2. Punima B.C. and Pande B.B .Lal. "Irrigation and Water Power Engineering", Laxmi Publishing, New Delhi, 16th Edition 2009.
3. Michael, A.M, "Irrigation Theory and Practice", Vikas Publishing Pvt Ltd, 2nd Edition 2006.
4. Garg, S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2011.
5. Dilip Kumar Majumdar, "Irrigation Water Management (Principles and Practices)", Prentice Hall of India (P), Ltd, 2008.
6. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000.
7. Sahasrabudhe, S.R., "Irrigation Engineering and Hydraulic Structures", Katson Publishers, 3rd edition, 2011.
8. Allen R G, Pereira L S, Raes D Smith M, "Crop Evapotranspiration – Guidelines for computing crop water requirements" Irrigation and Drainage, FAO, Rome Italy, 1998

15CE2002 -WATERSHED MANAGEMENT

Credit: 3:0:0

Course Objectives:

- Impart knowledge on the characteristics of watershed
- Understand the processes leading to degradation of soil and water resources and implementation of conservation measures.

Course Outcomes:

At the end of the course, students will be enabled to

- Delineate watershed of a river basin
- Apply the knowledge on water conservation techniques
- Estimate the rainfall runoff using curve number method.

Description:

Introduction to watershed: definition, concepts, objectives and need; characteristics of watershed: size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, runoff estimation using curve number method; watershed management: definition, factors affecting watershed management, controlling of soil erosion and soil salinity; estimation of soil loss due to erosion using Universal Soil Loss Equation; watershed delineation; land use impacts on watershed; types and design of soil and water conservation, water harvesting structures for different types of catchments; rainwater harvesting; soil moisture conservation; check dams; artificial recharge; sustainability concepts.

References:

1. Murthy J V S, "Watershed Management", New Age International Publishers, 2011
2. Ghanshyam Das, "Hydrology and Soil Conservation Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi, 2000.
3. Suresh R., "Soil and Water Conservation Engineering", Standard Publishing Distributors, New Delhi. 2000.
4. Timothy O. Randhir, "Watershed Management: Issues and Approaches", IWA Publishing, 2007
5. Vijay P. Singh, Ram Narayan Yadava, "Watershed Management", Allied Publishers, 2003

15CE2003 – INTRODUCTION TO WATER QUALITY ANALYSIS AND MODELING

Credits 3:0:0

Course Objectives:

- Understand the physical, chemical and biological processes influencing water quality
- Impart knowledge on the potential role of models in water quality management

Course Outcomes:

At the end of the course, students will be enabled to

- understand the instrumental methods
- apply the concepts of modeling in water quality analysis
- analyse the water samples

Description:

Water quality description; various characteristics of water; water quality criteria and standards, Water quality problems associated with excess iron, fluoride, arsenic, hardness, nitrate, heavy metals, pesticides and Ecoli; types of water pollution; classification of pollutants; eutrophication effects and control; instrumental methods of water quality analysis: UV spectrophotometer, flame spectrophotometer, atomic absorption spectrophotometer; Elements of reaction kinetics, spatial and temporal aspects of contaminant transport, transport mechanisms in rivers and streams; introduction to water quality modeling.

References:

1. Steven C.Chapra, “Surface Water Quality Modeling”, McGraw-Hill-Companies, Inc., New York, 2008.
2. Manahan S.E, “Environmental Chemistry” (7th Ed), Lewis Publications, Florida, U.S.A, 2000.
3. Stumm, Werner and James J. M, “Aquatic Chemistry, Chemical Equilibria and Rates in Natural Waters”, John Wiley and Sons, Inc., 3rd Edition, 2013
4. Sawyer, C.N. and McCarty, P.L., and Parkin, G.F., “Chemistry for Environmental Engineers”, 4thEdn. McGraw Hill, New Delhi, 2003
5. Miguel Valcárcel Cases, “Principles of Analytical Chemistry: A Textbook”, Springer Science and Business Media, 2000
6. Qasim, Motley, Guang, “Water Works Engineering”, Prentice-Hall India, 2006

15CE3001 STATISTICAL METHODS FOR ENGINEERS

Credits: 3:0:0

Course Objectives:

- Understand the concepts of Statistical methods and its applications in Engineering.
- Acquire knowledge on the effect of estimation theory, testing of hypothesis, correlation and regression, randomized design, and multivariate analysis.

Course Outcome:

On completion of this course the students will be able to

- Apply probability and statistical methods in the field of construction management
- Analyze and solve conflict problems
- Design problems with random parameter

Description

Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments, Tests based on Normal, t , X^2 and F distributions for testing of means, variance and proportions – Analysis of $r \times c$ tables – Goodness of fit. Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties of Residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and Partial correlations in terms of lower order coefficient - Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design, Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

References:

1. Gupta.S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, 2002
2. Freund J.E., Mathematical Statistical”, 5th Edition, Prentice Hall of India, 2001.
3. Jay L.Devore, “Probability and statistics for Engineering and the Sciences”, 5th Edition, Thomson and Duxbury, Singapore, 2002
4. Murray.R. Spiegel and Larry J.Stephens, “Schaum’s Outline- Statistics”, Third Edition, Tata McGraw-Hill, 2000
5. R.A. Johnson and C.B. Gupta, “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 7th Edition, 2007
6. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2007

15CE3002 BUILDING BYE LAWS

Credits: 3:0:0

Course Objectives:

- Understand the provisions of the act of building byelaws
- Knowledge on the procedure of applying building permit
- Knowledge on the building performance byelaws
- Application of Byelaws in different forms

Course Outcome:

On completion of this course the students will be able to

- Apply the Building Bye laws for planning of buildings
- Function effectively in obtaining sanctions
- Adapt safety measures in construction

Description:

Preamble – Provision of the act – Jurisdiction – Repeal and Saving - Commissioner – corporation – Dwelling Unit – Existing Buildings – Floor Area Ratio – Form – Ground coverage – Height of a building – Land use – Master plan – Period of construction – Plinth – Sanctioned Design and Specification – Sanctioned use – Schedule – Setbacks or Margins - Building permit and Building use permit – Procedure for obtaining a variance - Environmental Management – Pollution control – Structural Safety – Fire prevention and safety – Maintenance and upgradation - Heritage conservation byelaws – General planning byelaws - Schedules and forms

References:

1. Building bye laws of Delhi, 2005

15CE3003 CONSTRUCTION EQUIPMENT

Credits: 3:0:0

Course Objectives:

- Understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors
- Applications of various equipments in construction projects.

Course Outcome:

At the end of this course students will be able to

- Choose suitable equipments for the construction projects.
- Decide the equipments for special projects
- Improve the site performance by effective equipment management.

Description:

Identification – Planning of equipment - Equipment Maintenance and Management in Projects - Cost Control of Equipment - Depreciation Analysis – Replacement Analysis - Safety Management - types of earth work Equipment - Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling, pile driving and erection, Dewatering, Grouting, Demolition - pumps used in Construction - Different Crushers, Feeders and Screening Equipment for aggregate – Handling, Batching, Mixing and pumping Equipment – Equipment for Ready mix concrete, Concrete pouring, Asphalt laying - Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors, Cranes- Industrial Trucks

References:

1. Jha Kumar Neeraj, Kumar Neeraj Jha, “Construction Project Management: Theory and Practice”, Pearson Education India. 2011
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2006.
3. Douglas D. Gransberg, Calin M. Popescu, Richard Ryan, “Construction Equipment Management for Engineers, Estimators, and Owners”, of CRC Press, 2006
4. Robert L. Peurifoy, Cliff Schexnayder, William B. Ledbetter, “Construction Planning, Equipment and Methods”, McGraw-Hill Higher Education, 2001
5. Douglas D. Gransberg, Calin M. Popescu, Richard Ryan Construction Equipment Management for Engineers, Estimators, and Owners, CRC Press. 2006
6. Keoki Sears S., Glenn A. Sears, Richard H. Clough Construction Project Management: A Practical Guide to Field Construction”, John Wiley and Sons. 2010

15CE3004 PROJECT FORMULATION AND APPRAISAL

Credits: 3:0:0

Course Objectives:

- Understand the formulation, costing of construction projects, appraisal, finance and private sector participation.

Course Outcome:

On completion of this course the students will be able to

- Demonstrate the knowledge of report preparations
- Plan the key Indicators of the project
- Formulate effective technology transfer mechanisms

Description:

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Project Clearances - Project Cash Flows – Time Value of Money – Cost of Capital - Pay Back Period – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Selection of a Project and Risk Analysis in Practice. Project Financing – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios - Private sector participation in Infrastructure Development Projects - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer

References:

1. Kim H. Pries, Jon M. Quigley, “Total Quality Management for Project Management”, CRC Press. 2012
2. Matthias Kipping, Timothy Clark, “The Oxford Handbook of Management Consulting”, Oxford University Press, 2012
3. George Ritz, Sidney Levy, “Total Construction Project Management, Second Edition”, McGraw Hill Professional, 2013
4. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi. 2006.
5. Rajendra Mishra, Project Management, Excel Books, 2012
6. Subhash Chandra Das, “Project Management And Control”, PHI Learning Pvt. Ltd., 2011

15CE3005 QUANTITATIVE TECHNIQUES IN MANAGEMENT

Credits: 3:0:0

Course Objectives:

- Understand various quantitative methods applied to the elements of management.
- Application Techniques on production management, finance management, decision theory and managerial economics.

Course Outcome:

On completion of this course the students will be able to

- Interpret the path of operations of the project
- Examine the Quality of execution
- Decide on the budget of the projects

Description:

Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems -Inventory Control - EOQ - Quantity Discounts - Safety Stock – Replacement Theory – PERT and - CPM – Simulation Models – Quality Control - Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting - Decision Theory– Decision trees – Utility Theory - Cost Concepts – Break-even analysis – Pricing Techniques – Game theory Applications

References:

1. George E. Monahan, “ Management Decision Making: Spreadsheet Modeling, Analysis, and Application”, Volume 1, Cambridge University Press, 2000
2. Hamdy A.Taha, “Operations Research: An Introduction”, Prentice Hall, 2010.
3. Andreas Klose, M. Gracia Speranza, Luk N. Van Wassenhove, “Quantitative Approaches to Distribution Logistics and Supply Chain Management”, Springer, 2002
4. Andreas Klose, M. Gracia Speranza, Luk N. Van Wassenhove, “Quantitative Approaches to Distribution Logistics and Supply Chain Management”, Springer Science and Business Media, 2002
5. Tang S.L., Irtishad U.Ahmad, Syed M.Ahmed, Ming Lu, Quantitative Technique for Decision making in Construction, Hongkong University Press, HKU, 2004.
6. Schroeder, R.G, “Operations Management”, McGraw Hill, 2009.
7. Vohra, Nd., “Quantitative Techniques in Management”, Third Edition, Tata McGraw-Hill Company Ltd, 2007.

15CE3006 CONSTRUCTION PROJECT MANAGEMENT

Credits: 3:0:0

Course Objectives:

- Understand various management techniques for successful completion of construction projects.
- Understand the effect of management for project organization, design of construction process, labour, material and equipment utilization, and cost estimation.

Course Outcome:

On completion of this course the students will be able to

- Apply the modern trends in project management viz
- Design and cost estimate for the project construction
- Maximize the use of resource unitisation

Description:

Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers - Project Management –Constructor Sequence - Design and Construction as an Integrated System – Innovation, Technological and economical feasibility - Functional Design - Construction Site Environment - Job-Site Productivity - Labour Relations - Collective Bargaining - Materials Management - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks - Cost Estimation - Estimate Based on Engineer's List of Quantities - Operating Costs.

References:

1. Chitkara, K.K., “Construction Project Management: Planning, Scheduling and Control”, Tata McGraw-Hill Publishing Company, New Delhi, 2010.
2. Jack R. Meredith, Samuel J. Mantel, “Project Management: A Managerial Approach”, John Wiley and Sons, 2011
3. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000.
4. Frederick E. Gould, “Construction Project Management”, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
5. George J.Ritz and Sidney Levy, “Total Construction Project Management”, McGraw-Hill Inc, 2013.
6. Mishra R. C and Tarun Soota, “Modern Project Management”, New Age International (P) Limited, Publishers, 2006

15CE3007 ADVANCED CONSTRUCTION TECHNIQUES

Credits: 3:0:0

Course Objectives:

- Understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures
- Knowledge on rehabilitation and strengthening techniques and demolition techniques

Course Outcome:

On completion of this course the students will be able to

- Apply the modern construction techniques to be used in the construction
- Organize rehabilitation and strengthening techniques.
- Execute the operations of the project sequentially.

Description:

Jacking - Under water construction of diaphragm walls and basement - Laying operations for built up offshore system - Large reservoir construction - Concrete paving technology – Techniques of construction of tall buildings - Large span structures – Erection of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges - Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks. Seismic retrofitting - Protection methods of structures – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques. Demolition Techniques - Advanced techniques using Robotic Machines

References:

1. Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”, LexisNexis Butterworths India, 2000
2. Jimmie Hinze, “Construction Contracts”, McGraw Hill, 2001.
3. Joseph T. Bockrath, “Contracts and the Legal Environment for Engineers and Architects”, McGraw Hill, 2000.
4. Thomas E. Uher, Philip Davenport, “Fundamentals of Building Contract Management”, UNSW Press, 2009
5. Paul Watson, Tim Howarth, “Construction Quality Management: Principles and Practice”, Routledge, 2012
6. Bajirao Shankarrao Patil, “Civil Engineering Contracts and Estimates”, Universities Press (India) Private Limited, 2006.

15CE3008 CONTRACT LAWS AND REGULATIONS

Credits: 3:0:0

Course Objectives:

- Understand the various types of construction contracts and their legal aspects and provisions.
- Knowledge on the tenders, arbitration, legal requirement, and labour regulations.

Course Outcome:

On completion of this course the students will be able to

- Classify the contracts in construction
- Apply various regulations for construction
- Combine suitable laws for the project under consideration

Description:

Indian Contracts Act – Elements of Contracts – Types of Contracts – Design of Contract Documents – Law of Torts - Prequalification – Bidding – Accepting – Evaluation of Tenders – Contract Formation and Interpretation – World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act - Comparison of Actions and Laws – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence - Enforcement of Award – Costs Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws and their Influence on Construction Costs – Legal Requirements for Planning – Statutory Regulations - Social Security – Welfare Legislation – Insurance and Safety Regulations - Other Labour Laws.

References:

1. Gajaria G.T., “Laws Relating to Building and Engineering Contracts in India”, Lexis Nexis Butterworths India, 2000
2. Jimmie Hinze, “Construction Contracts”, 2nd Edition, McGraw-Hill, 2001
3. Joseph T. Bockrath, “Contracts and the Legal Environment for Engineers and Architects”, 6th Edition, McGraw-Hill, 2000
4. Hugh Collins, “The Law of Contract”, Cambridge University Press, 2003
5. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000.

15CE3009 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

Credits: 3:0:0

Course Objectives:

- Understand the concept of planning, scheduling, cost and quality control,
- Knowledge on safety during construction,
- Organization and use of project information necessary for construction project.

Course Outcome:

On completion of this course the students will be able to

- Develop suitable scheduling for execution
- Choose control methods for cash flow
- Adopt modern technology for information

Description:

Basic Concepts in the Development of Construction Plans – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Construction Schedules – Critical Path Method – Scheduling with Resource Constraints and Precedence's – Use of Advanced Scheduling Techniques – Calculations for Monte Carlo Schedule Simulation – Crashing and Time/Cost Tradeoffs - The Cost Control Problem – The Project Budget – Control of Project Cash Flows –Schedule Control - Quality and Safety Concerns in Construction – Statistical Quality Control with Sampling by Attributes and Variables – Safety - Types of Project Information – Computerized Organization and Use of Information – Information Transfer and Flow.

References:

1. Albert Lester Project Management, "Planning and Control: Managing Engineering, Construction and Manufacturing", Butterworth-Heinemann, 2013
2. Daniel W. Halpin, Bolivar A. Senior, "Financial Management and Accounting Fundamentals for Construction", John Wiley and Sons. 2011
3. Saleh A. Mubarak, "Construction Project Scheduling and Control", John Wiley and Sons, 2010
4. Charles Patrick, "Construction Project Planning and Scheduling", Pearson Education India. 2000
5. Willem Kymmell, "Building Information Modeling: Planning and Managing Construction Projects", McGraw Hill Professional. 2008
6. Chitkara, K.K., "Construction Project Management: Planning, Scheduling and Control", McGraw-Hill Publishing Company, New Delhi, 2010.
7. Sandra Christensen Weber, "Scheduling Construction Projects: Principles and Practices", Pearson Prentice Hall, 2005

15CE3010 ADVANCED CONSTRUCTION ENGINEERING AND COMPUTING TECHNIQUES LABORATORY

Credit: 0:0:2

Course Objectives:

- Knowledge on material selection through the material testing based on specification
- Utilizing the sophisticated spread sheets programs,
- Application on estimation software and other package programs

Course Outcomes:

On completion of this laboratory course students will be able to

- Design the concrete mixes as per IS, ACI and BS methods.
- Apply various tests on hardened concrete
- Develop scheduling of constructions projects using tools like primavera and MS projects.

Description:

Mix design - Flow characteristics of Self Compacting concrete - workability, strength and durability studies - Quantity takeoff, preparation and delivery of the bid or proposal of an engineering construction project - Design of a simple equipment information system for a construction project - Scheduling of a small construction project using Primavera scheduling systems including reports and tracking - Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking - Simulation models for project risk analysis.

References:

1. Neville, A.M., "Concrete Technology", Longman Scientific and Technical, England, 2008.
2. Krishnaraju, N., "Design of concrete mixes", Sehgal Educational Consultants and Publishers Pvt. Ltd., Faridabad, 2007.
3. Primavera, Software Manual

15CE3011 QUALITY CONTROL LAB

Credit: 0:0:2

Course Objectives:

- Hands on training on testing of cement and aggregates
- Hands on training on testing of concrete
- Knowledge on mix design procedures
- Knowledge on testing of highway materials

Course Outcome:

On completion of this course the students will be able to

- Carry out the experiments on materials
- Perform the analysis on test results
- Suggest the good materials for construction

Description:

Tests on Cement - Tests on Fine Aggregate - Tests on Coarse Aggregate - Test on Fresh Concrete - Tests on Hardened Concrete – Analysis of Results - Non Destructive Test

References:

1. Shetty, M. S., 'Concrete Technology', S. Chand and Co., New Delhi, 2005.
2. M L Gambhir; Neha Jamwal, "Building and Construction Materials: Testing and Quality Control", 1e (Lab Manual), Tata McGraw-Hill Education. 2014
3. Khanna, S.K., and Justo C.E.G., Highway Engineering, Nem Chand and Bros. 2005.
4. Hamant. Sood, "Laboratory Manual on Testing of Engineering Materials", New Age International. , 2003

15CE3012 CONSTRUCTION PERSONNEL MANAGEMENT

Credit: 3:0:0

Course Objectives:

- Fundamentals of human behaviour under various situations
- Relate the behaviour pattern to manpower planning in organizational setups
- Understand the means of management of construction personnel
- Knowledge on the methods to adopt training as a tool for improvement

Course Outcome:

On completion of this course the students will be able to

- Apply various processes in manpower planning
- Make use of human resources effectively
- Choose appropriate organization and welfare measures.

Description:

Manpower planning, organizing, staffing, directing, and controlling – personal principles - Organization charts – Staffing plan – Development and Operation of human resources – managerial Staffing – Recruitment – Selection – Placement Human management – basic individual psychology – job design and performance management – Managing groups at work – Leadership – Behavioral aspects of decision making; and communication for human management - Compensation – Wages and Salary, employee benefits, employee appraisal and assessment – Employee services – Safety and Health – Discipline and discharge – Special Human resource problems – Employee handbook and personal manual - Productivity of Human resources – Staff training and evaluation

References:

1. Dwivedi R.S, “Human Relations and Organisational Behaviour”, Macmillian India Ltd., 2005.
2. Charles D. Reese, James Vernon Eidson, “Handbook of OSHA Construction Safety and Health”, Second Edition, CRC Press. 2006
3. Reddy R.J., “Personnel Management”, APH Publishing, 2004
4. Andrew Dainty, Martin Loosemore, “Human Resource Management in Construction: Critical Perspectives”, Routledge, 2013
5. Paul S. Chinowsky, Anthony D. Songer, “Organization Management in Construction”, Routledge, 2011
6. Dwived R.S. “Human Relations and Organizational Behaviour”, Macmillan, 2011

15CE3013 SHORING, SCAFFOLDING AND FORMWORK

Credit: 3:0:0

Course Objectives:

- Understand the overall and detailed planning of formwork, plant and site equipment.
- Understand the design and erection of forms for various elements such as slabs, beams, columns, walls, shells and tunnels.
- Knowledge on the latest methods of form construction.

Course Outcome:

On completion of this course the students will be able to

- Detail the planning of formwork,
- design the formworks and
- Formulate the erection methods of form work.

Description:

Planning, Site Equipment and Plant for Form Work - General Objectives - Planning for Safety - Basic System - Cost Reduction - Overall Programme - Detailed Programme - Scaffold Frames - Framed Panel Formwork - Materials Accessories Proprietary Products and Pressures - Lumber, Plywood, Reconstituted Wood, Steel, Aluminum, Hardware and Fasteners - Uplift on Shores - Design of Forms and Shores - Building and Erecting the Form Work - Forms for Domes and Tunnels, Slip forms and Scaffolds

References:

1. Mary Krumboltz Hurd, "Formwork for Concrete", American Concrete Institute. 2005
2. JHA, "Formwork for Concrete Structures", Tata McGraw-Hill Education. 2012
3. "The Code of Federal Regulations of the United States of America" U.S. Government Printing Office, 2004
4. Raissa Patricia Douglas Ferron, "Formwork Pressure of Self-consolidating Concrete: Influence of Flocculation", Pro Quest. 2008.

15CE3014 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION

Credit: 3:0:0

Course Objectives:

- Understand the management and control of various resources involved in construction.
- Knowledge on the effect of resource planning, labour management, material and equipment, time management, and resource allocation and resource leveling in construction.

Course Outcome:

On completion of this course the students will be able to

- Allocate and resource leveling in construction.
- Formulate resource planning and management
- Develop the attitude of time management

Description:

Resource Planning, Procurement, Identification, Personnel - Planning for material, Labour, time schedule and cost control - Labour Management - Systems approach, Characteristics of resources, Utilization - Materials and Equipment - Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution – Equipment utilization - Time Management - Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control - Resource allocation - computer application

References:

1. Andrew P. Sage, William B. Rouse, “Handbook of Systems Engineering and Management”, John Wiley and Sons. 2011
2. Tang S.L., Irtishad U. Ahmad, Syed M. Ahmed, Ming Lu, “Quantitative Techniques for Decision Making in Constructio”, Hong Kong University Press. 2004
3. Thomas Uher, Adam S. Zantis., “Programming and Scheduling Techniques”, Routledge, 2012
4. Thomas Uher, Adam S. Zantis, “Programming and Scheduling Techniques”, Routledge. 2012
5. Andrew Whyte, “Integrated Design and Cost Management for Civil Engineers”, CRC Press, 2014

15CE3015 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION

Credit: 3:0:0

Course Objectives:

- Understand the concepts of Construction Economic and Finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, and management of accounting.

Course Outcome:

On completion of this course the students will be able to

- Apply the concepts in economics and finance in constructions
- Analyse the sources of finance and its utilization
- Solve financial issue using various methods

Description:

Basic Principles - Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest - Payment Methods - comparing alternatives proposals - Present Worth analysis, Annual Worth Analysis, Future Worth Analysis, Rate of return analysis and Incremental rate of return analysis – Evaluating alternative investments – Real estate - Funds Management - Sources of finance - Working Capital Management, Inventory valuation, Mortgage Financing - International financial management - Fundamentals of Management Accounting – principles - basic concepts, statements.

References:

1. Leland T. Blank, Anthony J. Tarquin, “Engineering Economy”, McGraw-Hill, 2012.
2. Sasmita Mishra, “Engineering Economics and Costing”, PHI Learning Pvt. Ltd., 2009
3. Patel, B M, “Project management- strategic Financial Planning, Evaluation and Control”, Vikas Publishing House Pvt. Ltd. New Delhi. 2000
4. Shrivastava, U.K., “Construction Planning and Management”, 2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi. 2000
5. John A. White, Kenneth E. Case, David B. Pratt, “Principles of Engineering Economic Analysis”, Wiley, 2012

15CE3016 PROJECT SAFETY MANAGEMENT

Credit: 3:0:0

Course Objectives:

- Understand the various safety concepts and requirements applied to construction projects.
- Knowledge on the construction accidents, safety programmes, contractual obligations, and design for safety.

Course Outcome:

On completion of this course the students will be able to

- Illustrate various constructions safety concepts
- Develop the safety culture in the work place
- Prioritize the responsibilities as an owner

Description:

Construction Accidents and their Causes – Human Factors in Construction Safety – Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications - Problem Areas in Construction Safety – Site Safety Assessment and Management – Substance Abuse – Safety Record Keeping - Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers - Top Management Practices – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation - Owner’s responsibility – Role of designer in ensuring safety

References:

1. Richard J. Coble, Jimmie Hinze, Theo C. Haupt, “Construction Safety and Health Management”, Prentice Hall Inc., 2000
2. Tamilnadu Factory Act, Department of Inspectorate of factories, Tamil Nadu. Health Management, Prentice Hall Inc., 2001
3. David MacCollum, “Construction Safety Engineering Principles (McGraw-Hill Construction Series)”, McGraw Hill Professional, 2007
4. Steve Rowlinson, “Construction Safety Management Systems”, Routledge, 2004

15CE3017 MANAGEMENT INFORMATION SYSTEMS

Credit: 3:0:0

Course Objectives:

- Concepts of information systems and their applications
- Knowledge on system development and information systems
- Implementation of control and system audit.

Course Outcome:

On completion of this course the students will be able to

- Organize structured design using modern tools
- Choose suitable security measures.
- Assess the risk to interpret suitable solutions

Description:

Information Systems – Establishing the Framework – Business Models – Evolution of Information Systems - Modern Information System – Structured Methodologies – Designing Computer based Methods – Designing Structured Programs - Integrated Construction Management Information System – Project Management Information System – Functional Areas, Finance, Marketing, Production, Personnel – Comparison, Concepts and Knowledge Representation – Managing International Information System – Testing Security – Validating – Cost Benefit Analysis – Assessing the value and risk of Information System - Software Engineering qualities – Verification and Validation

References:

1. Caryn Alison Conley, “ Design for Quality: The Case of Open Source Software Development”, ProQuest, 2008
2. Effy Oz “ Management Information Systems”, Cengage Learning, 2008
3. Sadagopan S, “Management Information Systems, PHI Learning Pvt. Ltd., 2014
4. Johannes Govardus Maria van der, “Designing Management Information Systems”, Oxford University Press, 2009
5. Kenneth C. Laudon, Jane Price Laudon, “Management Information Systems: Organization and Technology in the Networked Enterprise”, Prentice Hall, 2000
6. Gordon Schulmeyer G., “Software Quality Assurance and Management”, Artech House, 2008.
7. Janakiraman V. S., Sarukesi K., “Decision Support for Managers”, Prentice Hall, 2008

15CE3018 URBAN LAND ECONOMICS

Credit: 3:0:0

Course Objectives:

- Understand the features of growth and use of urban land
- Knowledge on real estate market

Course Outcome:

On completion of the course the student will be able to

- Illustrate the knowledge of urban infrastructure development
- Survey the real estate market
- Estimate the land prices

Description:

Features of growth: geographical area of settlement – migration population and density – occupational pattern – Uses of urban land: factor in supply; effects of zoning and development control – Urban infra-structure: bulk delivery of civic services: communication and transportation – real estate market: investments in real estate – Development decisions: agencies for decisions – factors affecting urban land value – land prices in the major cities: determining forces: comparative variation: globalization and its effect.

References:

1. Cliff Moughtin, “Urban Design: Street and Square”, Routledge, 2007
2. Richard U Ratchiff, “Urban land Economics”, Mc Graw Hill Publishing Company, Pvt., Ltd., 2009
3. John F. McDonald, Daniel P. McMillen, “Urban Economics and Real Estate: Theory and Policy”, John Wiley and Sons, 2010
4. Alan Evans, “Economics, Real Estate and the Supply of Land”, John Wiley and Sons, 2008
5. Cornelis Van Kooten G, “Land Resource Economics and Sustainable Development: Economic Policies and the Common Good”, UBC Press, 2011
6. Jean-Marie Huriot, Jacques-François Thisse, “Economics of Cities: Theoretical Perspectives”, Cambridge University Press, 2000

15CE3019 - PRINCIPLES OF RATING AND INSURANCE

Credit: 3:0:0

Course Objectives:

- Knowledge on the sources of rating law in India
- Understand the valuation principles and techniques
- Understand the Insurance policies and loss claim

Course Outcome:

On completion of the course the student will be able to

- Interpret the taxes in the construction industry
- Assess insurance for different categories
- Evaluate the settlement issues

Description:

Differences between rating law in India, England and USA – valuation and levy of tax on property for municipal taxation purposes in the Indian context – principle of communibus annis and rebus sic stantibus – considerations for fixing ratable value - Unit of assessment - incidences of tax owner's share and occupier's share – Municipal taxes - profit basis and contractor's method– judicial decisions on rating - Insurance and Loss Assessment - liabilities – Policies– Risk management – Insurance market– valuation principles and techniques - inflation provisions, - obsolescence and betterment – principles of claim settlement – obligations and rights of insures and insured – third party claims

References:

1. Ian J. Bateman, "Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries", Oxford University Press, 2001
2. Rangwala S. C., "Valuation of Real Properties", Charotar Publishing House Pvt. Limited, 2008
3. Peter Wyatt, "Property Valuation", John Wiley and Sons, 2013
4. Angadi D B, "Civic property Tax", Radha Publications, Madras, 2005
5. David Murphy, Russell D. Longcore, "Insurance Claim Secrets Revealed!", Russell Longcore, 2007
6. Jyotsna Sethi and Nishwan Bhatia, "Elements of Banking and Insurance", PHI Learning Pvt. Ltd., 2007

15CE3020 LAWS FOR ACQUISITION AND CONTRACT

Credit: 3:0:0

Course Objectives:

- Understand the Jurisprudence
- Understand the constitutional provisions, powers and functions sources of revenue
- Knowledge on Contract and Tort

Course Outcome:

On completion of the course the student will be able to

- Explain the laws of land acquisition
- Choose suitable contracts for projects
- Adapt suitable sales procedures

Description:

Elementary Jurisprudence: Law – its origin, source and ramifications – legislative enactments — Indian Legal system - salient features - Centre – State relationship – Local Government - rural and urban – constitutional provisions, powers and functions sources of revenue – Contract and Tort - formation of a contract - misrepresentation and fraud – termination of contract - performance of contract - law of agency - tort affecting valuation – outline procedure for sale of immovable property - contract by correspondence – Acquisition and requisition of immovable property – enactments – land acquisition act 1894 (1 of 1894) – provisions for acquisition of land under the municipal laws – law of arbitration and conciliation

References:

1. Karl N. Llewellyn, Jurisprudence: Realism in Theory and Practice, Transaction Publishers, -2011
2. Curzon L. B., Routledge-Cavendish, “ Jurisprudence”, Psychology Press, 2002
3. Sharma, Sharma B.k, “Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., 2007
4. Nilima Bhadbhade Contract Law in India, Kluwer Law International, 2010
5. Suraj Prasad Singh, Indrajit P. Singh, “Law of Tort: Including Compensation Under the Consumer Protection Act”, Universal Law Publishing Company, 2006
6. John Stephenson, “Building Regulations Explained”, Taylor and Francis, 2001

15CE3021 TOWN AND REGIONAL PLANNING

Credit: 3:0:0

Course Objectives:

- Highlight on evolution of planning
- Understand the land use planning and management

Course Outcome:

On completion of the course the student will be able to

- Demonstrate effective town planning
- Choose suitable agencies for various activities
- Adopt suitable legal mechanism for planning

Description:

Evolution of Planning – planning practices in India – Planning process and hierarchy of planning - Principles and Necessity of town planning – uses of land – site planning – collection of data – types of surveys – preparation of layouts – land use planning and management – concept of city and Building byelaws - their effect on valuation – preparation of development plan – land use zoning principles and its effect on real estate – threshold theories for utility services - Agencies involved in plan, preparation and implementation: Effect of Development Plan on valuation - Legal mechanism for enforcement of planning document – Regional planning – laws affecting planning

References:

1. Rangwala S C, Rangwala K S, Rangwala P S, “A text Book of Town Planning”, Charotar Publishing House Pvt. Ltd. 2009
2. Jonathan Barnett, “Urban Design as Public Policy and Architectural Record”, Mc Graw Hill Publication, 2008
3. Kopardekar H D, “Social Aspects of Urban Planning”, All India Institute of Local Self Government, Bombay, 2002
4. “Model Town and Country Planning Act” Published by Town and Country Planning Organization, Govt. of India. 2002

15CE3022 - VALUATION OF REAL ESTATE

Credit: 3:0:0

Course Objectives:

- Understand the Income approach to value
- Acquire knowledge on rate capitalization

Course Outcome:

On completion of the course the student will be able to

- Apply various methods for valuation of land
- Experiment with appropriate sale analysis techniques
- Assess the other factors influencing the value of property

Description:

Income approach to value – market approach to value – real estate market – cost approach to value: depreciated replacement cost – statistical and analytical methods in valuation – land characteristics – belting theory – hypothetical plotting scheme – hypothetical building scheme – transfer of development rights - market comparison techniques – adjustment grid model – regression analysis – residual technique – comparison by weight ages assigned to various factors – principles of income approach - sale analysis techniques and deriving rate of interest from sale transaction – rate capitalization – reversionary value of land – impact of other forms of investments on value of property

References:

1. Joni Larson, “Valuation Handbook”, LexisNexis, 2014
2. Walter Roy Huber, William H. Pivar, “Real Estate Appraisal: Principles and Procedures”, Educational Textbook Company, 2006
3. Peter Wyatt, “Property Valuation”, John Wiley and Sons, 2013
4. Richard M. Betts, “Basic Real Estate Appraisal, OnCourse Learning, 2012
5. Ronald L. Brown, “Valuing Professional Practices and Licenses”, Aspen Publishers, 2013

15CE3023 PROPERTY LAWS

Credit: 3:0:0

Course Objectives:

- Understand the laws related to immovable property
- Acquire knowledge on leases

Course Outcome:

On completion of the course the student will be able to

- Demonstrate the knowledge of laws pertaining to ownership of property
- Inspect transfer of immovable property
- Develop legal statements of possession of property as per the Indian acts

Description:

Laws relating to immovable property and easement – ownership and possession – co-ownership and concurrent ownership – co-operatives and condominiums – Transfer of Property Act 1882 – Transfer of Immovable property: sale, mortgage, gift, exchange, assignment – leases: lessor and lessee, sublease, period of lease, ground rent – expiration and renewal of leases – Indian Easement Act 1882 – Leave and license – laws of evidence – personal laws affecting inheritance of property – Indian Succession Act: Will and testament; succession certificate

References:

1. Ugo Mattei, “Basic Principles of Property Law: A Comparative Legal and Economic Introduction”, Greenwood Publishing Group, 2000
2. Shailendra Kumar Awasthi and Dwivedi, “Law of Land Acquisition and Compensation”, Law Agency, 2008
3. Avtar Singh, Harpreet Kaur, “Textbook on the Transfer of Property Act”, Universal Law Publishing, 2009
4. Joseph Bockrath and Fedric Plotnick, “Contracts and the Legal Environment for Engineers and Architects”, Mc Graw Hill Education, 7th Edition 2010
5. Das M N, “Laws Relating to Partition”, Jawahar Publishers (p) Ltd. 2001

14CE3013 DESIGN OF STRUCTURES FOR DYNAMIC LOAD (V-1.1)

Credit: 3:0:0

Pre-requisite: 14CE3005-Structural Dynamics

Course Objective

- Knowledge on the basic principles of dynamic loads
- Behavior of structures subjected to dynamic loads

Course Outcome

At the end of the course student will be able to

- carry out analysis and design various tall buildings and other structures subjected to various Dynamic Loads.

Description

Dynamic loads, behavior under impact and cyclic loads: concrete, steel, masonry and soil – design against earthquakes: hydraulic structures, life line structures, terminal buildings, towers, tunnels. Design against blast and impact, design against wind and cyclone– aero elastic and aerodynamic effect - design as per BIS code of practice including gust factor approach – tall buildings, stacks and chimneys, Passive and active control of vibrations, new and favorable materials.

References

1. Andreas Kappos, “Dynamic Loading and Design of Structures”, CRC Press, 2001
2. Ted Stathopoulos, Charalambos C. Baniotopoulos, “Wind Effects on Buildings and Design of Wind-Sensitive Structures”, Springer Science and Business Media, 2007
3. ViridiK. S., MatthewsR, ClarkeJ. L, FikryGaras, “Abnormal Loading on Structures: Experimental and Numerical Modelling”, CRC Press. 2000
4. Theodor Krauthammer, “Modern Protective Structures”, CRC Press. 2008
5. Robert E. Englekirk Seismic Design of Reinforced and Precast Concrete Buildings”, John Wiley and Sons, 2003

14CE201 PREFABRICATED STRUCTURES

Credits: 3:1:0

Course Objective:

- Design of Prefabricated structural components and its joints
- Design of prefabricated structures subjected to dynamic forces

Course Outcome:

At the end of the course, the student will be able to

- Understand the modular construction and industrialized construction
- Design the prefabricated elements
- Assemble the elements for the construction.

Unit I Introduction

Need for prefabrication – Principles – Materials – Modular coordination – Standardization Systems – Production – Transportation – Erection

Unit II Prefabricated Components

Behaviour of structural components – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Unit III Design Principles

Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

Unit IV Joint in Structural Members

Joints for different structural connections – Dimensions and detailing – Design of expansion joints

Unit V Design for Abnormal Loads

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, explosions, fire. Importance of avoidance of progressive collapse

Text Books

1. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag, GMBH, 1971.
2. John D. Quale., “Sustainable, Affordable, Prefab: The EcoMOD Project”, University of Virginia Press, 2012
3. Maurice Levitt, “Precast Concrete: Materials, Manufacture, Properties and Usage”, Taylor and Francis Group, 2007.
4. Lasslo Makk, “Prefabricated concrete for Industrial and Public sectors”, Akademiai Kiado, Budapest, 2004

LIST OF SUBJECTS

Subject Code	Name of the Subject	Credits
13CE307	Experimental Techniques and Instrumentation Methods	4:0:0
13CE308	Energy Conservation Techniques in Building Construction	4:0:0
13CE309	Chemical Behaviour of Concrete Composites	4:0:0
14CE1001	Basic Civil Engineering	3:0:0
14CE2001	Survey	3:0:0
14CE2002	Mechanics of Solids	3:1:0
14CE2003	Mechanics of Fluids	3:1:0
14ME2001	Engineering Mechanics	3:0:0
14CE2004	Building Materials and Geology	3:0:0
14CE2005	Applied Hydraulics and Hydraulic Machinery	3:0:0
14CE2006	Strength of Materials	3:1:0
14CE2007	Soil Mechanics	3:0:0
14CE2008	Water and Waste water Engineering	3:0:0
14CE2009	Reinforced Concrete Structures	3:0:0
14CE2010	Structural Analysis	3:1:0
14CE2011	Water Resources Engineering	3:0:0
14CE2012	Foundation Engineering	3:0:0
14CE2013	Design of Steel Structures	3:0:0
14CE2014	Transportation Engineering	3:0:0
14CE2015	Construction Technology	3:0:0
14CE2016	Strength of Materials Lab	0:0:2
14CE2017	Fluid Mechanics and Machinery Lab	0:0:2
14CE2018	Survey Lab	0:0:2
14CE2019	Building Drawing Lab	0:0:2
14CE2020	Geotechnical Engineering Lab	0:0:2
14CE2021	Environmental Engineering Lab	0:0:2
14CE2022	Concrete and Highway Lab	0:0:2
14CE2023	Computer Application Lab	0:0:2
14CE2024	Design and Drawing (RCC & Steel) Lab	0:0:2
14CE2025	Estimation and Costing	0:0:2
14CE2026	Design and Drawing (Irrigation and Environment) Lab	0:0:2
14CE2027	Engineering Practices Lab	0:0:1
14CE2028	Construction Management	3:0:0
14CE2029	Advanced Reinforced Concrete Structures	3:0:0
14CE2030	Advanced Structural Analysis	3:0:0
14CE2031	Concrete Technology	3:0:0
14CE2032	Basics of Dynamics and Aseismic Design	3:0:0
14CE2033	Building Services	3:0:0
14CE2034	Advanced Structural Engineering Lab	0:0:2
14CE2035	Advanced Computer Application Lab	0:0:2
14CE2036	Prefabricated Structures	3:0:0
14CE2037	Advanced Design of Steel Structures	3:0:0
14CE2038	Industrial Waste Treatment and Disposal	3:0:0

14CE2039	Solid Waste Management	3:0:0
14CE2040	Environmental Chemistry and Micro-Biology	3:0:0
14CE2041	Air Pollution Management	3:0:0
14CE2042	Global Climate Change and its Impact	3:0:0
14CE2043	Disaster Management and Mitigation	3:0:0
14CE2044	Advanced Environmental Engineering Lab	0:0:2
14CE2045	GIS Lab	0:0:1
14CE2046	Smart Materials and Structures	3:0:0
14CE3001	Applied Elasticity and Plasticity	3:0:0
14CE3002	Advanced Concrete Technology	3:0:0
14CE3003	Structural Optimization	3:0:0
14CE3004	Advanced Design of Reinforced Concrete Structures	3:0:0
14CE3005	Structural Dynamics	3:0:0
14CE3006	Finite Element Methods in Engineering	3:0:0
14CE3007	Seismic Design of Structures	3:0:0
14CE3008	Experimental Techniques and Instrumentation	3:0:0
14CE3009	Advanced Design of Metal structures	3:0:0
14CE3010	Advanced Bridge Engineering	3:0:0
14CE3011	Computer Aided Design Laboratory	0:0:1
14CE3012	Advanced Structural Testing Laboratory	0:0:1
14CE3013	Design of Structures for Dynamic load	3:0:0
14CE3014	Design of Space Structures	3:0:0
14CE3015	Design of Tall Buildings	3:0:0
14CE3016	Design of Offshore Structures	3:0:0
14CE3017	Geotechnical Earthquake Engineering	3:0:0
14CE3018	Design of Substructures	3:0:0
14CE3019	Design of Composite Structures	3:0:0
14CE3020	Stability of Structures	3:0:0
14CE3021	Prestressed Concrete Structures	3:0:0
14CE3022	Industrial Structures	3:0:0
14CE3023	Advanced Design of Prefabricated Structures	3:0:0
14CE3024	Analysis and Design of Plates and Shells	3:0:0
14CE3025	Energy Efficient Building	3:0:0

Electives for Non-CBCS students

14CE201	Prefabricated Structures	3:0:0
14CE202	Prestressed Concrete Structures	3:1:0
14CE203	GIS applications in Civil Engineering	4:0:0
14CE204	GIS lab	0:0:1
14CE205	Programming using MatLab	0:0:1

13CE307 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION METHODS

Credit: 4:0:0

Course Objectives:

- To have a knowledge on the advanced types of equipment used in lab and field
- To understand the testing methods of concrete
- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.

Course Outcome:

Students will

- Gain knowledge on various testing methods and technologies
- Acquire skills for carrying out experiments related to civil engineering problems
- Gain inspiration for lifelong learning towards applying latest equipment in the field

Unit I: Concrete Testing Methods

Determination of cement content – Determination of original w/c ratio – Physical method – Accelerated Curing test

Non-Destructive Test

Tests on composition of hardened concrete - Rebound Hammer Test – Ultrasonic pulse echo, Impact echo, impulse radar techniques – core cutter method - Penetration Techniques — acoustic emission– ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods:, Ground penetrating radar (GPR) - Resonant frequency methods - Dynamic or vibration methods - Electrical methods - Pullout tests for rehabilitation

Unit II: Strain Measurement:

Introduction – electrical resistance strain gauges – strain gauge circuits – recording instruments – strain analysis methods – Strain rosettes - Photo elastic experiments on disc, beam, frames and other structural models – concept of Moiré' and stress freezing techniques.

Unit III: Tests on Beams and Structures:

Modulus of rupture of plain beams – slope and deflection of beams – shear studies in RC beams – Creep test – Model analysis for concrete structures – Testing on two hinged parabolic arch with variable moment of inertia – fatigue/cyclic load test - Load tests on structural frames.

Unit IV: Equipment and Instrumentation:

Principles of operations of UTM, hydraulic loading systems, force measuring devices, etc., used in the experiments planned in the laboratory - Transducers – types – Linear Variable Displacement Transducers (LVDT) – working principles – Demountable mechanical strain gauges - Load cells - Proving rings - Calibration of testing machines - Long-term monitoring - Vibrating wire sensors - Fibre optic sensors.

Unit V: Testing of Earthquake Resistant Structures

Shake table – working principles – applications - accelerometers – types – Oscilloscope – types - Data acquisition systems – Amplifiers – Vibration generators

Text Books

1. Dalley, J.W and Riley, W.F, “Experimental Stress Analysis”, Mc Graw Hill Book Company, New York, 2007
2. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
3. Chopra, A.K., “Dynamics of structures - Theory and applications to Earthquake Engg”, Prentice hall of India, New Delhi, 2002
4. M.S. Shetty, “Concrete Technology- Theory and Practice”, S. Chand and Company, New Delhi, 2005

References:

1. Paz Mario, " Structural Dynamics - Theory and Computation", CBS publishers, 2003

2. Sirohi, R.S., Radhakrishna, H.C., “Mechanical Measurements”, New Age International (P) Ltd, 2004.
3. Bray, D.E. and Stanley, R.K., “Course Material on Non-destructive Evaluation”, McGraw Hill Publishing Company, New York, 2006
4. Ganesan, T.P., “Model Analysis of Structures”, University Press, India, 2005.

13CE308 ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION

Credit 4:0:0

Course Objectives:

- To enable the students to learn the energy production systems and conservation.
- To study the energy efficient design methods
- To understand the principles of energy management and energy audits

Course Outcome:

Students will be

- Able to understand the concepts of energy efficient design
- Able to design Green and smart buildings and have an exposure in the management of services.
- Able to do energy audit of buildings

Unit I Introduction

Fundamentals of Energy – Energy production systems – Heating, Ventilating and Air-conditioning – Solar Energy and conservation – Geothermal energy - Energy economics Analysis – Energy conservation – Domestic energy consumption – savings – challenges – Primary energy use in buildings – Residential – commercial – Institutional and public buildings

Unit II Environmental Parameters

Energy and resource conservation — Evaluation tools for building energy – Embodied and operating energy – Peak demand – Visual and acoustical quality – Land, water and materials – airborne emissions and Waste Management

Unit III Design

Natural building design consideration – Energy efficient design strategies – Contextual factors –Longevity and process assessment – Renewable energy sources and design –Acoustic Design- Rain Water harvesting -Design of green buildings –Indian Green Building Council and LEED standards - Advanced building technologies – Smart buildings – Economics and cost analysis.

Unit IV Services

Energy in building design – Energy efficient and environmental friendly building – thermal phenomena — climate, sun and solar radiation –Psychometrics – Passive and Active HVAC systems – Preliminary investigations – Goals and policies – Energy audit – Types of Energy Audit – Analysis of results – Energy flow diagram – Energy consumption/Unit production – Identification of wastage –Priority of conservative measures.

Unit V Energy Management

Energy management of electrical equipment – Improvement of power factor – Management of maximum demand – Energy savings in pumps – Fans – Compressed air systems – energy savings in lighting systems – Energy management in Façade systems - Air conditioning systems – Applications – Facility operation and maintenance – Facility modifications – Energy recovery dehumidifier – Water heat recovery – Steam plants and distribution systems – Improvement of boiler efficiency – Frequency of blowdown – steam leakage – Steam flash and condense return

Text book:

1. Vaughn Barshaw., "The Building Environment- Active and Passive Control Systems" John Wiley & Sons., 2006.

2. Brown, G.Z, Mark DeKay "Sun, Wind and Light: Architectural design Strategies ", John Wiley & Sons., 2000.
3. Parag Diwan, Mohammed Yaqoot, "Energy Management", Pentagon Press, 2010

References:

1. National Building Code-Part VIII Building Services- Section 4, Acoustics, Sound Insulation and Noise Control- Bureau of Indian Standards, New Delhi, 2005
2. IS: 2526 – 1963 (reaffirmed 1996) Code of Practice for Acoustical Design of Auditoriums and Conference Hall- Ninth reprint December 1998 (incorporating Amendment No: 1) New Delhi
3. IGBC Rating system Abridged Reference Guide, October 2013
4. LEED 2011 for India for New Construction and Core & Shell Projects, Green Building Rating systems – Detailed reference Guide

13CE309 CHEMICAL BEHAVIOUR OF CONCRETE COMPOSITES

Credits: 4:0:0

Course Objectives:

- To enable the student to study the composition and specifications of cement
- To make the student learn the properties of concrete
- To enable the students to understand the microstructure of concrete and the admixtures

Course Outcome:

Students will be

- Able to understand the concepts of chemistry of concrete composites
- Able to identify the suitable composition of concrete composites
- Able to bring solutions to existing problems using composite materials

Unit - I Chemistry of Cement

Introduction – Composition of cement phases – Phase diagrams – Oxide components of cement – Cement related systems – Chemical analysis of Portland cement – Alkali content – Use of compound content in cement specifications

Hydration of Cement

Introduction – Heat of hydration - Hydration of pure clinker minerals – Hydration of silicate, aluminate and ferrite phases – Energy of hydration – Hydration in the absence of sulphate – Hydration of composite cementitious materials

Unit- II Components and Properties of Concrete

Introduction – Types of aggregates – Classification and composition – Properties of natural aggregates – Influence of aggregates on concrete properties – Water and its quality - binders – Interrelation of cement properties to concrete - Durability properties – Influence of aggregates on concrete properties – Iron ore aggregates - Synthetic aggregates

Unit- III Microstructure of Concrete

Introduction – Microstructure of aggregate phase – Water in hydrated cement phase – Significance and influence of interfacial transition zone on properties of concrete – Strength-Porosity relationship - Optical examination of cementitious material – X-ray diffraction analysis – Scanning electron microscopy of cementitious material

Unit - IV Mineral Admixtures

Lime slag cement- Portland blast furnace cement- Composition of blast furnace Slag -Hydration of Portland blast furnace - Ground Granulated Blast Furnace Slag (GGBS) - Cementitious properties of flyash – chemical composition of flyash - Effect of flyash on hydration of cement - Condensed silica fume (CSF) - Pozzolanic material - Chemical resistance – Flyash - CSF combination

Unit - V Chemical Admixtures and Composites

Chemical Properties of: Air-entraining admixtures - Water reducing and plasticizing admixtures - Super plasticizing admixtures - Retarding admixtures - Accelerating admixtures - water proofing admixtures

Polymers: Polymerization - Composite materials - Constituents of Composite materials - Fiber reinforced composites – Layered composites - Processing of fiber reinforced composites

Text Books

1. Neville, A.M., "Properties of Concrete", Pearson Publications, 2006
2. Peter. C. Hewlett, Butterworth, "Lea's Chemistry of Cement and Concrete", Heinemann Publications, 2004
3. J. Bensted and P. Barnes, Taylor and Francis, "Structure and Performance of Cements", e-library, 2008.
4. P. Kumar Mehta and Paulo J.M. Monteiro, "Concrete-Microstructure, Properties and Materials", Tata McGraw Hill Publications, New Delhi, Edition 2006

References

1. Mehta, P.K., and D. Manmohan, "Proceedings of the Seventh International Congress on the Chemistry of Cements", Editions, Septima, Vol.III, Paris 1980.
2. ACI committee report 209R-2, Prediction of creep, shrinkage and temperature effects in concrete structures, ACI manual of concrete practice, American Concrete Institute, Farmington Hills, MI 2005.

14CE1001 BASIC CIVIL ENGINEERING

Credit: 3:0:0

Course Objective:

- To understand the selection of building materials and sites
- To supply the purified water and treat the sewage water
- To produce general layouts on transportation systems.

Course Outcome:

At the end of the course students will be able to

- Apply the basic knowledge of Civil Engineering to further advanced learning concepts.

Description:

Engineering – Civil Engineering – Characteristics of good building materials such as stones, bricks, timber, cement, concrete and steel sections – Basic principles of surveying - Field measurement - Area of a plot - Basic functions of buildings – site selection - Major components of buildings and its construction methods - Valuation of a building by plinth area method - Sources of water supply –water requirements – Purification of water by sedimentation, filtration and disinfection - Rainwater harvesting - Sewerage systems – Working principle of Septic tanks and oxidation ponds – Collection and disposal of solid wastes – Transportation engineering - Classification and cross sections of water bound macadam, bituminous and cement concrete roads - Importance of railways – Gauges – Components of a permanent way - General layout of an airport and harbour – Bridges and its types – Dams, its purpose and its types – Selection of site for a dam - Irrigation and its types.

References:

1. Palanichamy, M. S., "Basic Civil Engineering", Tata McGraw Hill Publishing Co. Limited, New Delhi, 2008.
2. Ramesh Babu V., 'Basic Civil Engineering', Anuradha Agencies, Kumbakonam, 2001
3. Devadass. C.S.C., Jemimah Carmichael. M and Sheeba Ebenezer. J., "Basic Civil Engineering", Shristi Publishers, Coimbatore, 2004.

14CE2001- SURVEY

Credit: 3:0:0

Co-requisite: 14CE018: Survey Lab

Course Objective:

- To understand the principles of land and hydrographic surveying
- To know the application of surveying in civil engineering projects

Course Outcome:

Students at the end of the course will be able to

- Choose modern survey equipments to measure angles and distances
- Extend the knowledge to other civil engineering field
- Analyze and solve the problems related to survey

Description:

Principle and practices of leveling, contouring, calculation of areas and volumes - Principle and practices of theodolite surveying, omitted measurements, closing error and distribution, heights and distances - Principle of tachometric surveying, curve surveying – simple curves, transition curves - Triangulation systems, intervisibility of stations, base line corrections, satellite stations : reduction to centre.

References:

1. Duggal, S.K., “Surveying”, Volume I and II, McGrawHill & Co., New Delhi 2009
2. Kanetkar, T.P. and Kulkarni, S.V., “Surveying and Levelling”, Parts 1 and 2, Pune Vidyarthi Griha Prakashan, 2012.
3. Basak, N., “Surveying and Levelling”, McGrawHill & Co., New Delhi 2011.
4. Arthur Bannister, Stanley Raymond, Raymond Baker, “Surveying”, Pearson, 2009.
5. Bhavikatti. S.S., “Surveying: Theory and Practice”, IK International Publishing House Pvt Ltd, 2010

14CE2002 - MECHANICS OF SOLIDS

Credit: 3:1:0

Co-requisite: 14CE2016: Strength of Materials Lab

Course Objective:

- To learn the state of stress and principal stresses and strains
- To study the Bending moment and shear force of determinate beams
- To study the different types of stresses on structural elements

Course Outcome:

Students at the end of the course will be able to

- Establish the fundamental concepts of mechanics of deformable solids; including static equilibrium, geometry of deformation, material constitutive behavior stress and strain.
- Adopt systematic methods for solving engineering problems in solid mechanics
- Discuss the basic mechanical principles underlying modern approaches for design of various types of structural members subjected to axial load, torsion, bending, transverse shear, and combined loading.
- Build the necessary theoretical background for further structural analysis and design courses

Description:

Axial, shear and Thermal stresses and strains in solids- Elastic constants and relationship between them - Analytical method and Graphical methods for determination of Principal stresses and strains - Bending moment and Shear force of determinate beams – Theory of pure bending and elastic torsion -Stresses in beams due to bending, shear and torsion- Strength of section- power transmitted by shafts

References:

1. Egor, P.Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2003
2. Rajput, R.K., "Strength of Materials", S. Chand & Co. Ltd., New Delhi, 2010
3. Bansal, R.K., "Strength of Materials", Laxmi Publications, New Delh, 2007.
4. Subramanian R., "Strength of Materials", Oxford University Press, 2005
5. Srinath L S., "Advanced Mechanics of Solids", Tata McGraw Hill Publishing 2003.

14CE2003 - MECHANICS OF FLUIDS**Credit: 3:1:0****Course Objective:**

- To introduce the fundamental concepts of fluid statics, kinematics and dynamics
- To introduce the concepts of flow measurements, flow through pipes

Course Outcome:

Students at the end of the course will be able to

- Understand the various types of flow and flow profiles
- Carry out flow measurements
- Design pipe networks
- Built capacity to carry out dimensional analysis and model studies

Description:

Fluid Properties and Fluid Statics :Viscosity, Density, Perfect gas, vapour pressure and surface tension- Basic equation of fluid statics- Pascal's Law- Basic Concepts of Fluid Flow: Classification of flows- streamline, Streak line and pathlines- Flownets- Dynamics- Concepts of system and control volume- Application of control volume to continuity, energy and Momentum- Euler's equation and Euler's equation of motion and Bernoulli's equation- Flow through Pipes: Reynold's number- Laminar flow- Turbulent flow –Energy Loss in pipes – Hydraulic gradient – Energy gradient- Flow Measurement: Venturimeter- orifice meter- pitot tube- mouthpiece and orifice- Open channel flow-Weirs and notches.

References:

1. Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 9th edition, 2011.
2. Modi, P.N. and Seth, S.M., "A Text book of Fluid Mechanics and Hydraulic Machines", Standard Book House, New Delhi, 2007.
3. Som, S.R and Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2nd edition, 2007.
4. Hubert Chanson, "Hydraulics of Open Channel flow", Butterworth-Heinemann Ltd., 2nd Edition, 2004.
5. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S. Chand and Co., New Delhi, 2008.
6. Agarwal, S.K., "Fluid Mechanics and Machinery", Tata McGraw Hill Co.New Delhi, 2006.

14CE2004 – BUILDING MATERIALS AND GEOLOGY**Credit: 3:0:0****Course Objective:**

- To impart the knowledge of Geology
- To study the basics of seismology

Course Outcome:

Students at the end of the course will be able to

- Classify an appreciation of the geologic processes related to the formation of different soils and rocks
- Define the physical and mechanical soil properties commonly used in engineering practice

- Interpret the causes and mitigation of Land slides

Description:

Building Materials – Bricks, Cement, timber, steel, concrete, water proofing materials - Miscellaneous Building Materials-Properties, tests, applications-General Geology- Geology for engineers- Branches- Geological formations-action of water and wind on rocks- Mineralogy- Study of rock forming minerals - Petrology – Classification-engineering properties and description- Structural Geology- Geological maps- folds, faults and joints, Hydro Geology, Study of structural models- Geophysical methods and Investigations- Investigation of landslides and subsidence- causes and mitigation.

References:

1. Parbin Singh, “Engineering and general Geology”, Katson publication House, 2010.
2. Gokhale K.V.G.K. “Principles of Engineering Geology”. BS Publications, 2010
3. Bell F G.,” Fundamentals of Engineering Geology”, Butterworth-Heinemann, 2007.
4. Michael H. De Freitas, “Engineering Geology”, Springer-Verlag Berlin Heidelberg, 2009
5. Chenna Kesavulu., “Textbook of Engineering Geology” 2nd Edition, Macmillan Publishers India Ltd. 2009
6. Varghese P.C., “Building materials “, Prentice Hall, 2005

14CE2005 - APPLIED HYDRAULICS AND HYDRAULIC MACHINERY

Pre-requisite: 14CE2003: Mechanics of Fluids

Credit: 3:0:0

Course Objective:

- To learn the fundamentals on flow in open channels
- To introduce the concepts of boundary layer theory and flow around submerged objects
- To impart the knowledge on pumps and turbines

Course Outcome:

Students at the end of the course will be able to

- Design channels with uniform flow conditions
- Define the displacement, momentum and energy.
- Determine the forces on submerged bodies and the forces due to impact on moving and stationary objects
- Apply the linear momentum principle, Impact and forces exerted by the jet on inclined, curved and stationary bodies
- Build capacity to operate and select turbines and pumps

Description:

Open Channel Flow : Types of flow- Chezy’s and Manning’s Equation- Specific energy- critical flow- Varied flow: Hydraulic jump- Gradually varied flow- Backwater and drawdown curves- Boundary Layer and Dimensional Analysis: Displacement, Momentum and energy thickness- laminar and turbulent boundary layers- forces on submerged bodies –drag- Momentum Principle; Impulse momentum equation- Application of linear momentum principle- Impact of Jet- Turbines : Typical layout and components of Hydro- electric project- working principles of Pelton wheel, Francis and Kaplan turbine- Draft tube -Specific Speed –Inlet and outlet velocity triangles- Headlosses and efficiency – Specific Speed – Positive Displacement pump: Reciprocating pump- Types and components , working principle- miscellaneous pumps.

References:

1. Bansal, R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi, Edition 9. 2011.
2. Modi, P.N. & Seth, S.M., “A Text book of Fluid Mechanics and Hydraulic Machines”, Standard Book House, New Delhi, 19th Edition, 2011.
3. Som, S.R. & Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, Edition 3. 2011.

4. Hubert Chanson, "Hydraulics of Open Channel flow", Butterworth-Heinemann Ltd., 2nd Edition, 2004.
5. Rajput, R.K., "A Text book of Fluid Mechanics and Hydraulic Machines", S. Chand and Co., New Delhi, 2006.
6. Agarwal, S.K., "Fluid Mechanics and Machinery", Tata Mc Graw Hill Co., Edition 1. 2002.

14CE2006 - STRENGTH OF MATERIALS

Pre-requisite: 14CE2002: Mechanics of Solids

Credit: 3:1:0

Course Objective:

- To understand the concepts of deflection, stability criteria, theories of failure
- To study the analysis of indeterminate beams

Course Outcome:

Students at the end of the course will be able to

- Independently perform basic calculations and determine the internal mechanical stresses in loaded structural elements
- Develop an understanding of the relation between material properties and strength of materials

Description:

Biaxial bending- Deflection of Determinate beams- Double integration, Macaulay's method - Moment area method - Conjugate beam method - Bending moment and Shear force of Indeterminate beams - Columns and struts - behaviour of axially loaded short, medium and long members - Critical loads with different end conditions - Euler's method, Analysis of thin and thick cylinders, Failure theories, Concept of Shear Center

References:

1. Egor, P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, New Delhi, 2006.
2. Rajput, R.K., "Strength of Materials", S. Chand & Co. Ltd., New Delhi, 2006
3. Bansal, R.K., "Strength of Materials", Laxmi Publications Ltd., New Delhi, 2010
4. Bedi, D.S., "Strength of Materials", Khanna Book Publishing Co. (P) Ltd., Delhi, 2003
5. Bhavikatti S.S., "Strength of Materials, 3E", Vikas Publishing House Pvt Ltd, 2009

14CE2007 - SOIL MECHANICS

Credit: 3:0:0

Course Objective:

- To gain knowledge about index and engineering properties of soil
- To study about stress distribution and settlement behaviour of soil
- To gain knowledge on stability of slopes

Course Outcome:

Students at the end of the course will be able to

- Explain the multiphase nature of soils and to derive quantities relating to the volumes and masses of the different phases of a soil
- Describe and classify soils according to Indian Standard
- Determine and describe the engineering properties of soils from tests and basic theories

Description:

Index properties of soil such as water content, specific gravity and classification of soil according to BIS, Phase relations and plasticity characteristics - Engineering properties of soil such as permeability, compaction and consolidation- Stress Distribution analysis by Boussinesq equation and Westergaard's analysis and Causes &

methods of minimizing settlement - Determination of shear Strength by lab and field methods - Stability of slopes - Analysis by slip circle and friction circle method

References:

1. Punmia, B.C., "Soil Mechanics and Foundations", Punmia B.C., Suar & Co., Madras 2005.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, 2011.
3. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics", New Age International (P) Limited, 2005
4. Purushothama Raj. P., "Soil Mechanics and Foundation Engineering" Pearson Education, 2008
5. Murthy V N S, "Geotechnical Engineering" Library of Congress Cataloging-in-Publication Data, 2002.
6. IS 2720 (Parts 1 to 10, 13, 14, 30, 36)

14CE2008 - WATER AND WASTE WATER ENGINEERING

Co-requisite: 14CE2021Environmental Engineering Lab

Credit: 3:0:0

Course Objective:

- To educate the students in planning and design concepts related to water storage and distribution
- To educate the students in planning and design concepts relating wastewater collection, treatment and disposal.

Course Outcome:

Students at the end of the course will be able to

- apply the concept to manage water resources and also apply it for hydrological modeling
- Plan and design basic water resources projects
- List the characteristics of wastewater
- Estimate the quantity of wastewater
- Design and develop appropriate sewerage systems
- Recommend the house connections in civil works

Description:

Water Storage and Distribution: population forecast- water demand for various purposes- estimation of waste water quantity- Water Quality and Treatment: waste water characteristics- Industrial Waste water treatment: Equalisation - Neutralisation - Oil separation - Flotation - Precipitation - Heavy metal removal - Wastewater collection - Wastewater – Primary: Philosophy of treatment- Unit operations of processes-Biological treatment: types of micro-organisms- Aerobic treatment: Suspended growth aerobic treatment process- Secondary treatment and Disposal: Underground drainage systems

References:

1. Arceivala, S. J., "Wastewater Treatment for Pollution Control", Tata McGraw Hill, 3rd edition 2006.
2. Bajwa G. S., "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003.
3. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
4. "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP, Washington, 1998.
5. Barbara Hauser A., "Practical Hydraulics Handbook", Lewis Publishers, New York, 2nd edition, 1995.

14CE2009 - REINFORCED CONCRETE STRUCTURES

Credit: 3:0:0

Course Objective:

- To study the behavior and design of RCC structural elements
- To study the design of supporting components of the buildings

Course Outcome:

Students at the end of the course will be able to

- apply the fundamental concepts of working stress method and limit state method
- apply IS code of practice for the design of concrete elements
- design structural components like water tanks and retaining walls
- detail reinforcement for various RCC structural elements

Description:

Design philosophies – limit state design of one way, two-way, continuous slab and circular slabs – rectangular and flanged beams – axial and eccentrically loaded columns, straight, dog legged and open well staircases, Deep and Shallow foundations – resting on ground and underground water tanks – cantilever and counterfort retaining wall

References:

1. Unnikrishna Pillai and Devdass Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd., 2003
2. Ashok, Kumar Jain, “Limit state design of Reinforced Concrete”, Laxmi Publications, New Delhi., 2007
3. Sinha. S.N. “Reinforced Concrete Design”, Tata McGraw Hill, 2002
4. Purushothaman. P, “Reinforced Concrete Structural Elements”, Tata McGraw Hill Publishing Co. Ltd., 2006
5. Krishna Raju. N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi 2005
6. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
7. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.
8. IS 3370 (Part I) - 1975 - Code of Practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi.

14CE2010 - STRUCTURAL ANALYSIS

Pre-requisite: 14CE2006 Strength of Materials

Credit: 3:1:0

Course Objective:

- To understand the deflection and force methods for the analysis of structures
- To learn the concepts of moving loads and influence lines
- To study the analysis of indeterminate beams and frames

Course Outcome:

Students at the end of the course will be able to

- Analyze statically determinate trusses, beams, and frames and obtain internal loading
- Analyze cable and arch structures

Description:

Work energy principles – Principle of virtual work-Castigliano’s first, second theorem- Williot diagram- Rolling loads and Influence lines- reaction, shear force and bending moment- Muller Breslau’s principle -Slope Deflection- Analysis of continuous beams and rigid frames with and without sway, Moment Distribution method – short cut methods – Multistoried frame analysis by substitute frame method, portal and cantilever method.

References:

1. Bhavikatti, S., "Structural Analysis", Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2003.
2. Devadas Menon, "Advanced Structural Analysis", Alpha Science International, 2009.
3. Norris and Wilber, "Elementary Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
4. Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
5. Vaidyanathan, R. and Perumal, P., "Structural Analysis" Vol.1 & 2, Laxmi Publications, New Delhi, 2004.
6. Pandit, G.S. and Gupta, S.P., "Structural Analysis – A Matrix Approach", Tata McGraw Hill Publishing Co. Ltd., 2006.

14CE2011 - WATER RESOURCES ENGINEERING**Credit: 3:0:0****Course Objective:**

- To introduce the concepts of surface and ground water hydrology
- To enable the student to develop skills to appreciate water resources systems

Course Outcome:

Students at the end of the course will be able to

- Select the water sources, treatment and distribution methods
- Acquire skills to undertake major water supply projects

Description:

Surface water hydrology : Hydrologic cycle and hydrological data-forms of precipitation- Hydrologic abstractions- Run-off – flood estimation by empirical formulae-Groundwater Hydrology – types of aquifers- steady flow towards well in confined and unconfined aquifer- pumping test- artificial recharge- conjunctive use of surface and groundwater - Potable Water - Water for Energy and other uses:Basic components of Hydro-electric project , Conservation of water: Reservoir- Single and multi purpose – Flood levees and flood walls.

References:

1. Linsley, R. K. and Franzini, J.B., "Water Resources Engineering", McGraw Hill Inc, 4th edition 2013.
2. Subramanya, K., "Engineering Hydrology", Tata McGraw Hill, 4th edition, 2013.
3. Sahasrabudhe, S.R., "Irrigation Engineering and Hydraulic Structures", Katson Publishers, 3rd edition, 2011.
4. Garg S. K., "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2009.
5. Michael, A.M., "Irrigation – Theory and Practices", Vikas Publishing House, New Delhi, 2004

14CE2012 - FOUNDATION ENGINEERING**Pre-requisite:** 14CE2007 Soil Mechanics**Credit: 3:0:0****Course Objective:**

- To gain knowledge about exploration and bearing capacity of soil
- To study about types, selection and design of foundation
- To gain knowledge about pile and shallow foundation in detail

Course Outcome:

Students at the end of the course will be able to

- Apply the basic theories in determining suitable soil parameters.
- Interpret the application of field and laboratory tests
- Perform geotechnical design of shallow and deep foundations and understand limitations and uncertainties in geotechnical design.
- Develop an appreciation of the modes of failure of retaining walls and foundation supports.

Description:

Objectives of Soil Exploration, sampling methods and requirement, Choices - factors governing selection of foundation - Bearing Capacity of soil - Analysis by Terzaghi and Skempton, Determination and methods of improving - Earth Pressure analysis by Rankine, Coulomb, Culmann and Rehmann's methods, Design of shallow foundations such as rectangular combined footing & trapezoidal combined footing and types, functions and designing of deep foundations, Sheet Pile walls.

References:

1. Punmia, B.C., "Soil Mechanics and Foundations", Punmia B.C., Suara & Co., Madras 2005
2. Kasmalkar, B.J., "Foundation Engineering", Pune, Vidyarthi Griha Prabakar, Pune, 2002.
3. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers, New Delhi, 2011.
4. Purushothama Raj. P., "Soil Mechanics and Foundation Engineering", Pearson Education, 2008
5. Murthy V NS., "Geotechnical Engineering" Library of Congress Cataloging-in-Publication Data, 2002

14CE2013 - DESIGN OF STEEL STRUCTURES

Credit: 3:0:0

Course Objective:

- To study the design of connections
- To study the design of axial and flexural members
- To study design of roof truss

Course Outcome:

Students at the end of the course will be able to

- Design the structural elements and its joints
- Classify the structural steel connections in industrial building
- Evaluate the strength of light gauge steel elements

Description:

Concepts of steel design – Design of Bolted and Welded connections - Design of Members for Axial forces – Tension splices-lug angle - Design of lacings, battens and Column bases - Design of Flexural Members - beams, rolled and built-up section- laterally restrained and unrestrained beams, welded plate girder and Beam Columns - Design of Industrial Roof Truss and Gantry Girder .

References:

1. Subramanian N, "Design of Steel Structures", Oxford University Press, New Delhi 2008.
2. Duggal S.K, "Limit State Design of Steel Structures", Tata Mc Graw Hill Education Private Limited, New Delhi, 2010
3. "Teaching Resources for Structural Steel Design – Vol. I & II", INSDAG, Kolkatta
4. Bhavikatti S.S., "Design of Steel Structures (By limit state method as per IS 800:2007)" I K International Publishing house pvt ltd, 2010
5. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.

14CE2014 TRANSPORTATION ENGINEERING

Credit: 3:0:0

Course Objective:

- To impart knowledge in planning, geometric design, construction and operation of highways and railways
- To understand the layouts and operation of airport and harbours

Course Outcome:

Students at the end of the course will be able to

- Classify the different types of transportation engineering

- Plan various public transportation system
- Classify and design roads as per IRC Standards
- Design pavements as per IRC recommendations
- Demonstrate various test methods for highway materials
- Plan, design airports and harbors and recognize its operation

Description:

Introduction to Transportation Engineering - Planning and Geometric design of highways - super elevation – design principles of flexible and rigid pavements – Defects in pavements - Planning, Geometric design and construction of Railways – Maintenance and materials- Conventional and modern methods (GIS and GPS), Airport planning, wind rose diagram, runway design and airport terminal buildings - Planning of harbor terminal buildings – Navigational aids and coastal structures – Dredging methods

References:

1. Saxena S.C and Arora S.P., “A Text book of Railway Engineering”, Dhanpat Rai Publishers,2001
2. Khanna, S.K., and Justo C.E.G., “Highway Engineering”, Nem Chand and Bros, 2005.
3. Oza H. P. and Oza G. H., “Dock and Harbour Engineering”, Charotar Publishing House, New Delhi, 2013.
4. Rangwala, S. C., “Airport Engineering”, Charotar Publishing House, New Delhi, 2013.
5. Narasimha Murthy A.S, Henry R. Mohle., “Transportation Engineering Basics” ASCE press 2000.

14CE2015 – CONSTRUCTION TECHNOLOGY

Credit: 3:0:0

Course Objective:

- To impart knowledge about site planning and construction of foundations.
- To study the various methods of constructions and service requirements
- To understand the usage of equipments for construction

Course Outcome:

Students at the end of the course will be able to

- Classify the different types of construction materials
- Select the construction methodology for different types of construction
- Plan and execute construction projects
- Tell about disposal of effluents and the standards for disposal
- Maximize the knowledge on waste management
- Develop skills to undertake major project related to industrial treatment

Description:

Planning of Building –setting of foundation- Methods of Construction – Concrete, Steel, Brick and Stone masonry, Hollow block masonry, pre-cast, roofs, expansion joints, damp proof course, Composite-Formwork, shoring, underpinning and scaffolding – Service and safety requirements - Construction equipments.

References:

1. Varghese P.C, “Building Constructions”, Prentice Hall, 2007
2. Rangwala S.C., “Building Construction”, Charotar Book Stall, Anand, 2003
3. Punmia, B.C., “Building Construction”, Laxmi Publications (P) Ltd., 2008
4. Relevant IS Codes and National Building Code of India, 2005
5. Sushil Kumar, “Building Construction”, Standard Publishers, New Delhi, 2003
6. Arora, S.P. and Bindra, S.P., “Building Construction”, Dhanpat Rai and Sons, 2003

14CE2016 – STRENGTH OF MATERIALS LAB

Co-requisite: 14CE2002 Mechanics of Solids

Credits: 0:0:2

Course Objective

- To apply the theory of mechanics of solids on real specimens
- To give hands on training on testing of real specimens

Course Outcome

Students at the end of the course will be able to

- Determine the important mechanical properties of materials
- Identify the materials for practices based on mechanical properties
- Verify the theorem studied in engineering mechanics

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Jindal, U.C, “Strength of Materials”, Asian Books Pvt. Ltd, 2007

14CE2017 - FLUID MECHANICS AND MACHINERY LAB

Co-requisite: 14CE2005 Applied Hydraulics and Hydraulic Machinery

Credit: 0:0:2

Course Objective:

- To give hands on training on the principle and working of different types of turbines
- To impart knowledge on open channel flow profiles

Course Outcome:

Students at the end of the course will be able to

- Adopt the working principles and select the turbines
- Identify various forms of open channel flows

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Modi, P.N and Seth, S.M., “Fluid Mechanics & Fluid Machines”, Standard Book House, New Delhi, 2007.
2. Rajput, R.K., “A Text book of Fluid Mechanics and Hydraulic Machines”, S.Chand and Co., New Delhi, 2002.

14CE2018 - SURVEY LAB

Co-requisite: 14CE2001 Survey

Credit: 0:0:2

Course Objective:

- To train the students to acquire skill in operation of various survey instruments

- To give hands on training on the use of conventional and modern tools of surveying

Course Outcome:

Students at the end of the course will be able to

- Acquire skill in operation of various survey instrument
- Develop an understanding on the use of conventional and modern tools of surveying
- Demonstrate various types of surveys

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Kanetkar, T.P and Kulkarni, S.V., “Surveying and Levelling”, Part 1 and 2, Pune Vidyarthi Griha Prakashan 2010.
2. Basak, N., “Surveying and Levelling”, McGrawHill & Co. 2011.

14CE2019 - BUILDING DRAWING LAB

Credit: 0:0:2

Course objectives:

- To understand the principles of planning and bylaws
- To draw plan, elevation and section of load bearing and framed structures
- To draw plan, elevation and section of public and industrial structures
- To prepare detailed working drawing for doors, windows, etc.

Course outcomes:

Students at the end of the course will be able to

- Understand the principles of civil engineering drawing
- Plan Residential and commercial buildings

Description:

Building planning - Building bye-laws- Building Information model (BIM) - Detailed drawings using AutoCAD

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References

1. Shah M.G. Kalec. M. & Patki SY, “Building Drawing”, Tata Mcgraw Hill, New Delhi, 2000
2. AUTO CAD Tutorials and Manual- Autodesk Work Book on AUTO CAD Level I and II, CAD/CAM Centre, Coimbatore
3. Gurucharan Singh and Jagdish Singh, “Building Planning, Designing and scheduling”, Standard Publishers, New Delhi, 2001
4. IS: 962 – 1967, Code of Practice for Architectural and Building Drawing, Bureau of Indian Standards, New Delhi
5. IS: 3021 – 1983, Specification for Timber Door, Window and Ventilator Frames, Bureau of Indian Standards, New Delhi
6. IS: 1003 – 1977, Part I, II Specification for Timber Panelled and Glazed Shutters, Bureau of Indian Standards, New Delhi
7. Revit Package Manual

14CE2020 - GEOTECHNICAL ENGINEERING LAB

Co-requisite: 14CE2007: Soil Mechanics

Credit: 0:0:2

Course Objective:

- To determine the index and engineering properties of soil
- To classify the soil according to IS

Course Outcome:

Students at the end of the course will be able to

- Explain the multiphase nature of soils and to derive quantities relating to the volumes and masses of the different phases of a soil
- Describe and classify soils according to Indian Standard
- Determine and describe the engineering properties of soils from tests and basic theories

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Lambe, T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
2. IS 2720-1983, "Indian Standard Code of Practice: Methods of tests for Soil", Bureau of Indian Standards, New Delhi

14CE2021 - ENVIRONMENTAL ENGINEERING LAB

Co-requisite: 14CE2008 Water and Waste Water Engineering

Credit: 0:0:2

Course Objective:

- To make the students conversant with the experimental procedures for quantitative estimation of water quality parameters
- To give hands on training on the testing of wastewater quality

Course Outcome:

Students at the end of the course will be able to

- Recall the characteristics of water and wastewater
- Examine the water quality parameters
- Categorize the water samples according to BIS standards
- Recommend for necessary water or wastewater treatment required

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References

1. Sawyer, N.C., and McCarty, P.L., "Chemistry for Environmental Engineering", McGraw-Hill Book Co., New York, 2003.
2. "Standard Methods for the Examination of Water and Waste Water", APHA- AWWAWPCF, latest Edn., Washington (D.C). 1995

14CE2022 - CONCRETE AND HIGHWAY LAB

Credit: 0:0:2

Course Objective:

- To give hands on training in testing of cement and aggregates
- To give hands on training in testing of concrete and highway materials
- To impart knowledge on mix design procedures

Course Outcome:

Students at the end of the course will be able to

- Test all the concrete materials as per IS code
- Design the concrete mix using ACI and IS code methods
- Determine the properties of fresh and hardened of concrete
- Measure the physical properties of the bitumen

Description:

Destructive and non destructive tests on constituents of concrete - Tests on aggregates, bitumen and bituminous mixes

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Shetty, M. S., "Concrete Technology", S. Chand and Co., New Delhi, 2005
2. Gambhir, M.L., "Concrete Technology – Theory and Practice", Tata McGraw Hill Publishing Ltd, New Delhi, 2009
3. IS 2386 – 1963 Part I, III, "Methods of test for aggregate for concrete", Bureau of Indian Standards, New Delhi.
4. IS 516 – 1959," Method of test for strength of concrete", Bureau of Indian Standards, New Delhi.
5. IS 10262-2009, "IS standard for recommended guidelines for concrete mix design", Bureau of Indian Standards, New Delhi.

14CE2023 - COMPUTER APPLICATION LAB

Pre-requisite: 14CE2011 Structural Analysis

Credit: 0:0:2

Course Objective:

- To give hands on training on Matlab Programming
- To analyze and design various structural elements using STAAD Pro

Course Outcome:

Students at the end of the course will be able to

- Create 'c' programs for analysis and design of structures
- Develop spreadsheets in Ms Excel to solve problems in civil engineering
- Formulate programs and spreadsheets for economical design of structures

Description:

Developing Matlab program for the design of structural elements – Project management software - Analysis of structures using STAAD Pro software

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Rudra Pratap, "Getting Started with MATLAB", Oxford University Press, 2002
2. STAAD Pro Package Manual

14CE2024 - DESIGN AND DRAWING (RCC & STEEL) LAB

Pre-requisite: 14CE2009 Reinforced Concrete Structures
14CE2013 Design of Steel Structures

Credit: 0:0:2

Course objectives:

- To design and detail RCC structures
- To design and detail steel structures

Course outcomes:

Students at the end of the course will be able to

- Summarize the reinforcement detailing in the field
- Design various structures for the requirements of the society as per IS codes
- Develop the reinforcement detailing for various structures for various structures

Description:

Detailed design of the reinforced concrete structures and drawing using software - Detailed design of the steel structures and drawing using software

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Dayaratnam P., "Design of Reinforced Concrete Structures", Oxford & IBH Publishers & Co., New Delhi, 2011
2. Victor, D.J., "Essentials of Bridge Engineering", Oxford & IBH Publishers Co., New Delhi. 2009
3. IS456-2006 Code of practice for Plain and reinforced concrete code of practice.
4. SP-34-1987, Handbook on Reinforcement and Detailing.
5. SP 6: Part 1: 1964, Handbook for Structural Engineers - Structural steel sections.
6. IS 800-2007, "General Construction in Steel - Code of Practice", Bureau of Indian Standards, New Delhi.

14CE2025 - ESTIMATION AND COSTING

Credit: 0:0:2

Course Objective:

- To impart techniques of estimation of buildings, roads and irrigation structures
- To introduce the concepts of rate analysis

Course Outcome:

Students at the end of the course will be able to

- Execute rate analysis of various works in construction
- Estimate the total construction cost of the structure

Description:

Estimate of buildings - Estimate of road, sanitary and retaining structures - Specification and tenders – Valuation - Report preparation

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Dutta.B.N, “Estimating and Costing”, UBS Publications, 2005.
2. Rangawala..S.C., “Estimating and Costing”, Charotar Anand, 2002.
3. IS 1200-1 (1992): Methods of measurement of building and civil engineering works, Part- 1: Earthwork [CED 44: Methods of Measurement of Works of Civil Engineering]
4. IS: 1200 - 1974- Parts 1 to 25, Methods of Measurement of Building and Civil Engineering Works, Bureau of Indian Standards, New Delhi.

14CE2026 - DESIGN AND DRAWING (IRRIGATION AND ENVIRONMENT) LAB

Pre-requisite: 14CE2008 Water and Waste Water Engineering
14CE2011 Water Resources Engineering

Credit: 0:0:2

Course Objective:

- The purpose of this course is to impart the knowledge about the design of irrigation and environmental engineering structures
- To get hands-on experience in drawing of irrigation and environmental engineering structures

Course Outcome:

Students at the end of the course will be able to

- design and drawing of various irrigation structures
- Match the requirements of irrigation design engineers in large and small consulting firms, and at all levels of government and Private sectors

Description:

Design of major irrigation works to be worked out and detailed drawings using software- Design of major environmental engineering works to be worked out and detailed drawings using software.

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Ellis, W.M., College of Engineering Manual: Irrigation, The Textile Institute Publishers, 2012.
2. Santosh Kumar Garg., “A Text Book of water supply Engineering”, Khanna Publishers, 2010

14CE2027 - ENGINEERING PRACTICES LAB

Credit: 0:0:1

Course Objective:

- To study the basic practices in civil engineering construction

Course Outcome

Students at the end of the course will be able to

- Inspect electrical and plumbing work for buildings and factories
- Explain the bar bending schedule to supervisors
- Select appropriate flooring for building work

Description:

Plumbing and electrical services - Welding joints - Bar bending - Brickwork –plastering- floor finish

Experiments

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Saravanapandian M, Pranitha S, Jeyapoovan T., “Engineering Practices Laboratory Manual”, VRB Publishers Private Ltd 2009
2. Jeyachandran.K., Natarajan.S. and Balasubramanian.S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
3. Bawa.H.S., “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad.A. and Sarma.P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.

14CE2028 - CONSTRUCTION MANAGEMENT

Credit: 3:0:0

Course Objective:

- To introduce the concepts of management, resources and construction planning
- To introduce the labour laws, principle of accounting
- To introduce fundamentals and concepts of computer applications in construction management

Course Outcome:

Students at the end of the course will be able to

- Manage the resources and labours in the construction
- Plan the construction projects
- Estimate the cost of the projects and evaluate the tenders

Description:

Management Principles –Functions – Construction Management - Quantity method of management- management by network analysis and control – CPM/PERT - control by graphical representation, by bill of quantities and by network analysis - Tender and tender documents- Definition - calling of tenders - tender documents - submission of tenders - processing of tenders - negotiations and settlement of contracts – Contracts –Arbitration- Software applications in Recording and Operations – Environment health and safety (EHS)

References:

1. Seetharaman, S., “Construction Engineering and Management”, Umesh Publications, 2007.
2. Sengupta, B., and Guha, H., “Construction Management and Planning”, Tata McGraw-Hill Book Co., 2000.
3. Rana,V.K., “Construction Management Practice”, Tata McGraw-Hill publishing Co.,2000.
4. Chitkara, K.K., “Construction Project Management”, Tata McGraw-Hill publishing Co., 2000.
5. Sharma, J.L., “Construction Management and Accounts”, Sathya Prakashan, New Delhi, 2011.

14CE2029 – ADVANCED REINFORCED CONCRETE STRUCTURES

Pre-requisite: 14CE2009 Reinforced Concrete Structures

Credit: 3:0:0

Course Objective:

- To study the design on structural components
- To study design of bridges for IRC loadings

Course Outcome:

Students at the end of the course will be able to

- Adopt the design methods
- Design the advanced reinforced concrete structures like bridges, corbels etc.
- Verify the structural stability.

Description:

Design of flat slab- components - BIS code recommendations, direct tension method - Equivalent frame method – Design of box culverts and road bridges (slab and T beam) as per IRC code provisions – Design of Corbels and brackets – Design of deep beam, grid floor – Design of RCC domes

References:

1. Unnikrishna Pillai and Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co. Ltd. 2003
2. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India Pvt. Ltd. 2000
3. Punmia.B.C., Ashok, K. Jain., Arun.K.Jain , “Limit State Design of Reinforced Concrete”, Laxmi Publications (P). 2007
4. Krishna Raju, N, “Design of Reinforced Concrete Structures”, CBS Publishers and Distributors, Delhi. 2005
5. IS 456-2000, “Indian Standard Code of practice for Plain and Reinforced concrete Structures”, Bureau of Indian Standards, New Delhi.
6. SP 16-1980, “Design Aids for Reinforced Concrete”, Bureau of Indian Standards, New Delhi.
7. IRC Bridge Codes, IRC-21 and Pigeaud's charts

14CE2030 ADVANCED STRUCTURAL ANALYSIS

Pre-requisite: 14CE2010: Structural Analysis

Credit: 3:0:0

Course Objective:

- To impart knowledge about arches, suspension bridges and space trusses
- To analyze indeterminate structures using flexibility and stiffness method
- To determine shear centre and analyze curved
- To apply analysis to Civil Engineering Structures

Course Outcome:

Students at the end of the course will be able to

- Demonstrate the basic concept of numerical analysis and formulation of analytical models of structure
- Identify degrees of freedom and formulate flexibility and stiffness matrix
- Interpret the concept of structural stability and its significance in structural design
- Apply the theoretical concepts in computer applications for structural analyses

Description:

Arches-parabolic and semi circular arches- cables and suspension bridges - Analysis of space trusses – Matrix flexibility method – Determinate and indeterminate trusses, beams and frames-Matrix stiffness method- Determinate and indeterminate trusses, beams and frames - curved beams.

References:

1. Norris and Wilber, "Elementary Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
2. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of structures", Laxmi Publications, New Delhi, 2004.
3. Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill Publishing Co., 2005.
4. Vaidyanathan, R. and Perumal, P., "Structural Analysis", Vol.1 & 2, Laxmi Publications New Delhi, 2004.
5. Pandit, G.S. and Gupta, S.P., "Structural Analysis – A Matrix Approach", Tata McGraw Hill Publishing Co. Ltd., 2006.
6. Wang, C.K., "Intermediate Structural Analysis", Tata McGraw-Hill Publishing Co., 2010

14CE2031 - CONCRETE TECHNOLOGY

Credit: 3:0:0

Course Objective:

- To study about the constituents of concrete
- To study the properties of fresh and hardened concrete
- To understand the concepts of mix design methods

Course Outcome:

Students at the end of the course will be able to

- Understand about concrete making materials, properties of fresh and hardened concrete
- Apply the concepts of durability of concrete, special concretes and non- destructive testing of concrete
- Design the concrete mixes by various mix design methods
- concrete mixes by various mix design methods

Description:

Concrete- Constituents: cement, fine aggregates and coarse aggregates, Admixtures: chemical and mineral, Properties, Compositions and Tests - Properties of Fresh Concrete- workability, segregation, bleeding, mixing compaction and curing - strength and durability studies on Hardened Concrete - Mix Design: BIS, ACI and BS method - special concrete: light weight concrete, ready mix concrete, fiber reinforced concrete, Aerated concrete, No fines concrete, high strength concrete, ferrocement, high performance concrete, shotcrete, pumped concrete, preplaced concrete - repair and rehabilitation.

References:

1. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, 2005.
2. Gambhir, M.L., Concrete Technology, Tata Mc Graw Hill Publishing Company limited, New Delhi, 2004
3. Shetty, M.S., "Concrete Technology", S.Chand & Co., New Delhi, 2013
4. Santhakumar A.R, "Concrete Technology" Oxford University press, Jai Singh road, Delhi, 2006
5. Adam Neville, "Concrete: Neville's insights and issues", Thomas Telford Books, 2006

14CE2032 - BASICS OF DYNAMICS AND ASEISMIC DESIGN

Credit: 3:0:0

Course Objective:

- To introduce to the student the phenomena of earthquakes, the process, measurements and the factors that affects the design of structures in seismic areas.
- To introduce the concepts of seismic design of buildings
- To understand codal provisions and the aseismic design methodology.

Course Outcome:

Students at the end of the course will be able to

- Apply the basic concept of seismic design of concrete structures.
- Adopt design methods for various structures.

Description:

Theory of vibrations – One degree, two degree of freedom system with and without damping- free and forced vibration-Response spectrum- Seismology-Plate tectonics- lessons from past earthquakes-seismic zone map of India- Seismic analysis of RCC and steel building using codal provision- improving seismic resistance of masonry buildings-strong column-weak beam concept- Ductile detailing - Seismic strengthening and Structural control methods –Base isolation, bracings, dampers.

References:

1. Pankaj Aggarwal, Manish Shrikande, “Earthquake resistant design of structures”, Prentice Hall of India, Delhi, 2006
2. Anil K. Chopra, “Dynamics of structures- Theory and applications to earthquake engineering”, Prentice hall of India, New Delhi, 2007
3. Mario Paz, M., “Structural Dynamics – Theory & Computation”, CSB Publishers & Distributors, Shahdara, Delhi, 2004
4. NPEEE Publications, 2005
5. Roy R Craig Jr, Andrew J Kurdila., ”Fundamentals of Structural Dynamics”, John Wiley and Sons, 2011
6. IS1893:2002, Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi
7. IS 13920:1993, Ductile detailing of Reinforced Concrete Structures subjected to seismic forces, Bureau of Indian Standards, New Delhi

14CE2033 - BUILDING SERVICES

Credit: 3:0:0

Course Objective:

- To learn about water supply and sanitation arrangements in a building
- To understand the essentials of electrical installations in a building
- To get an exposure to air conditioning and fire safety arrangement
- To pioneer the concepts of intelligent building

Course Outcome:

Students at the end of the course will be able to

- Explain different services required for building
- Classify different types of air conditioning systems.
- Plan electrical, sanitation and air conditioning system in the building

Description:

Building Sanitation and Byelaws- septic and sewage treatment plant-Rain water harvesting - Electrical Installations in Buildings-wiring system-main and distribution boards, transformers, switch gears-lighting design - Air Conditioning System and Applications- Natural and artificial ventilation - Fire Safety control measures and Regulations - Introduction to Intelligent buildings- building automation- green buildings, Smart buildings.

References:

1. Arceivala, S. J., "Wastewater Treatment for Pollution Control", Tata McGraw Hill, 3rd edition 2006.
2. Bajwa G. S., “Practical Handbook on Public Health Engineering”, Deep Publishers, Shimla, 2003.
3. National Building Code-Part VIII Building Services- Section 4, Acoustics, Sound Insulation and Noise Control- Bureau of Indian Standards, New Delhi, 2005.

4. IS: 2526 – 1963 (reaffirmed 1996) Code of Practice for Acoustical Design of auditoriums and Conference Hall- Ninth reprint December 1998 (incorporating Amendment No: 1) New Delhi.
5. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2009.

14CE2034 - ADVANCED STRUCTURAL ENGINEERING LAB

Credit: 0:0:2

Pre-requisite: 14CE2031 Concrete Technology
14CE2009 Reinforced Concrete Structures

Course Objective:

- To learn the concepts of mix design
- To understand the flexural behaviour of RCC and steel beam by experimental Investigation
- To get an exposure on NDT methods

Course Outcome:

Students at the end of the course will be able to

- Experiment with RCC and Steel beam and column
- Determine the behaviour of concrete materials
- Design the mix proportions of concrete

Description:

Mix Design - High performance concrete – behavior of beams, columns, slabs – NDT Tests – Steel beam, column test – joints test - frame test.

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. ACI Manual of Concrete Practice, Part 3 and Part 5
2. IS 2386 – I, II – Methods for test of aggregates for Concrete, Bureau of Indian Standards, New Delhi
3. IS 10262 Indian Standard code for Concrete Mix Design, Bureau of Indian Standards, New Delhi

14CE2035 – ADVANCED COMPUTER APPLICATION LAB

Credit: 0:0:2

Pre-requisite: 14CE2010: Structural Analysis
14CE2009: Reinforced Concrete structures
14CE2013: Design of Steel Structures

Course Objective:

- To analyze and design various structural elements using SAP/ETABs and Matlab
- To analyze the structural elements using ANSYS Software

Course Outcome:

Students at the end of the course will be able to

- Model 2D and 3D building frames using STAAD
- Analyse the RCC and steel building frame
- Design the structural elements

Description:

Analysis of structures using SAP/ETABs, Matlab

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. SAP / ETABS Package Manual
2. ANSYS Package Manual
3. Matlab Manual

14CE2036 PREFABRICATED STRUCTURES

Pre-requisite: 14CE2009: Reinforced Concrete structures

Credit: 3:0:0

Course Objective:

- To study the design of Prefabricated structural components and its joints
- To study the design of prefabricated structures subjected to dynamic forces

Course Outcome:

Students at the end of the course will be able to

- Adopt the prefabrication technique and methodology of residential structures
- Adopt the prefabrication technique of various industrial structures

Description:

Prefabrication and its components - Modular co-ordination- standardization systems- production- transportation- erection- Behaviour of Structural components- construction of roof and floor slabs-wall panels-columns-shear walls - Design principles- Disuniting of structures- Design of cross section based on efficiency of material used - Joints in Structural members - Design for dynamic forces – Progressive collapse-Equivalent design loads for considering abnormal effects such as earthquake, cyclones, explosions and fire

References:

1. John D. Quale., “Sustainable, Affordable, Prefab: The EcoMOD Project”, University of Virginia Press, 2012
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc., 2012
3. Koncz T., “Manual of precast concrete construction”, Vols. I, II and III, Bauverlag, GMBH, 1971.
4. Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures”, Wiley, 2013
5. Colin Davies., “The Prefabricated Home”, Reaktion Books, 2005

14CE2037 - ADVANCED DESIGN OF STEEL STRUCTURES

Credit: 3:0:0

Course Objectives

- To study the design of advanced types of framed connections
- To study the concepts and design of pre-engineered buildings
- To study the analysis and design of towers and chimneys
- To understand the behaviour of composite members and design the composite slab, beam and column

Course outcomes:

Students at the end of the course will be able to

- Classify different types of bolted and welded joints
- Design the steel beam and columns

- Plan, analyse and design the industrial building

Description:

Design of bolted and welded connections for framed structures and advanced connections – stiffened and unstiffened seat connections - Design of Industrial bents, sway and non-sway frames, Gable column, purlins and bracings – Analysis and design of Towers and Chimneys - Design of Steel Concrete Composite Beams and Columns – IS and Euro codal provisions – ultimate load theory – design of shear connectors – Composite deck slab

References:

1. Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2008
2. Duggal S.K, “Limit State Design of Steel Structures”, Tata Mc Graw Hill Education Private Limited, New Delhi, 2010
3. “Teaching Resources for Structural Steel Design – Vol. I & II”, INSDAG, Kolkatta, 2003
4. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.
5. Johnson R.P., "Composite Structures of Steel and Concrete", Blackwell Scientific Publications, 2004

14CE2038 - INDUSTRIAL WASTE TREATMENT AND DISPOSAL

Credit: 3:0:0

Pre-requisite: 14CE2009 Water and Waste water engineering

Course Objective:

- To know the effects, importance and fundamental methods in Industrial waste treatment
- To impart knowledge about disposal of effluents and the standards for disposal

Course Outcome:

Students at the end of the course will be able to

- Select suitable method for industrial waste treatment and disposal
- Design industrial waste treatment plant
- Determine the water quality

Description:

Effects of industrial wastes on environment, waste minimization techniques: volume and strength reduction - Physical, chemical and biological treatment of industrial sewage, advanced wastewater treatment – manufacturing process, wastewater characteristics and treatment processes of major industries - Effluent standards and legislations, zero discharge concepts - environmental protection act – Air Act – Water Act – Wetland Regulatory Notification and Coastal Zone Regulation.

References:

1. Rao, M.N. and Dutta, “Waste Water Treatment”, Oxford and IBH Publishing Ltd. Calcutta, 2008
2. Eckenfelder, W.W., “Industrial Waste Pollution Control”, McGraw Hill Book Co., New Delhi 2003
3. Nemerow, N.L., “Theory and Principles of Industrial Waste Treatment”, Addison Wesley, Reading Mass, 2003
4. Water Environment Federation., “Industrial Wastewater Management Treatment and Disposal 3E”, Mc Graw Hill, 2008
5. Frank Woodard., “Industrial Waste Treatment Handbook”, Butterworth-Heinemann, 2001

14CE2039 - SOLID WASTE MANAGEMENT

Credit: 3:0:0

Course Objective:

- To educate the students on the principles involved in the management of municipal solid waste and hazardous wastes – from source identification up to disposal.

Course Outcome:

Students at the end of the course will be able to

- Involved the principles in management of municipal solid waste and hazardous wastes from source identification up to disposal
- Select municipal solid waste collection and treatment methods
- Develop skills to undertake major projects related to municipal solid waste management

Description:

Types and sources of solid waste, integrated waste management, legislations on municipal solid waste, hazardous wastes, biomedical wastes - Composition, physical, chemical and biological properties of solid waste, Source reduction, recycling and reuse - Storage, collection and transport of solid waste, handling of hazardous waste and its transport - Material separation and processing technologies - biological, chemical and thermal conversion and disposal – treatment of biomedical wastes.

References:

1. George Tchobanoglous, Hilary Theisen and Samuel, A. Vigil, “Integrated Solid Waste Management”, McGraw- Hill International edition, New York, 2012.
2. “CPHEEO Manual on Municipal Solid waste management”, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Micheael, D. LaGrega, Philip, L. Buckingham, Jeffrey, C. E., “Environmental Resources Management, Hazardous waste Management”, McGraw-Hill International edition, New York, 2001.
4. Vesilind, P.A., Worrell, W and Reinhart, “Solid waste Engineering”, Thomson Learning Inc., Singapore, 2002.
5. Jagbir Singh, A. L Ramanathan, “Solid Waste Management Present and future Challenges”, IK International, 2010

14CE2040 - ENVIRONMENTAL CHEMISTRY AND MICRO-BIOLOGY

Credit: 3:0:0

Course Objective:

- To educate the students the chemistry of water, air and soil and the microbiology of the environment.

Course Outcome:

Students at the end of the course will be able to

- Assess the chemical reactions in the atmosphere
- List the micro-organisms in air, water and soil
- Analyse the reduction and sorption in aquatic environment

Description:

Chemical reactions, Chemical equilibrium and thermodynamics, Instrumental methods - chromatographic and spectroscopic techniques - Complex formation, oxidation, reduction and sorption in aquatic environment - Chemical and photochemical reactions in the atmosphere, photochemical smog, green house gases and global warming - Distribution of microorganisms in water, air and soil, indicator organisms, metabolism of microorganisms, isolation of microorganisms.

References:

1. Sawyer C.N, MacCarty P.L and Parkin G.F, “Chemistry for Environmental Engineering and Science”, Tata McGraw-Hill, Fifth edition, New Delhi, 2002
2. Vanloon G.W and Duffy S.J “Environmental chemistry – a global perspective”, Oxford University press, New York., 2000.
3. Pradipta K Mohapatra.,”Environmental Microbiology”, I K International, 2008
4. Anita Rajor.,” Practical Methods for Environmental Microbiology and Biotechnology”, Krishna Prakashan Ltd. Meerut, 2002
5. Mehrotra And Sumbali, “Principles of Microbiology”, Tata McGraw-Hill Education, 2009

14CE2041 - AIR POLLUTION MANAGEMENT

Credit: 3:0:0

Course Objective:

- To educate the students on various methods of control of particulate and gaseous air pollutants

Course Outcome:

Students at the end of the course will be able to

- Classify different types of pollutants
- Analyse the possibilities of air pollution and control
- Measure the noise and develop the standard's for control

Description:

Sources and classification of pollutants and their effects on human health, vegetation and property, emission standards, atmospheric stability, atmospheric diffusion theories - plume rise – Methods for the control of particulate and gaseous contaminants, operational considerations and monitoring - Process modification for the minimization of automobile pollution, Technical and Economic Feasibility of emerging technologies for air pollution control, indoor air quality, noise measurements and standards – Radioactive pollution and its control.

References:

1. Rao C S, Environmental Pollution Control Engineering, New Age International (p) Limited, 2006.
2. Lawrence K.Wang, Norman C Perelra, Yung-Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
3. David H.F Liu, Bela G.Liptak "Air Pollution", Lewis Publishers, 2000.
4. Anjaneyulu.Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd, India, 2002.
5. Mudakavi, J R, "Principles and Practices of Air Pollution Control and Analysis" IK International, 2010

14CE2042 - GLOBAL CLIMATE CHANGE AND ITS IMPACT

Pre-requisite: 14CE2012: Water Resources Engineering

Credit: 3:0:0

Course Objective:

- To appreciate the global climate change scenario, causes and consequences
- To learn about climate change modelling

Course Outcome:

Students at the end of the course will be able to

- List the factors affecting global climate change
- Analyze the impacts of global climate change
- Explain the importance of water

Description:

Concept of Global Climate: climate in the spot light- the earth's natural green house effect- Green house gases- vital importance of monsoon rains, clouds, storms and climate- Causes for climate change: Patterns of large-scale variability - Influences and feedbacks of hydrological changes on climate- Climate Modelling - Potential consequences and impacts of climate change- Water-related adaptation to climate change in the fields of Ecosystems and biodiversity- Agriculture and food security, land use and forestry, Human health, water supply and sanitation, infrastructure and Economy (insurance, tourism, industry and transportation) -Adaptation, vulnerability and sustainable development.

References:

1. Singh, K. P., "Geomorphology and global climate change", 2011.

2. Thomas R Karl , Jerry Melillo., “Global Climate Change Impacts in the United States”, U S Global Change Research. 2009
3. Syed M. H., “Climate Change”. Daya Publishing House, 2009
4. Syed M.H, Encyclopaedia of SAARC Nations, Gyan Publishing House, 2003
5. Alper Baba, Gökmen Tayfur, “Climate Change and Its Effects on Water Resources” Springer Publishers, 2010

14CE2043 - DISASTER MANAGEMENT AND MITIGATION

Credit: 3:0:0

Course Objective:

- To expose the students to the natural and manmade disasters
- To train the students to study the effect of disasters and methods to mitigate disasters.

Course Outcome:

Students at the end of the course will be able to

- Students exposed to the natural and manmade disasters
- Develop the mitigate methods for various disasters
- Adopt the disaster management strategies.

Description:

Types and effects of natural disasters, climate change: sea level rise and global warming, ozone layer depletion - Types of man-made disasters, effects on the environment, types of accidents - Mitigation of natural disaster, national disaster management framework, financial arrangements, community based organizations, role of central, state, district and armed forces in disaster response, police and other organizations - Skills and strategies for disaster preparedness, reconstruction and rehabilitation, risk-time charts

References

1. Iyengar, C.B.R.I., “Natural Hazards in the Urban Habitat” , Tata McGraw Hill Co., 2001.
2. Jon Inglestone, “Natural Disaster management”, Tulor Rose, 1999.
3. Singh, R.B., “Disaster Management”, Rawat Publications, 2000.
4. Sachindra Narayan, “Anthropology of Disaster management”, Gyan Publishing House, 2000
5. Damon P. Coppola, “Introduction to International Disaster Management”, Elsevier Publication, 2011

14CE2044 - ADVANCED ENVIRONMENTAL ENGINEERING LAB

Pre-requisite: 14CE2021: Environmental Engineering Lab

Credit: 0:0:2

Course Objective:

- To give hands-on training on the site as well as laboratory methods of water and wastewater analysis
- To educate the students on the analysis of chemical and biological parameters of water and wastewater

Course Outcome:

Students at the end of the course will be able to

- Estimate the BOD and COD in water samples
- Analyse the chemical properties of water and waste water
- Classify the heavy metals in waste water

Description:

Physical analysis of water and wastewater - Chemical analysis of water and wastewater - Estimation of BOD and COD of wastewater samples - Analysis of heavy metals in water - Bacteriological analysis of water and wastewater

Experiments

The faculty conducting the Laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Sawyer, N.C., and McCarty, P.L., “Chemistry for Environmental Engineering”, McGraw-Hill Book Co., New York, 2002.
2. “Standard Methods for the Examination of Water and Wastewater”, APHA-AWWAPCF, Washington (D.C), 2012.

14CE2045 - GIS LAB

Credits: 0:0:1

Course Objectives:

- To give hands-on training on the applications of GIS in the context of water resources

Course Outcome:

Students at the end of the course will be able to

- Analyse the geo spatial maps and related data
- Model geographical information system
- Manage land and water resources

Description

Map processing - Spatial analysis - Assessment of water quality and quantity - land use – land cover changes

Experiments

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

References:

1. Lillesand, T. M. and Kiefer, R. W. “Remote Sensing and Image Interpretation”., Third Edition. John Wiley and Sons, New York, Fifth Edition 2003.
2. Basudeb Bhatta. “Remote Sensing and GIS”. Oxford University Press. 2nd Edition 2011.
3. Lo C P Yeung, K W Albert, “Concepts and Techniques of GIS”, Prentice Hall of India, 2002.
4. Michael N. Demers, “Fundamentals of GIS with Lab Manual Set”, John Wiley & Sons, 2000

14CE2046 SMART MATERIALS AND STRUCTURES

Credit: 3:0:0

Course Objective

- To give an in-depth knowledge on properties of smart materials and their use in structures.

Course Outcome

Students at the end of the course will be able to

- Select the smart materials for smart structures
- Apply the smart materials in the construction
- Design the smart structures using smart materials

Description:

Properties of smart materials- mechanisms and properties - fiber optic strain sensors, vibration absorbers- vibration characteristics of mistuned systems strain measuring techniques control systems: classical control, modern control, optimal control and digital control - active structures in practice, Application of smart materials in bridges, high rise structures – structural health monitoring - concept of smart concrete.

References

1. Srinivasan, A.V., and Michael McFarland. D., "Smart Structures – Analysis and Design", Cambridge University Press, 2001.
2. Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996.
3. Donald J. Leo, "Engineering Analysis of Smart Material Systems" John Wiley & Sons. 2007
4. Hartmut Janocha, "Adaptronics and Smart Structures: Basics, Materials, Design, and Applications", Springer, 2007
5. Brebbia C. A, Samartin A., "Computational methods for smart structures and materials - II", WIT Press/Computational Mechanics Publications, 2000

14CE3001 APPLIED ELASTICITY AND PLASTICITY

Credit: 3:0:0

Course Objective

- To study the stress and strain analysis of 2D and 3D problems and torsion
- To have a brief introduction to failure criteria and elasto-plastic problems of beams in bending, pressure vessels and torsion

Course Outcome

At the end of the course student will be able to

- apply the concept of advanced structural mechanics in real time structures

Description:

Analysis of stress and strain in three dimensional cartesian coordinates, generalized Hook's law, formulation of elasticity problems, two dimensional problems in rectangular and polar co-ordinates, torsion of non-prismatic bars and thin walled open and closed sections, Yield criteria, elasto-plastic problems –Beams in bending, cylinders subjected to internal pressure and torsion of bars.

References:

1. Sadhu Singh., "Theory of Elasticity", Khanna Publishers, N.Delhi, 2013.
2. Sadhu Singh., "Theory of Plasticity and Metal forming", Khanna Publishers, New Delhi, 1999.
3. Timoshenko, S and James M Gere, "Theory of Elasticity Stability", Dover Publication, 2009.
4. Chakrabarthy, J., "Theory of Plasticity", BH publishers, 2006.

14CE3002 ADVANCED CONCRETE TECHNOLOGY

Credit: 3:0:0

Course Objective:

- To study about the constituents of concrete
- To study the properties of fresh and hardened concrete
- To apply new theories and testing techniques

Course Outcome:

At the end of the course the students will be able to

- understand the behaviour of the concrete
- carry out the mix design by various methods and for special concrete

Description:

Concrete- Constituents: cement, fine aggregates and coarse aggregates, - use of various additives, production techniques and chemical processes, degree of control over the properties of specific concretes for a wide range of applications - New theories, models and testing techniques, Fracture mechanics of hardened concrete, advanced

cementitious composites, production of durable, economical and sustainable concrete – Non destructive testing of concrete

References:

1. John Newman, B S Choo,. “Advanced Concrete Technology 2: Concrete Properties”, Butterworth-Heinemann. 2003
2. Murari Lal Gambhir, “Concrete Technology: Theory and Practice” Tata McGraw-Hill Education. , 2013
3. Nayak N. V., Jain A. K., “Handbook on Advanced Concrete Technology”, Alpha Science International, Limited, 2012
4. Zongjin Li. “Advanced Concrete Technology”, John Wiley & Sons. 2011

14CE3003 STRUCTURAL OPTIMIZATION

Credits: 3:0:0

Course Objective

- To enable the student to understand the concept of optimization
- To enable them apply optimization concept to different civil engineering problems

Course Outcome

At the end of the course student will be able to

- carry out cost optimization of structures using different methods
- apply the knowledge in designing real time problems

Description:

Concepts of minimum weight - minimum cost design, constrained and unconstrained optimization techniques, linear and non-linear programming- simplex algorithm, geometric programming, dynamic programming, Non-conventional optimization techniques-genetic algorithm, ant colony algorithm, artificial neural networks, fuzzy logic in civil engineering. Optimal design of beams, frames and trusses.

References:

1. Rao, S.S., “Engineering Optimization, Theory and Practice”, New Age International (p) Ltd., New Delhi, 2002.
2. David. W. A Rees., “Mechanics of Optimal Structural Design: Minimum Weight Structures”, John Wiley and Sons, 2009
3. Rajasekaran,S. and Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and GeneticAlgorithm”, Prentice Hall of India Pvt. Ltd, Delhi, 2003.
4. Kalyanmoy Deb., “Multi-Objective Optimization using Evolutionary Algorithm”, John Wiley and Sons, 2001.

14CE3004 ADVANCED DESIGN OF REINFORCED CONCRETE STRUCTURES

Credit: 3:0:0

Course Objective:

- To understand the behavior of structural elements
- To study the design of special structures

Course Outcome:

At the end of the course student will be able to

- apply knowledge to analyse and design statically indeterminate structures

Description:

Limit State Design of Beams for Shear, Torsion and Bond - Composite column and Tubular column - Design of Bunkers and Silos - design of RCC chimney - cooling tower and nuclear structures - Limit Analysis and Design of

isotropically and orthotropically reinforced slabs of various shapes - Design of flat slabs, Limit Analysis and Design of Statically Indeterminate Structures - Check on rotation capacity - Grid floors - Shells and folded plates of simple configuration.

References:

1. Bhavikatti S.S, "Advanced RCC Design", New age International Pvt. Ltd. 2006.
2. Varghese, P.C., "Advanced Reinforced concrete structures ", Prentice – Hall of India Ltd, New Delhi 2003.
3. Krishnaraju,N., "Advanced Reinforced Concrete Design", CBS publications, New Delhi 2005.
4. Punmia B.C "Advanced RCC Design", Laxmi Publications Pvt Ltd", 2006.
5. James K. Wright, James Grierson MacGregor, "Reinforced Concrete: Mechanics and Design (4th Edition), Pearson Education Limited, 2012

14CE3005 STRUCTURAL DYNAMICS

Credit: 3:0:0

Course Objective

- To impart knowledge free and forced vibration SDOF, MDOF and distributed parameter

Course Outcome

At the end of the course student will be able to

- carry out vibration studies and their importance to structural engineering problems
- analyze multi storied buildings subjected to dynamic loads

Description:

Principles of dynamics, single degree of freedom- damped and undamped free and forced vibration – transmissibility - response to general dynamic loading (blast or earthquake), two degrees of freedom systems, normal modes of vibration –vibration absorber, mathematical modeling of multiple degree of freedom system- shear building, free vibration of undamped system- orthogonality of normal modes, solution of eigen value problem, distributed parameter system, solution for equilibrium equations in dynamics

References:

1. Clough, R.,W., and Penzien, "Dynamics of Structures", McGraw Hill Book Co Ltd, 1986.
2. Paz Mario, "Structural Dynamics - Theory and Computation", CBS publishers, US, 1999.
3. Anil K. Chopra, "Dynamics of Structures" (4th Edition), Prentice Hall; 2011
4. Roy R. Craig, Andrew J. Kurdila., "Fundamentals Structural Dynamics ", John Wiley and Sons, UK, 2011.
5. Thomson, W.T., "Theory of Vibrations with applications", Prentice Hall of India, 2008.
6. Humar J. "Dynamics of Structures", Third Edition, CRC Press, 2012

14CE3006 FINITE ELEMENT METHODS IN ENGINEERING

Credit: 3:0:0

Course Objective

- To understand the basic concept of finite element for one, two, and three dimensional finite elements
- To study the various finite element procedures and solution techniques for linear and nonlinear structures.

Course Outcome

At the end of the course student will be able to

- analyze the discrete and continuum problems using finite element method.

Description

Concept of finite element - variational and weighted residual methods - convergence and compatibility requirements - elements for trusses - beams and frames - stress and strain analysis of two dimensional planar problems - concept of shape functions - triangular elements - rectangular elements - iso-parametric elements stress

analysis (three dimensional elements): numerical integration techniques plate and shell elements - finite strip method nonlinear - vibration and thermal problems, meshing and solution problems - auto and adaptive mesh generation techniques .

References:

1. Robert D.Cook, et al, “ Concepts and Applications of Finite Element Analysis”, John Wiley & Sons, Inc. Singapore, 2007
2. Bathe. K.J., "Finite Element Procedure", Prentice Hall of India, New Delhi, 2006.
3. Zienkiewicz O. C., Robert Leroy Taylor., "The Finite Element Method Vol. 1 & 2", McGraw Hill Book Company, New York, 2005
4. Tirupathi, R.Chandrupatla and Ashok, D. Belegundu., "Introduction to Finite Elements in Engineering", Prentice Hall of India Private Limited., New Delhi, 2004.
5. Rajasekaran, S., "Finite Element Methods in Engineering Design", S.Chand& Co Ltd., NewDelhi, 2003.
5. Mukhopadhyay, M., "Matrix, Finite Element Computer and Structural Analysis", Oxford & IBH publishing Co., Pvt. Ltd. New Delhi, 1993.

14CE3007 SEISMIC DESIGN OF STRUCTURES

Credit: 3:0:0

Course Objective

- To introduce about the seismology
- To introduce the concepts of seismic design of buildings

Course Outcome:

At the end of the course the student will be able to

- analyse and detail buildings for seismic resistance
- apply knowledge to strengthen the existing buildings

Description:

Engineering seismology - lessons learnt from past earthquakes - conceptual design considerations - seismic methods of analysis - lateral load analysis using codal provisions - principles of earthquake resistant design - ductility consideration of earthquake design of RC buildings - capacity based design, behavior and design of shear wall in earthquake - seismic design of masonry buildings - seismic behaviour of steel structures - design of steel structures - response control concepts, methods of retrofitting.

References:

1. Pankaj Agarwal and Manish Shrinkhande., “Earthquake Resistant Design of Structures”, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
2. Duggal, S.K., “Earthquake Resistant Design of Structures”, Oxford University Press, New Delhi, 2007.
3. Chopra, A.K., “Dynamics of Structures - Theory and Applications to Earthquake Engineering”, Prentice Hall of India private limited, New Delhi, 2002.
4. Steven, L.Kramer., “Geotechnical Earthquake Engineering”, Prentice Hall of India Pvt Ltd., New Delhi, 2004.
5. Naeim, F., “The Seismic Design Hand Book”, 2nd Edition, Kluwer academic publishers, London, 2001.

14CE3008 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

Credit: 3:0:0

Course Objective:

- To study the various techniques for experimentation
- To study the Modeling of different structures
- To understand the various non destructive tests

Course Outcome:

At the end of the course student will be able to

- Apply the knowledge to various experiments
- Model complex structures for static and dynamic load
- Analyze the distress in structures

Description:

Forces and strain measurement, principles and operation - vibration measurements - velocity and acceleration measurements - digital data acquisition systems, acoustics and wind flow measurement - structural modeling - Model analysis for concrete structures - wind tunnel, load tests on actual structures - bridges and dams - distress measurements and control tests on beams and structures - non-destructive testing methods.

References:

1. Arthur P. Boresi, Ken Chong, James D. Lee “Elasticity in Engineering Mechanics”, John Wiley & Sons, 2012
2. Dalley, J.W and Riley, W.F, “Experimental Stress Analysis”, Mc Graw Hill Book Company, New York, 2004
3. Ganesan T.P., “Model Analysis of Structures”, University Press, India, 2005.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 1996.
5. William N. Sharpe, Jr., William N. Sharpe, “Springer Handbook of Experimental Solid Mechanics”, Springer, 2008

14CE3009 ADVANCED DESIGN OF METAL STRUCTURES

Credit: 3:0:0

Course Objective:

- To study the design of framed connections, pre-engineered buildings and towers and chimneys.
- To understand the behaviour of composite members and design

Course outcomes:

At the end of the course student will be able to

- apply the codal provisions for the design of steel structural elements
- design the components of pre-engineered buildings
- design the composite structural members

Description:

Design for simple and moment resistant connections- welded and bolted seat connections, Limit state design of Beams and Beam columns, lateral torsional buckling, modes of failure, Design of Industrial steel buildings, pre-engineered buildings, Wind load analysis and Design of Towers and Stacks, Design of light gauge steel sections, Concepts of Plastic analysis, continuous beams and portal frames.

References:

1. N. Subramanian N, “Design of Steel Structures”, Oxford University Press, USA, 2008
2. Dayaratnam, P., “Design of Steel Structures”, A.H.Wheeler & Co. Ltd., Allahabad, 2008
3. Arya and Ajmani, “Design of Steel Structures”, NemChand Brothers, Roorkee, 2007
4. Punmia B.C., Ashok kumar Jain and Arunkumar Jain, ‘Design of Steel Structures’, Arihant Publications, Bombay, 2008
5. Gray, C. S. Kent L.E Mitchell, W.A., and Godfey, W.B., "Steel Designer's manual", English Language Book Society and Granada Publishing, London, 2003
6. Teaching Resource Materials on Steel – SERC, INS DAG, Anna University and IIT Madras

14CE3010 ADVANCED BRIDGE ENGINEERING

Credit: 3:0:0

Course Objectives:

- To get exposed to the design aspects of various types of bridges using IRC specifications and railways
- To learn the concept of design of substructure for the bridges
- To learn the construction and maintenance of bridges

Course Outcome:

At the end of the course the student will be able to

- design various types of bridges and substructures
- carry out the construction and maintenance of buildings

Description

Design of Concrete Bridges-slab, T-beam and- slab – arch - bow string girder types - Prestressed Concrete Bridges - simple spans, continuous decks - Steel Bridges - Plate girder, box girder, truss and arch types - Cable stayed bridges and suspension bridges; principles of design, aerodynamic stability and vibrations - Substructure design: piers and abutments and Foundations - River draining works - Design of bearings - Erection techniques - Bridge maintenance management: inventory, inspection and rehabilitation. Failures – case studies.

References:

1. Johnson Victor, D., "Essentials of Bridge Engineering", Oxford & IBH Publishing Co., New Delhi, Fourth Edition, 2007.
2. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, New Delhi, 2007
3. Krishna Raju, N., "Design of Bridges", Oxford & IBH Publishing Co., New Delhi, Third Edition, 2007.
4. Jagadeesh T.R., Jayaram M.A., "Design of Bridge Structures", Prentice Hall of India Private Limited, New Delhi, 2007.

14CE3011 COMPUTER AIDED DESIGN LABORATORY

Credit: 0:0:1

Course Objective

- To introduce the application of FEM in Software Packages
- To enable the students to analyze and design various structural elements using software packages

Course Outcome

- Student capacitated to analyse and design RCC and steel structures by using software packages

Experiments

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD and notify it at the beginning of the semester.

References:

1. STAAD Pro 2007 V8i Analysis Reference Manual.
2. ANSYS 11.0 Analysis Reference Manual.
3. SAP Analysis Reference Manual – "Computers and structures".
4. Rudra Pratap, "Getting Started with MATLAB", Oxford University Press, 2002

14CE3012 ADVANCED STRUCTURAL TESTING LABORATORY

Credit: 0:0:2

Course Objective

- To impart basic knowledge on properties of building materials

- To impart knowledge on concrete mix design for low strength and high strength concrete
- To study the behaviour of fresh and hardened concrete, high performance concrete
- To impart knowledge on non-destructive testing

Course Outcome

At the end of the course student will be able to

- identify the suitable materials needed for concreting
- understood the behaviour of concrete for different types of loading

Experiments:

The faculty conducting the Laboratory will prepare a list of 12 experiments on static and dynamic loading tests and get the approval of HoD and notify it at the beginning of the semester.

References:

1. Neville, A.M., "Concrete Technology", Longman Scientific & Technical, England, 2008.
2. Gambir, M.L., "Concrete Technology", Tata McGraw Hill, New Delhi, 2004.
3. Shetty, M.S., "Concrete Technology", S. Chand & Co., New Delhi, 2005.
4. Krishnaraju, N., "Design of concrete mixes", Sehgal Educational Consultants & Publishers Pvt.Ltd., Faridabad, 2007.

14CE3013 DESIGN OF STRUCTURES FOR DYNAMIC LOAD

Credit: 3:0:0

Course Objective

- To study the basic principles of dynamic loads
- To study the behaviour of structures subjected to dynamic loads

Course Outcome

At the end of the course student will be able to

- carry out analysis and design of various tall buildings and other structures subjected to various dynamic loads.

Description:

Dynamic loads - behavior under impact and cyclic loads: concrete, steel, masonry and soil – design against earthquakes: hydraulic structures, life line structures, terminal buildings, towers, tunnels - Inelastic earthquake analysis of multi-storey building frames, Pushover Analysis, Design against blast and impact - design against wind and cyclone– aero elastic and aerodynamic effect - design as per BIS code of practice including gust factor approach – tall buildings, stacks and chimneys - Passive and active control of vibrations - new and favorable materials - Stability of nonlinear and time varying Systems - Inverse problems in vibrations: System identification approaches.

References:

1. Paulay,T and Priestly, M.N.J "Aseismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons, 1991.
2. Alan G. Davenport, "Wind Effects on Buildings and Structures", Proceedings of the Jubileum Conference on Wind effects on Structures, Port Alegre, Brazil, pp 25-29, Balkema A.A. Publishers, 1998.
3. Viridi K. S., Matthews R, Clarke J. L, Fikry Garas, "Abnormal Loading on Structures: Experimental and Numerical Modelling", CRC Press. 2000
4. Theodor Krauthammer, "Modern Protective Structures", CRC Press. 2008
5. Graham, M.L. Gladwell, "Inverse Problems in Vibration", Springer Verlag. 2004
6. Datta T. K, "Seismic Analysis of Structures", John Wiley & Sons (Asia). 2010

14CE3014 DESIGN OF SPACE STRUCTURES

Credits 3:0:0

Course Objective

- To understand the concept of space structures
- To understand the behaviour of space structures

Course Outcome

At the end of the course student will be able to

- design the space structures

Description:

Space structures - Single and multi-layer grids - Barrel vaults – Domes - Towers - Tension structures - Pneumatic structures - Material- Protection coats for the members - Practical construction methods – Drainage - Transportation problem - Lifting technique - corrosion protection - Maintenance and fire protection - forms of space structures - Tensegrity frame work – Tensile structures - Pneumatic structures Prefabricated Space Structural Systems: Mero, Space deck, Nodus, Unistrut, Triodetic, Unibat and NS truss - Node Connectors: Mero - Octatube - Nodus system – Triodetic - Modular system – Tomo unit truss. Finite element method - Linear – Nonlinear - Collapse - Dynamic and Stability analysis - Design of Members: Joints - Support systems – Foundations. Configuration Processing: Formian Algebra - case studies - Failures.

References:

1. Ramaswamy G. S, Mick Eekhout, Suresh G. R, “Analysis, Design and Construction of Steel Space Frames”, Thomas Telford 2002
2. Subramanian, N. ”Space Structures: principles and Practice I” Multi Science Publishing Company 2006.
3. S. Woinowsky-Kriege, “Theory of plates and shells”, Mc Graw Hill 2003.
4. Reinhold Kienzler, Holm Altenbach, Ingrid Ott “Theories of Plates and Shells: Critical Review and New Applications”, Springer 2013

14CE3015 DESIGN OF TALL BUILDINGS

Credit: 3:0:0

Course Objective

- To provide an insight into the techniques for the analysis of tall buildings.

Course Outcome

At the end of the course the student will be able to

- perform linear and non-linear and stability analysis of tall buildings.

Description:

Design principles and loading: methods of live load reduction - Behaviour of various structural systems: factors affecting growth, height and structural form - high rise behavior: rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, outrigger braced and hybrid mega systems, modeling for approximate analysis , computerized general three dimensional analysis, stability of tall buildings, p-delta analysis

References:

1. Bungale S Taranath, “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 2011.
2. Bungale S. Taranath, “Reinforced Concrete Design of Tall Buildings”, CRC Press, 2009
3. Bungale S. Taranath , “Wind and Earthquake Resistant Buildings: Structural Analysis and Design”, CRC Press, 2005
4. Guy Nordenson, “Tall Buildings”, Museum of Modern Art. , Delhi, 2003.
5. Mark P Sarkisian, “Designing Tall Buildings: Structure as Architecture”, Routledge, 2012.

14CE3016 DESIGN OF OFFSHORE STRUCTURES

Credit: 3:0:0

Course Objective

- To learn the theories on wave motion
- To understand the behavior and design aspects of offshore structures

Course Outcome

At the end of the course the student will be able to

- analyze and design offshore structures

Description:

Theories of periodic wave motion - mathematical formulation of wave problem - forces due to ocean waves on structures: wave forces on breakwaters and sea walls due to non-breaking and broken waves - wave forces on piles. Shore protection works: natural and artificial, design of breakwaters, Functional aspects and design of piers, wharf, quay walls, gravity dry docks - floating dry docks - dolphins - fenders - offshore mooring buoys - offshore marine platform.

References:

1. Mohamed A. El-Reedy, "Offshore Structures: Design, Construction and Maintenance Gulf Professional Publishing, 2012
2. Gudmestad O.T, Holand I., Jersin E., "Design of Offshore Concrete Structures", CRC Press. 2002
3. Ben C. Gerwick, Jr, "Construction of Marine and Offshore Structures, Third Edition, CRC Press, 2007
4. API Recommended Practice, "Planning, Designing and Constructing Fixed Offshore Platforms", American Petroleum Institute Publication, RPZA, Dallas, 1999.

14CE3017 GEOTECHNICAL EARTHQUAKE ENGINEERING

Pre-requisite: 14CE3007 Seismic Design of Structures

Credit: 3:0:0

Course Objective:

- To provide fundamental knowledge of soil-dynamics and seismic behavior of soils.

Course Outcome:

At the end of the course the student will be able to

- apply the concept of soil dynamics for seismic design

Description:

Wave Propagation, Attenuation of stress waves – Dispersion - waves in a layered medium - Static and dynamic characteristics of soils - Ground Response Analysis: Equivalent and nonlinear finite element approaches - soil-structure interaction – Liquefaction - Earth Pressure: Active and passive earth pressures; Terzaghi's passive wedge theory, numerical methods, earth pressure measurements.; Seismic design of retaining walls - Types of earthquake induced landslides - Evaluation of slope stability - Ground Improvement Techniques - Applications.

References:

1. Prasad Bharat Bhushan, "Advanced Soil Dynamics and Earthquake Engineering", PHI Learning Pvt. Ltd. 2011
2. Ranjan, G. and Rao A.S.R., "Basic and Applied Soil Mechanics", New AgeInt. Ltd., 2000
3. Kameshwara, Rao, N.S.V, "Dynamic Soil Tests & Applications", Wheeler Publications, 2000
4. Day Robert, W., "Geotechnical Earthquake Engineering Handbook", McGraw-Hill, 2001
5. Kramer, S.L., "Geotechnical-Earthquake Engineering", Pearson Education, 2004
6. Saran, S. "Soil Dynamics & Machine Foundation", Galgotia Publication, 2006

14CE3018 DESIGN OF SUBSTRUCTURES

Credit: 3:0:0

Course Objective:

- To study the design of various types of foundation.

Course Outcome:

At the end of the course the student will be able to

- carry out soil investigation and selection of foundation
- design various types of foundations.

Description:

Soil Investigation and Selection of foundation - Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation, pile foundations , pile load test – structural design of straight piles, structural design of pile cap - Types and design of well foundation – lateral stability - principles of design of machine foundation design for reciprocating machines and impact machines, vibration isolation - Foundation on expansive soils, under-reamed pile foundation - foundation for concrete towers, chimneys, anchors- reinforced earth retaining walls.

References:

1. Swamy Saran, “Analysis and Design of substructures”, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
2. Varghese.P.C, “Design of Reinforced Concrete Foundations” – PHI learning private limited, New Delhi – 2009
3. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 2001.
4. Kameswara Rao N. S. V., “Foundation Design: Theory and Practice”, John Wiley & Sons, 2010

14CE3019 DESIGN OF COMPOSITE STRUCTURES

Credit: 3:0:0

Course Objective

- To understand the behaviour of steel concrete composite structures
- To design composite elements and structures and their connections

Course Outcome

At the end of the course the student will be able to

- design steel concrete composite beams, columns, trusses with connection details

Description:

Steel - concrete composite construction -IS, BS and Euro code provisions, elastic and ultimate load behavior, Design of simply supported and continuous steel – concrete composite beams with solid deck slabs and profiled deck slabs - Design of composite trusses and columns - Design of Connections, typical shear connectors and interaction with concrete, Seismic behaviour of composite structures – case studies on steel-concrete composite construction in buildings and bridges

References

1. Johnson, R.P., “Composite Structures of Steel and Concrete”, Blackwell Scientific Publications, UK, 2008.
2. Narayanan R., “Steel-Concrete Composite Structures”, CRC Press. 2005
3. Alain Nussbaumer, Luis Borges, Laurence Davaine, “Fatigue Design of Steel and Composite Structures: Eurocode 3: Design of steel structures”, John Wiley & Sons. 2012
4. INSDAG, “Design of Composite Truss for Building”, Institute for Steel Development and Growth Publishers, Calcutta.
5. IS: 11384-1985., “Code of Practice for Composite Construction in Structural Steel and Concrete”, Bureau of Indian Standards, New Delhi.
6. Appropriate IS, British and Euro Codes.

14CE3020 STABILITY OF STRUCTURES

Credit: 3:0:0

Course Objective

- To understand the basic principles of stability
- To understand the buckling behaviour of columns, plates and shells

Course Outcome

At the end of the course the student will be able to

- apply the principles of stability for civil engineering structures

Description:

Concept of stability, stability criteria, static and dynamic approach stability of columns - large deflection of columns, effect of shear on buckling, Inelastic buckling theories, beam columns: stability of frames, stability functions, lateral stability of beams, buckling of thin-walled open sections, stability of plates, post-buckling strength, buckling of shells, Donnell's equation, sensitive and insensitive systems - symmetric and asymmetric bifurcation

References:

1. Stephen P. Timoshenko, James M. Gere., "Theory of Elastic Stability", 2nd Ed. McGraw-Hill, 2012.
2. Iyengar, N.G.R., "Elastic Stability of Structural Elements", Macmillan India Ltd., New Delhi, 2007
3. Murali, L. Gambir, "Stability Analysis and Design of Structures", Springer-Verlog, Berlin, 2004.
4. Robert Millard Jones, "Buckling of Bars, Plates and Shells", Mc Graw Hill, 2006.
5. George J. Simitses, Dewey H. Hodges, "Fundamentals of Structural Stability", Butterworth-Heinemann. 2006
6. Chen W.F., Lui E.M, "Principles of Structural Design" CRC Press, 2005
7. Iyengar NGR, "Elastic Stability of Structural Elements", Macmillan, 2007

14CE3021 PRESTRESSED CONCRETE STRUCTURES

Credit: 3:0:0

Course Objective

- To understand the concepts of prestressing concrete structures and the design of various structural components.

Course Outcome

At the end of the course the student will be able to

- analyse and design prestressed concrete structures

Description:

Prestressing systems - Analysis of prestress and bending stresses, concept of load balancing - losses of prestress, deflection, design for flexure, shear and torsion, combined bending, torsion and transverse shear - composite construction of prestressed and in-situ concrete, concordant cables - analysis and design of continuous beam - Circular prestressing - partial prestressing - non-prestressed reinforcement.

References

1. Krishna Raju, N., "Prestressed Concrete", 4th Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
3. Perumalsamy Balaguru, Antonio Nanni, James Giancaspro, "FRP Composites for Reinforced and Prestressed Concrete Structures: A Guide to fundamentals and design for repair and retrofit", CRC Press. 2008
4. Loo/Chowdhury, "Reinforced and Prestressed Concrete: Analysis and Design with Emphasis on application of AS 3600 – 2009", Cambridge University Press., 2010
5. Rajagopalan N, "Prestressed Concrete", CRC Press. 2002

14CE3022 INDUSTRIAL STRUCTURES

Credit: 3:0:0

Course Objective

- To provide an insight to the techniques for the analysis and design of industrial buildings

Course Outcome

At the end of the course the student will be able to

- perform the analysis and design of industrial buildings

Description:

Functional Requirements of industrial buildings, Design and detailing of R.C. gable frames, corbels, bunkers, silos and chimneys - North light roofs - Cooling towers -Application of prefabrication techniques, gantry girders, steel bunkers, silos and chimneys - High pressure boilers and piping design. Design of nuclear containment structures, power transmission structures: cables, transmission line towers - Substation structures - Tower foundations – Design of machine foundations.

References

1. Mohamed A. El-Reedy, "Construction Management and Design of Industrial Concrete and Steel Structures", CRC Press, 2010
2. Bhavikatti S.S, "Design of Steel Structures" (By Limit State Method As Per Is: 800 2007), I. K. International Pvt Ltd, 2009
3. Sp32: 1986 - Handbook on "Fundamental Requirements of Industrial Buildings (Lighting and Ventilation)", BIS.
4. Dayaratnam, P., "Design of Steel Structures", A.H. Wheeler & Co., Ltd., Allahabad, 1999.
5. Duggal, "Design of Steel Structure" - 3E, Tata McGraw-Hill Education., 2009
6. Somerville G., "The Design Life of Structures", CRC Press.2003

14CE3023 ADVANCED DESIGN OF PREFABRICATED STRUCTURES

Credit: 3:0:0

Course Objective

- To know the prefabrication technique of various structural components

Course Outcome

At the end of the course the student will be able to

- design various Prefabricated buildings

Description:

Principles of prefabrication - Transportation, Erection - Analysis and design of prefabricated floors, stairs, roofs and joints, walls: leak prevention - joint sealant and sandwich wall panels - materials, erection and joining techniques used in precast construction, design for handling and erection stresses - prefabricated roof for industrial sheds - precast roof trusses, roof panels, crane-gantry girders, corbels, columns and wind bracing - joints between columns and foundations

References

1. Maurice Levitt, "Precast Concrete: Materials, Manufacture, Properties and Usage", Taylor and Francis Group, 2007.
2. Lasslo Mokka, "Prefabricated concrete for Industrial and Public sectors", Akademiai Kiado, Budapest, 2004.
3. "Seismic Design of Precast Concrete Building Structures: State-of-art Report", edited by International Federation for Structural Concrete, FIB - Féd. Int. du Béton. 2003
4. Kim Elliott, "Prefabricated concrete structures", Butterworth-Heinemann, 2002.

14CE3024 ANALYSIS AND DESIGN OF PLATES AND SHELLS

Credit : 3:0:0

Course Objective

- To enable the student to understand the structural behavior of plates and shells
- To enable the student to analyze and design different types of shells and folded plates

Course Outcome

- Student enabled to analyze and design shells and folded plate roofs

Description:

Classical theory of plates - levy and naviers solution of plates - small deflection theory of plates -analysis of laterally loaded (concentrically loaded) plates: circular thin plates with simply supported or clamped edges - Design of folded plate roof, design of shells: spherical shell, conical shell, paraboloid - ellipsoid. R.C. Cylindrical shell, prestressed Cylindrical shells, hyperbolic paraboloid shell, design of R C north-light shells

References

1. S. Woinowsky-Kriege “Theory of plates and shells”, Mc Graw Hill 2003.
2. Reinhold Kienzler, Holm Altenbach, Ingrid Ott “Theories of Plates and Shells: Critical Review and New Applications”, Springer 2013
3. Farshad M, ”Design and Analysis of Shell Structures” Springer 2010
4. “Design of Cylindrical concrete shell roofs”, Manual of Engineering Practice No.31 ASCE, New York, 1952.
5. Varghese PC, “Design of Reinforced Concrete Shells and Folded Plates”, PHI Learning Pvt Ltd, 2010

14CE3025 ENERGY EFFICIENT BUILDING

Credits: 3:0:0

Course Objective:

- To give the concept of Energy efficient buildings with the holistic approach
- To acquaint the students with the international assessment systems and documentation procedure
- To be aware of the economic benefits of High performance buildings

Course Outcome:

At the end of the course students will be able to

- document and assess the energy efficient building
- Evaluate the economic performance of buildings as related to their resource-consumption and environmental performance.

Description

Energy efficient building concepts and materials - the integrated design process - documentation requirements - Sustainable sites and landscaping- Indoor environment quality – building water and waste management - Green building implementation and assessment (IGBC and LEED standards) of residential building, Industrial building and commercial building – Planning - Site protection- health and safety- waste management - reducing the footprint of construction operations - maximizing the value of building commissioning in HVAC System, lighting and non mechanical Systems - Evaluation of existing buildings and recommendations for improvement- Managing initial costs- cost barrier in project management- long-term environmental benefits.

References

1. Jerry Yudelson, “Green building A to Z, Understanding the Language of Green Building”, New Society Publishers, Canada, 2007.
2. Jerry Yudelson, “Green Building through Integrated Design”, McGraw Hill, USA, 2009
3. Means, R.S., “Green Building: Project Planning and Cost Estimating”, Wiley, Kingston, 2006.

4. Charles J. Kibert, “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, Wiley, New Jersey, 2007.
5. Green building guidelines: Meeting the Demand for Low-energy, Resource-Efficient homes. Sustainable Buildings Industry Council, Washington, D.C., 2004.

14CE201 PREFABRICATED STRUCTURES

Credits: 3: 0: 0

Course Objective:

- To study the design of Prefabricated structural components and its joints
- To study the design of prefabricated structures subjected to dynamic forces

Course Outcome:

At the end of this course the student shall be able to appreciate modular construction, industrialized construction and shall be able to design some of the prefabricated elements and also have the knowledge of the construction methods using these elements.

Description:

Unit I Introduction

Need for prefabrication – Principles – Materials – Modular coordination – Standardization Systems – Production – Transportation – Erection

Unit II Prefabricated Components

Behaviour of structural components – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Unit III Design Principles

Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.

Unit IV Joint in Structural Members

Joints for different structural connections – Dimensions and detailing – Design of expansion joints

Unit V Design for Abnormal Loads

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, explosions, fire - Importance of avoidance of progressive collapse.

Text books

1. John D. Quale., “Sustainable, Affordable, Prefab: The EcoMOD Project”, University of Virginia Press, 2012
2. Koncz T., “Manual of precast concrete construction”, Vols. I, II and III, Bauverlag, GMBH, 1971.

Reference Books:

1. Gerostiza C.Z., Hendrikson C. and Rehat D.R., “Knowledge based process planning for construction and manufacturing”, Academic Press Inc., 2012
2. Kim S Elliott, Colin Jolly., “Multi-Storey Precast Concrete Framed structures” Wiley, 2013
3. Colin Davies., “The Prefabricated Home” Reaktion Books, 2005

14CE202 – PRESTRESSED CONCRETE STRUCTURES

Credits: 3:1:0

Course Objective

- To understand the performance of prestressed concrete structures
- To impart knowledge on design of prestressed concrete

Course Outcome

At the end of the course students will be able to

- design prestressed concrete structural members

Description:**Unit I Introduction – Theory and Behaviour**

Basic concepts – Advantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections - Losses of prestress – Estimation of crack width

Unit II Design for Flexure and Shear

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per IS1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on IS 1343 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on IS 1343 Code.

Unit III Deflection and Design of Anchorage Zone

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

Unit IV Composite Beams and Continuous Beams

Analysis and design of composite beams – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

Unit V Miscellaneous Structures

Design of tension and compression members – Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing - merits and demerits of partial prestressing

Text Books

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2008
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2008.

Reference Books

1. Rajagopal, N., "Prestressed Concrete", 2nd Edn., Narosa Publications, New Delhi, 2007.
2. Lin, T. Y., "Design of Prestressed Concrete Structures", Asia Publishing House, Bombay, 1995.
3. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013
4. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
5. IS 1343-2012, "Prestressed Concrete - Code of Practice", Bureau of Indian Standards, New Delhi.

14CE203 GIS APPLICATIONS IN CIVIL ENGINEERING

Credits: 4:0:0

Course Objective:

- To introduce the concepts of GIS, Spatial Analysis DEM and DTM
- To impart knowledge on application of GIS for land information system, Civil, water resources management, environmental analysis, Network analysis and urban sprawl analysis

Course Outcome:

At the end of the course, students will be able to

- Students enabled to apply GIS concepts in various aspects of Civil Engineering

Description:

Unit I Introduction: Definition – Map and map analysis, - Coordinate concepts - History and development of GIS – GIS components- - Standard packages.

Unit II Data Entry, Storage and Maintenance:

Type of data - Spatial and non spatial data - Data structure - Points, lines, polygon - Vector and raster - Files, file organization – Database - Digitiser, scanner - Dbase files and data formats – Data compression.

Unit III Data Analysis and Modelling: Spatial Analysis - Data retrieval - Query, simple analysis - Recode, overlay - Vector data analysis, raster data analysis - Modelling in GIS - Digital Elevation Model – DTM - Artificial intelligence.

Unit IV Data Output and Analysis: Types of output data - Display on screen, printer and other output devices - Sources of errors - Types of errors - Elimination, accuracies

Unit V GIS Applications: Application - Civil engineering – transportation engineering - Environmental analysis - Network analysis - Remote sensing applications – software – ArcGIS, QGIS - introduction.

Text Books:

1. Thomas M. Lillisand, “Remote Sensing and Image Interpretation”, Wiley India (p) Ltd., 2007.
2. Peter, A. Burrough, “Principle of Geographical Information System” ,Oxford University Press, 2000

Reference Books:

1. Ian Heywood, “An introduction to Geographical Information systems”, Pearson Education Limited, 2003.
2. M.Anji Reddy, “Textbook of Remote Sensing and Geographical Information Systems”, BS Publications, 2001.

14CE204 GIS LAB

Credit 0:0:1

Course Objective:

- To introduce the application of GIS

Course Outcome:

At the end of the course students will be able to

- apply GIS in various fields of engineering

Experiments

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of the semester.

Reference Books:

1. GIS lab manual

14CE205 PROGRAMMING USING MATLAB

Credit 0:0:1

Course Objective:

- To introduce the application of Matlab

Course Outcome:

At the end of the course the students will be able to

- analyse and design RCC and steel structures by using Matlab

Experiments

The faculty conducting the Laboratory will prepare a list of 6 experiments and get the approval of HoD and notify it at the beginning of the semester.

References Books:

1. Matlab manual