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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **17ME3033** | **Duration** | **3hrs** |
| **Course Title** | **DESIGN AND ANALYSIS OF HEAT EXCHANGERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Classify the types of fins used in heat exchangers. | CO1 | An | 15 |
|  | b. | Explain ‘fin efficiency’ and various factors on which it depends. | CO1 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Illustrate LMTD method of analysis for heat exchanger. Derive the form for parallel flow heat exchanger. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Analyze the equations used to calculate the pressure drop on shell side and tube side in heat exchangers. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain different types of compact heat exchangers. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | A shell and tube type condenser is to be designed for a coal fired power station of 200 MWe. Steam enters the turbine at 5 MPa and 400 °C (hi=3195.7 kJ/kg). The condenser pressure is 10kPa. The thermodynamic efficiency of the turbine is 0.85. The actual enthalpy of the steam entering the condenser at 0.1 bar is calculated to be 2268.4 kJ/kg with 80% quality. The condenser is to be designed without subcooling. A single tube pass is used and the cooling water velocity is assumed to be 2 m/s. Cooling water is available at 20 °C and exits the condenser at 30 °C. Allowable total pressure drop on tube side is 35 kPa. The tube wall thermal conductivity is 111 W/mK. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Classify the types of heat exchangers used in a conventional plant. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Illustrate heat transfer and pressure drop characteristics of different types of compact heat exchangers. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Air flowing at a rate of 5 kg/s is to be heated in a shell and tube heat exchanger from 20 °C to 50 °C with hot water entering at 90 °C and exiting at 60 °C. The overall heat transfer coefficient is 400 W/m2K. The length of the heat exchanger is 2 m. Estimate the surface area of the heat exchanger and the number of tubes required by using   1. 1 to 2 shell-and-tube type heat exchanger. 2. 2 to 4 shell-and-tube type heat exchanger. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Write short notes on:   1. Steam turbine exhaust condensers 2. Shell and tube condensers 3. Water cooling evaporators 4. air cooled evaporators. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the constructional aspects of various types of heat exchangers |
| CO2 | Predict the effectiveness of heat exchangers NTU method |
| CO3 | Calculate the design parameters of shell-and-tube heat exchanger |
| CO4 | analyze compact heat exchanger |
| CO5 | Evaluate the performance of condensers. |
| CO6 | Formulate concepts of single and multi-effect evaporators |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **18ME2060** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL SAFETY ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate any two products which are manufactured using product layout. | | CO1 | U | 1 |
| 2. | Define “occupational health”. | | CO1 | R | 1 |
| 3. | Indicate the purpose of Lockout/Tagout (LOTO). | | CO2 | U | 1 |
| 4. | State the purpose of applying Zero Mechanical State (ZMS) during machine maintenance. | | CO2 | R | 1 |
| 5. | Give examples for ionizing radiation. | | CO3 | R | 1 |
| 6. | Define industrial hygiene. | | CO3 | R | 1 |
| 7. | Describe Threshold Limit Value (TLV). | | CO4 | U | 1 |
| 8. | State the routes of chemical entry into the human body. | | CO4 | R | 1 |
| 9. | List two examples of ergonomic hazards. | | CO5 | R | 1 |
| 10. | Indicate the negative effects of glare on humans. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the role of periodic safety audits in an industrial setting. | | CO1 | U | 3 |
| 12. | Distinguish between lockout and tagout. | | CO2 | U | 3 |
| 13. | Describe the health impacts of noise pollution in industrial settings. | | CO3 | U | 3 |
| 14. | Identify the factors influencing the effects of toxic substances on the human body. | | CO4 | U | 3 |
| 15. | Classify the factors that influence the selection of material handling equipment. | | CO5 | U | 3 |
| 16. | Explain the health problems caused by improper lighting. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Illustrate any two types of plant layout with advantages and disadvantages. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain any two types of safety guards used in industry and how it ensures industrial safety. | CO2 | An | 6 |
|  | b. | Summarize the various types of safety control devices used in industries. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the effects of humidity in industrial environments. | CO3 | An | 6 |
|  | b. | Explain the causes of biological hazards in the workplace. Also, discuss their effects and preventive measures. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the major routes through which toxic substances enter the human body. | CO4 | A | 6 |
|  | b. | Illustrate the process of industrial hygiene survey and its role in worker safety. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Write the importance of selecting proper handling equipment in industries. | CO5 | A | 6 |
|  | b. | Illustrate the role of OSHA in ensuring workplace safety, including its key responsibilities. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the safety precautions employed in industries to prevent electrical accidents. | CO3 | A | 6 |
|  | b. | Evaluate the role of Material Safety Data Sheets (MSDS) in workplace safety. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the protective equipment used for eye, face and body protection. | CO1 | A | 6 |
|  | b. | Summarize the types of hazards present in an industrial environment. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the role of industrial lighting in enhancing safety and productivity. | CO6 | A | 6 |
|  | b. | Explain the various worker facilities that enhance industrial safety. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understanding the importance of safety in process industries. |
| **CO2** | Understanding the ethical issues that may arise from industrial processes. |
| **CO3** | Communicate the difference between Hazard and Risk. |
| **CO4** | Be able to express Safety in terms of Risk and to recognize unacceptable/inappropriate levels of Risk. |
| **CO5** | Be able to Assess & identify the potential hazards in process industries. |
| **CO6** | Appreciation and applying safety procedures in a process industry. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20ME2009** | **Duration** | **3hrs** |
| **Course Title** | **INTELLIGENT ROBOTIC SYSTEM** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the role of an embedded system in robotics. | | CO1 | U | 1 |
| 2. | Name the type of robot designed to resemble a human. | | CO1 | R | 1 |
| 3. | Define SHAKEY. | | CO2 | R | 1 |
| 4. | Drives are also known as \_\_\_\_\_\_\_\_\_\_\_ | | CO2 | R | 1 |
| 5. | Cite the equation used to find the optimal policy in a Markov Decision Process (MDP). | | CO3 | U | 1 |
| 6. | List the methods commonly used to solve an MDP. | | CO3 | R | 1 |
| 7. | Hybrid Architectures combine elements of \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | In Subsumption Architecture, behaviors are organized into \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | Cite the use of Newton-Euler Algorithm. | | CO5 | U | 1 |
| 10. | List the primary functions of an actuator in a robot. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define Virtual Reality and mentions its three types. | | CO1 | R | 3 |
| 12. | Illustrate the uses and functions of STRIPS. | | CO2 | A | 3 |
| 13. | Cite the limitations of the Partially Observable Markov Decision Process. | | CO3 | U | 3 |
| 14. | Discuss Formalizing behavior-based control. | | CO4 | U | 3 |
| 15. | Classify the types of model learning approaches. | | CO5 | U | 3 |
| 16. | List the robot kinematics with suitable examples. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Illustrate with neat sketches about Agent-Task Model. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the feedback closed loop system for linear control and architecture of an industrial-robot controller. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the robot navigation system. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the subsumption architecture with suitable sketches. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the Reinforcement Learning process used in Robot Control. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate with neat sketches about embodied systems used in Robot Control. | CO1 | A | 6 |
|  | b. | Explain the use of virtual reality in robot control with neat sketches. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the Markov Decision Process (MDP). | CO3 | A | 8 |
|  | b. | Illustrate the features and importance of Partially Observable Markov Decision Process. | CO3 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the following  1. Vision sensors  2. Muscle wires  3. Power supply  4. Electric motors (AC/DC) | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Design, build and program simple autonomous robots |
| **CO2** | Implement standard signal processing and control algorithms |
| **CO3** | Describe and analyze robot processes using appropriate methods |
| **CO4** | Solve simple control problems by hand using appropriate methods |
| **CO5** | Write a detailed report on a robot project |
| **CO6** | Carry out and write up investigations using appropriate experimental methods |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20ME2010** | **Duration** | **3hrs** |
| **Course Title** | **KINEMATICS AND DYNAMICS OF MACHINERY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define inversion of a mechanism. | | CO1 | R | 1 |
| 2. | Distinguish binary link and ternary link. | | CO1 | U | 1 |
| 3. | Describe instantaneous center of rotation. | | CO2 | U | 1 |
| 4. | Illustrate velocity ratio in belt drive. | | CO3 | U | 1 |
| 5. | Define the term ‘addendum’ in gear terminology. | | CO4 | R | 1 |
| 6. | Describe reverted gear train. | | CO4 | U | 1 |
| 7. | State the need of a governor in an engine. | | CO5 | R | 1 |
| 8. | Define 'base circle' in cam terminology. | | CO5 | R | 1 |
| 9. | Discuss the primary condition for static balancing. | | CO6 | U | 1 |
| 10. | Differentiate forced vibration from free vibration. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Apply Gruebler’s equation to find the DOF of a five-bar mechanism. | | CO1 | A | 3 |
| 12. | Explain the method of locating an instantaneous center in a mechanism. | | CO2 | U | 3 |
| 13. | A belt has a maximum tension of 1200 N and centrifugal tension of 200 N. Calculate the condition for maximum power transmission. | | CO3 | A | 3 |
| 14. | Compare spur gear and helical gear. | | CO4 | U | 3 |
| 15. | Illustrate the influence of gyroscopic effect on an airplane during a right turn. | | CO5 | A | 3 |
| 16. | Compare free vibration, damped vibration, and forced vibration. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain with a diagram the inversions of any two four-bar mechanism. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | The crank of a slider crank mechanism rotates clockwise at a constant speed of  300 rpm. The crank is 150 mm and the connecting rod is 600 mm long.  Evaluate: (i) linear velocity at mid-point of connecting rod and (ii) angular  velocity of connecting rod, at crank angle of 45º from the inner dead centre  position. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | A 100 mm wide and 10 mm thick belt transmits 5 kW power between two parallel shafts. The distance between the shaft centres is 1.5 m and the diameter of the smaller pulley is 440 mm. the driving and driven shafts rotate at 60 rpm and 150 rpm respectively. The coefficient of friction is 0.22. Determine the stress in the belt, if the two pulleys are connected by open belt drive. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Two involute gears in mesh have 20º pressure angle. The number of teeth on the pinion and gear are 24 and 72 teeth respectively. The teeth have a module of 6 mm. The addendum is equal to one module. Compute the angle turned by the pinion when one pair of teeth is in the mesh. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Each arm of a Porter governor is 200 mm long and are pivoted on the axis of the governor. The radii of rotation of the balls at minimum and maximum speeds are 100 mm and 130 mm respectively. The mass of each ball is 4 kg and the mass of the sleeve is 24 kg. Evaluate the range of speed of the governor, if the friction at the sleeve is 15 N. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | An epicyclic gear consists of three gears A, B and C as shown in figure. The gear A has 100 internal teeth and gear C has 50 external teeth. The gear B has 25 external teeth. The gear B meshes with both A and C and is carried on an arm EF which rotates about the centre of A at 20 r.p.m. If the gear A is fixed, estimate the speed of gears B and C. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | A ship is propelled by a turbine rotor which has a mass of 5000 kg and a speed  of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Determine the gyroscopic couple and its effects in the following conditions:  (i) The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.  (ii) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Four masses A, B, C and D are to be completely balanced. The planes containing masses B and C are 250 mm apart. Masses C and D make angles of 90° and 195° respectively with that of mass B in the counter-clockwise direction. The rotating masses have the following properties:mb = 25 kg; mc = 40 kg; md = 35 kg; ra = 150 mm; rb = 200 mm; rc = 100 mm; rd = 180 mm. Estimate the magnitude of mass A and its angular position with that of mass B. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic concepts of Mechanisms, Machines and their relative motions, then apply it to appropriate environments. |
| **CO2** | Carry out kinematic analysis (Displacement, Velocity and Acceleration) of simple mechanisms (Single slider Crank Mechanism and four bar Mechanisms) by graphical and analytical method. |
| **CO3** | Construct & Design different CAM profiles for given conditions using graphical & Theoretical methods. |
| **CO4** | Apply the concept of balancing and use it for reducing the unbalanced forces in rotating masses and reciprocating engines under operating conditions exposure to IS standards. |
| **CO5** | Acquire knowledge on types of vibrations in different systems and damping methods to minimize vibrations. |
| **CO6** | Understand, apply and analyze the control mechanisms in Governors and Gyroscopes. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20ME2012** | **Duration** | **3hrs** |
| **Course Title** | **INTERNET OF THINGS FOR MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term IoT. | | CO1 | R | 1 |
| 2. | List any two components of an IoT system. | | CO1 | R | 1 |
| 3. | Recall any two benefits of Smart Factories. | | CO2 | R | 1 |
| 4. | State the role of sensors in Industrial IoT. | | CO2 | R | 1 |
| 5. | Outline the applications of IOT in Manufacturing Process. | | CO3 | U | 1 |
| 6. | State the ‘Business Model’ for Industry 4.0 | | CO3 | R | 1 |
| 7. | Mention any one application of Virtual Reality. | | CO4 | R | 1 |
| 8. | Classify the various phases of ‘Industrial Revolution History’. | | CO4 | R | 1 |
| 9. | List any two goals of material handling. | | CO5 | U | 1 |
| 10. | Cite few risks involved in autonomy | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List two functions of the gateway in IoT. | | CO1 | An | 3 |
| 12. | Compare and contrast structured and unstructured data. | | CO2 | U | 3 |
| 13. | Compare ‘Smart Manufacturing’ with ‘Smart Design’. | | CO3 | An | 3 |
| 14. | Infer cyber physical systems with respect to IOT. | | CO4 | U | 3 |
| 15. | Compare ‘weak AI’ with ‘strong AI’. | | CO5 | An | 3 |
| 16. | Cite the method in which IoT enhances predictive maintenance in mechanical applications. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the essentials of IoT for modern engineers with relevant examples. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Discuss the significance of smart and digital factories. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | Analyze design implications for smart manufacturing of products. | CO3 | An | 6 |
|  | b. | Appraise the ‘Maturity Scale’ for products which are smart manufactured. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain few trade policies for IOT in India. | CO4 | An | 6 |
|  | b. | Summarize the key approaches for successful implementation of smart manufacturing. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. |  | Analyze the major challenges faced in implementing IoT solutions for mechanical systems. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the use of augmented reality and virtual reality in IoT applications. | CO2 | A | 6 |
|  | b. | Explain the methods in which IoT enables smart decision-making in industrial automation. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the impact of IoT in the optimization of resource utilization. | CO4 | An | 6 |
|  | b. | Explain how IoT contributes to waste reduction in manufacturing. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate on the key drivers of AI in Automotive sector. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Interpret the Essentials of IoT for Modern Engineers. |
| **CO2** | Examine the importance of Smart and Digital Factories. |
| **CO3** | Make use of IoT in Manufacturing Process and Applications. |
| **CO4** | Model IoT for Cyber-Physical Systems, Virtual Reality and Data Analytics. |
| **CO5** | Interpret the IoT Challenges in Mechanical Systems. |
| **CO6** | Apply IoT concepts in various applications. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **20ME2017** | **Duration** | **3hrs** |
| **Course Title** | **AUTOMOTIVE MATERIALS AND ELECTRONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the property that measures a material’s resistance to deformation under load. | | CO1 | R | 1 |
| 2. | State environmental factors influencing material selection in automotive design. | | CO1 | U | 1 |
| 3. | Define the term "material index" in material selection. | | CO2 | R | 1 |
| 4. | Identify common software applications for computer-aided material selection in engineering. | | CO2 | U | 1 |
| 5. | List two critical properties required for materials used in connecting rods. | | CO3 | R | 1 |
| 6. | Give an example of a material used for gearbox components | | CO3 | U | 1 |
| 7. | Identify the primary function of a spark plug in an ignition system. | | CO4 | U | 1 |
| 8. | Give an example of a sensor used in electronic ignition systems. | | CO4 | U | 1 |
| 9. | Explain the purpose of vehicle condition monitoring systems. | | CO5 | U | 1 |
| 10. | List two components controlled by a combined ignition and fuel management system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the role of material selection charts in optimizing design for a given engine components. | | CO1 | An | 3 |
| 12. | Evaluate the trade-offs between material performance and environmental sustainability in material selection. | | CO2 | E | 3 |
| 13. | Compare the material requirements for pistons and piston rings in terms of thermal and mechanical properties. | | CO3 | An | 3 |
| 14. | Compare electronic ignition systems with conventional contact-point ignition systems in terms of efficiency and reliability. | | CO4 | An | 3 |
| 15. | Interpret the mechanism of gear shifts in automatic transmissions. | | CO5 | A | 3 |
| 16. | Compare traditional engine control systems with AI-based management systems. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze the evolution of engineering materials and its impact on the automotive industry. | CO1 | An | 6 |
|  | b. | Evaluate the impact of regulations and environmental concerns influence the material selection for automotive and marine applications. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the role of shape and manufacturing processes in selecting materials for lightweight automotive body panels. | CO2 | A | 6 |
|  | b. | Evaluate the trade-offs between material cost, availability, and performance for designing an energy-efficient automotive exhaust system. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 19. |  | Summarize the material selection process for a piston and crankshaft to enhance performance and longevity of an automobile. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the significance of multiplexed wiring systems in of automotive electrical networks with suitable examples. | CO4 | An | 6 |
|  | b. | Examine the working principle of petrol fuel injection system with neat sketches. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe electronic power steering and its role in improving vehicle handling. | CO5 | A | 6 |
|  | b. | Justify the importance of vehicle condition monitoring systems in modern automobiles. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the role of engine fueling in reducing exhaust emissions. | CO4 | E | 6 |
|  | b. | Examine the role of thermal expansion and fatigue resistance in selecting materials for engine blocks. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the material selection process for the body and chassis considering reduction in weight with increased durability. | CO1 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Appraise the role of combined ignition and fuel management system in a modern vehicle using a practical example. | CO6 | An | 6 |
|  | b. | Articulate the effectiveness of airbags and seat belt tensioners in minimizing injuries during high-speed collisions. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Familiar with different materials used for automotive component manufacturing |
| **CO2** | Select proper material for Automobile applications. |
| **CO3** | Choose a suitable material for selected part of the engine components |
| **CO4** | Know the working of electronic starting and ignition systems. |
| **CO5** | Use the instrumentations and electronic controls |
| **CO6** | Understand the engine managements system, lighting and security systems. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **21ME2008** | **Duration** | **3hrs** |
| **Course Title** | **BIOMECHANICS AND BIOMATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Discuss three types of motions with relevant sketches, that occurs between the two articulating surfaces of joint in about 50 words. | | CO1 | U | 1 |
| 2. | Express two reasons to study biomechanics in about 50 words. | | CO1 | U | 1 |
| 3. | Label the parts of the Elbow joint with a sketch. | | CO2 | R | 1 |
| 4. | State three Newton’s law of motion. | | CO2 | R | 1 |
| 5. | A cyclist is traveling at an average speed of 12 m/s., determine how far will he traveled after 15 minutes of time? | | CO3 | U | 1 |
| 6. | Sketch the free body diagram for the kind of forces acting for the shown figure. A.1.    **Figure. A.1** | | CO3 | A | 1 |
| 7. | Define the biomaterials according to Clemson University advisory Board for Biomaterials. | | CO4 | R | 1 |
| 8. | Discuss Host response with respect to the foreign material in the human body. | | CO4 | U | 1 |
| 9. | Illustrate the surface modification in about 50 words. | | CO5 | U | 1 |
| 10. | Explain the Biomedical Sensor. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Classify Applied Mechanics. | | CO1 | U | 3 |
| 12. | Explain the commonly used supports, connections, and connecting elements, and some of their characteristics. | | CO2 | A | 3 |
| 13. | Explain the general method for solving kinetic problems in biomechanics. | | CO3 | A | 3 |
| 14. | Illustrate the evolution of biomaterial in science and technology. | | CO4 | An | 3 |
| 15. | Interpret the importance of Nano bio materials. | | CO5 | A | 3 |
| 16. | Discus three orthopaedic implant biomaterials in about 150 words. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Consider a 15 kg block being pushed up the rough incline by a constant force of P = 160 N applied parallel to the horizontal. The incline makes an angle θ = 25° with the horizontal and the coefficient of friction between the block and the incline is μ = 0.35. If the block is moved up the incline by l.9 m, determine the work done on the block by,  (a) The externally applied force WP  (b) The force of gravity Wg  (c) The frictional force Wf  Also, determine the net work done W on the block. | CO1 | A | 8 |
| b. | Determine the reactions at A and B for the beams loaded as shown in figure.C.1.    Figure. C.1. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain the coordinate planes and direction terminologies with relevant sketches of a human body in standing position. | CO2 | A | 6 |
| b. | How much force must be produced by the brachioradialis and biceps (Fm) to maintain the 15 N forearm and hand in the position shown in below figure.C.2, given moment arms of 5 cm for the muscles and 15 cm for the forearm/hand weight? What is the magnitude of the joint reaction force? (Note: - Assume the appropriate notations as shown in figure below)    Figure. C.2. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | As shown in figure.C.3, consider a 9 kg object initially rested at position (1), which is measured at distance h above the ground. The object falls with a constant gravitational acceleration of g = 9.8 m/s2 and after t2 = 2.5 s hits the ground at position (2). If the air resistance is negligible, determine:   1. The speed V2 of the object at position (2). 2. The vertical distance h between positions (1) and (2). 3. The potential energy EP1 of the object at position (1). 4. The kinetic energy EK2 of the object at position (2).     Figure. C.3. | CO3 | A | 8 |
| b. | Discuss the normal hip joint with sketch of its cross-sectional view in about 200 words. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Explain the impact of biomaterials in about 300 words. | CO4 | A | 6 |
| b. | Illustrate the few of construction materials with their merits and demerits. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Discuss the following with relevance to human body in about 50 words each: TCP, PTFE, PLA, PLGA, PMMA & PET. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Classify various metallic biomaterials with their merits and demerits. | CO5 | An | 6 |
| b. | Discuss different ceramic biomaterials with their pros and cons. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the paradigm design of Implants with block diagram. | CO6 | A | 6 |
| b. | Describe the relevance of Bioelectrodes in biomedical instrumentation in about 200 words each. | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain three polymer-based biomaterials in about100 words each. | CO6 | A | 6 |
| b. | Interpret three biomedical sensors in about 100 words each. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
| **COURSE OUTCOMES** | |
|  | The student will be able to |
| **CO1** | Understand the applicability of statics to biomechanics. |
| **CO2** | Apply the principles of kinematics dynamics to biomechanics. |
| **CO3** | Apprehend the mechanical properties of biological tissues. |
| **CO4** | Know different types of biomaterials available in the market. |
| **CO5** | Choose appropriate biocompatible materials for medical use. |
| **CO6** | Recognize the practical aspects of biomaterials for various implants |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **21ME2012** | **Duration** | **3hrs** |
| **Course Title** | **MEMS AND MICRO SYSTEM FABRICATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Cite any two common applications of microsystems. | | CO1 | U | 1 |
| 2. | List the primary energy domains in microsystems. | | CO1 | R | 1 |
| 3. | Name the common types of micro actuators. | | CO2 | R | 1 |
| 4. | Summarize the advantages of MEMS sensors. | | CO2 | U | 1 |
| 5. | Indicate the importance of GaAs in microsystems. | | CO3 | U | 1 |
| 6. | **Identify two common silicon compounds used in MEMS.** | | CO3 | R | 1 |
| 7. | **Name the two types of photolithography processes.** | | CO4 | R | 1 |
| 8. | **Define ion implantation.** | | CO4 | R | 1 |
| 9. | **Cite the common etching techniques used in bulk micromachining.** | | CO5 | U | 1 |
| 10. | **Interpret the use of LIDAR radar microsystem in automobiles.** | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the multidisciplinary nature of microsystems. | | CO1 | U | 3 |
| 12. | Explain the role and importance of micro actuators in MEMS applications | | CO2 | An | 3 |
| 13. | **Discuss the advantages of silicon compounds in microsystems.** | | CO3 | U | 3 |
| 14. | **Illustrate the steps involved in photolithography.** | | CO4 | A | 3 |
| 15. | **Differentiate surface micromachining from bulk micromachining.** | | CO5 | U | 3 |
| 16. | **Summarize the importance of MEMS-based inertial sensors in aviation.** | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Sketch the key components of MEMS. Discuss in detail the different energy domains in microsystems that interact with the miniaturized devices governed by the fundamental principles to capture and convert one form of energy into another. | CO1 | A | 6 |
|  | b. | Explain in detail the different types of MEMS materials that ensure durability and reliability of the tiny structures under various stresses and operating conditions. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Define Micro optics in MEMS. Discuss its types, fabrication methods and applications in MEMS technology. | CO2 | A | 6 |
|  | b. | Apply the principles of micro actuator, construction and design to explain its working in MEMS applications with relevant diagrams. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Examine the factors that make single crystal silicon the most widely used substrate material for MEMS and microsystems and explain its significance. | CO3 | A | 6 |
|  | b. | Analyze the diverse roles of polymers in MEMS and microsystems by explaining their applications in different fabrication methods. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the principle of oxidation and the oxidation process with a neat diagram. | CO4 | A | 6 |
|  | b. | Explain the process of photoresist formation in photolithography and illustrate it with a neat diagram. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the steps involved in MEMS fabrication using bulk micromachining, focusing on the photolithography process. | CO5 | U | 6 |
|  | b. | Discuss the steps involved in MEMS fabrication using the LIGA technique. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain the process of MEMS fabrication using surface micromachining, highlighting the roles of chemical vapor deposition and sputtering. Discuss the advantages of MEMS technology. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Examine the significance of MEMS technology in aerospace applications that evaluates its impact on aviation and space systems. | CO6 | A | 6 |
|  | b. | Apply MEMS technology in aeronautical engineering by illustrating its key applications and analyzing its impact on system performance and efficiency. | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the application of MEMS technology in defence systems with relevant examples that highlight its functionality and benefits. | CO6 | A | 6 |
|  | b. | Explain the role of MEMS technology in marine applications that assess its impact on naval and underwater systems. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Illustrate the concepts of MEMS and Microsystems. |
| **CO2** | Identify various sensors and actuators in MEMS. |
| **CO3** | Select suitable material for MEMS and Microsystems. |
| **CO4** | Demonstrate the principles and applications of micro-fabrication processes. |
| **CO5** | Interpret the various micro-manufacturing processes used in MEMS industries. |
| **CO6** | Develop MEMS and Microsystems for industrial applications. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **21ME3017** | **Duration** | **3hrs** |
| **Course Title** | **DIGITAL MANUFACTURING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Analyze the future trends and advancements in digital manufacturing technologies with product lifecycle management strategies. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 2. |  | Explain the architecture of Digital Manufacturing System with neat sketch. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. |  | Explain the principles and techniques of reverse engineering in digital manufacturing with neat sketch. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. |  | Explain the impact of intelligent manufacturing systems on productivity, flexibility, and sustainability with neat sketch. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the functionalities of Networked Control System, Virtual NC Technology, and Embedded Control Technology through schematic diagrams. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Explain the principles of topology optimization and its significance in enhancing product design performance. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Discuss the Laminated Object Manufacturing (LOM) technology involved in direct digital manufacturing with neat sketch. | CO6 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Illuminate the fused deposition modeling technologies involved in direct digital manufacturing with neat sketch. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Learn the Design processes and methods in product development. |
| CO2 | Get a basic knowledge on the importance of digital manufacturing. |
| CO3 | Understand the digital transformation in manufacturing. |
| CO4 | Implement decision knowledge in manufacturing. |
| CO5 | Integrate the digital technologies in product life cycle. |
| CO6 | Know the additive manufacturing technologies used in digital manufacturing. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **22ME2001** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL APPLICATIONS OF AI TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the organization that recognized the beginning of the Industry 4.0 revolution. | | CO1 | R | 1 |
| 2. | Classify the different phases of the Industrial Revolution. | | CO1 | A | 1 |
| 3. | Infer the role of "Classification" as a learning technique. | | CO2 | R | 1 |
| 4. | State two real-world applications of Object Detection. | | CO2 | R | 1 |
| 5. | Define the concept of Thresholding in image processing. | | CO3 | R | 1 |
| 6. | Infer the function of the region-growing technique in image segmentation. | | CO3 | U | 1 |
| 7. | Mention two practical applications of a Vectorizer in data processing. | | CO4 | R | 1 |
| 8. | Recall the contribution of the ‘Markov Model’ to machine learning. | | CO4 | A | 1 |
| 9. | State an approach for implementing AI in spam mail filtering techniques. | | CO5 | R | 1 |
| 10. | Differentiate ‘weak AI’ from ‘strong AI’ based on their characteristics. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Cite the mitigation technique to reduce the risks associated with the autonomy of mechanical systems | | CO1 | R | 3 |
| 12. | Cite the ways in which three key principles of 3D vision software contribute to its functionality | | CO2 | U | 3 |
| 13. | Articulate the advantages of machine vision over traditional inspection methods. | | CO3 | R | 3 |
| 14. | Identify the role of Histogram of Oriented Gradients (HOG) in feature extraction. | | CO4 | R | 3 |
| 15. | Assess the impact of major challenges in natural language processing on AI applications. | | CO5 | An | 3 |
| 16. | Design an approach for implementing anomaly detection using an AVI system. | | CO6 | AN | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Demonstrate the implementation of the concept of "smartization" based on the principles of Industry 4.0. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Compare ‘supervised learning’ with ‘unsupervised learning’. Identify suitable industrial applications for each within Industry 4.0. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | Demonstrate POS tagging with a relevant example. | CO3 | An | 6 |
|  | b. | Examine the phases involved in image processing. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | Justify the significance of lighting in achieving successful machine vision results. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Assess the interaction between the agent, environment, and reward system and its influence on the learning process in reinforcement learning. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Develop a structured approach to implement the seven key NLP techniques for speech recognition. | CO2 | A | 6 |
|  | b. | Compare and contrast two Object Detection with Recognition techniques used for data processing. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the different phases of analysis in Natural Language Processing for mechanical system applications. | CO4 | An | 12 |
|  | | | | | |
| 24. | a. | Describe two Anomaly Detection techniques commonly used in industrial applications. | CO6 | E | 4 |
|  | b. | Distinguish between Augmented Reality and Virtual Reality, highlighting their unique features and applications. | CO6 | An | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand AI Techniques in Mechanical Systems. |
| **CO2** | Classify Machine Learning Techniques. |
| **CO3** | Apply various computer Vision Techniques. |
| **CO4** | Compare Natural Language Processing Techniques. |
| **CO5** | Analyze the Reinforcement Learning Techniques. |
| **CO6** | Understand AI Techniques in Mechanical Systems. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23ME1003** | **Duration** | **3hrs** |
| **Course Title** | **INNOVATION AND CREATIVITY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Express the process that generating unique and useful ideas. | | CO1 | U | 1 |
| 2. | Name one common barrier to creativity in organizations. | | CO1 | R | 1 |
| 3. | Define Empathizing. | | CO2 | R | 1 |
| 4. | Describe one example of technological innovation. | | CO2 | R | 1 |
| 5. | Define creative problem solving. | | CO3 | R | 1 |
| 6. | Describe mind mapping. | | CO3 | U | 1 |
| 7. | List two metrics used to measure the success of open innovation. | | CO4 | R | 1 |
| 8. | Name any two successful women entrepreneurs in India. | | CO4 | R | 1 |
| 9. | Describe the primary goal of social entrepreneurs compared to traditional entrepreneurs. | | CO5 | U | 1 |
| 10. | Indicate the importance of a business plan. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the ways in which individuals can enhance their creativity. | | CO1 | U | 3 |
| 12. | Describe the importance of innovation in entrepreneurship. | | CO2 | U | 3 |
| 13. | Indicate the barriers to innovation and creativity. | | CO3 | U | 3 |
| 14. | Differentiate between a patent and a trade secret. | | CO4 | An | 3 |
| 15. | Explain the importance of Intellectual Property Rights (IPR). | | CO5 | A | 3 |
| 16. | Describe the role of a social entrepreneur and explain how they contribute to solving social and environmental challenges. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Discuss the various steps in the problem-solving process in detail. Also, list and explain the barriers to innovation and creativity with suitable examples | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Compare the key differences between the traditional problem-solving approach and the design thinking process. | CO2 | An | 8 |
|  | b. | Explain the advantages of open innovation. | CO2 | A | 4 |
|  |  |  |  |  |  |
| 19. |  | Discuss the various tools used for fostering creativity in the creative process. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the different ways of improving empathy. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the evolution and growth of entrepreneurship in India, focusing on the key factors that have shaped its development and the role of government initiatives in promoting entrepreneurship. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the emerging trends in entrepreneurship development, focusing on the impact of technology, innovation, and social entrepreneurship on business models and growth. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss a few success and failure stories of women entrepreneurs in India. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate how emerging technologies like AI, blockchain, or IoT can be integrated into a startup to improve operations, customer engagement, and scalability. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Design innovative systems with enhanced performance. |
| **CO2** | Devise innovative techniques for optimizing the system's performance. |
| **CO3** | Develop new products for industrial applications. |
| **CO4** | Collaborate with external partners and stakeholders to develop new products. |
| **CO5** | Design new processes and methodologies to improve system performance. |
| **CO6** | Evolve creative technology for innovative entrepreneurial ventures |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23ME1005** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO MECHANICAL SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define an ‘isolated system’ | | CO1 | R | 1 |
| 2. | A body is said to be in equilibrium, the resultant of the force system act on it is \_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Specify one key difference between a heat pump and a refrigerator. | | CO2 | U | 1 |
| 4. | A heat engine operates between two reservoirs one at 600 K and the other at 300 K. The maximum efficiency of the heat engine is \_\_\_\_\_\_\_\_\_\_\_. | | CO2 | A | 1 |
| 5. | Property that represents the internal resistance of a fluid to its motion is\_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 6. | Brass is an alloy of **\_\_\_\_\_\_\_\_\_\_\_**. | | CO4 | A | 1 |
| 7. | The ability of a material to undergo plastic deformation without breaking is called \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 8. | Thermal conductivity of solid metals \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with rise in temperature | | CO5 | U | 1 |
| 9. | Ability of a material to conduct heat is termed as \_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 10. | Solar cell is used to convert solar energy into \_\_\_\_\_\_\_\_\_\_\_ energy. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain how the principles of statics and dynamics are relevant in real-world engineering. | | CO1 | An | 3 |
| 12. | A system executes a cyclic process during which there are four transfers of heat Q12= 880 kJ, Q23= -100 kJ, Q34= -720 kJ, Q41= 200 kJ. The work transfers during the process are given as W12= 60 kJ , W23= -40 kJ ,W34= -80 kJ. Find the work done W41. | | CO2 | A | 3 |
| 13. | Draw a neat sketch of a venturi-meter. | | CO3 | U | 3 |
| 14. | Discuss the reasons behind the material choices of bicycle frame made of metal and polymer components. | | CO4 | An | 3 |
| 15. | Analyze the role of thermal conductivity in influencing heat transfer efficiency. | | CO5 | An | 3 |
| 16. | Discuss the working principle of wind turbine generator. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | If five forces act on a particle as shown in the given figure, determine the magnitude and direction of the resultant force. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7m/s velocity,100 kPa and 0.95 m3/kg volume and leaving at 5 m/s, 700 kPa and 0.19 m3/kg. The internal energy of the air leaving is 90 KJ/Kg greater than that of air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58kW (a) calculate the rate of shaft work input to the air in kW (b) find the ratio of the inlet pipe diameter to outlet pipe diameter. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm2 (gauge) and with mean velocity of 2.0 m/s. Calculate the total head or total energy per unit weight of the water at a cross section, which is 5m above the datum line. | CO3 | A | 6 |
|  | b. | A simple manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe. If the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Describe the different types of material properties and characteristics with examples. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | In winter, the outside temperature is -50C, and the inside temperature is 200C. A single-pane window of dimensions 1.5 m X 1m and a thickness of 5 mm separates the inside and outside. The thermal conductivity of the glass is 0.96 W/mK. Determine the rate of heat loss through the window. | CO5 | A | 6 |
|  | b. | A blackbody plate with an area of 0.1m2 is at a temperature of 8000C, while another blockbody plate with an area of 0.2 m 2 is at 5000C. Calculate the net radiative heat transfer from the hotter plate to the cooler plate. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Describe the working principle of heat exchangers with neat sketch and compare between shell-and-tube and finned-tube heat exchangers. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the working principle of Hydroelectric power plant with a neat sketch. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the working principle of Geo-thermal power plant with a neat sketch. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Draw free body diagram and analyze the systems under equilibrium |
| **CO2** | Design heat engine and refrigeration systems |
| **CO3** | Apply fluid mechanics principles in designing hydraulic pumps |
| **CO4** | Select appropriate materials required for mechanical systems |
| **CO5** | Design various types of heat exchangers specific to heat transfer applications. |
| **CO6** | Analyze the performance of renewable energy production systems. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23ME2011** | **Duration** | **3hrs** |
| **Course Title** | **STRENGTH OF MATERIALS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term ‘linear strain’. | | CO1 | R | 1 |
| 2. | Write the relation between Young’s modulus and Shear modulus. | | CO1 | A | 1 |
| 3. | Classify the different type of beams. | | CO2 | U | 1 |
| 4. | Write the different type of supports that act on a beam. | | CO2 | A | 1 |
| 5. | Define factor of safety. | | CO1 | R | 1 |
| 6. | Write the maximum bending moment for a simply supported beam carrying point load at its centre. | | CO3 | A | 1 |
| 7. | Define polar modulus. | | CO4 | R | 1 |
| 8. | Write the purpose of thin cylindrical shell. | | CO5 | A | 1 |
| 9. | Define strain energy. | | CO4 | R | 1 |
| 10. | Write the mode of failure of a long column. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch the stress strain curve for mild steel. | | CO1 | A | 3 |
| 12. | Differentiate between statically determinate beam and statically indeterminate beam. | | CO2 | U | 3 |
| 13. | State the assumptions made in the theory of torsion. | | CO4 | R | 3 |
| 14. | Differentiate between ductile and brittle materials. | | CO4 | U | 3 |
| 15. | Define principal stresses and principal planes. | | CO1 | R | 3 |
| 16. | A cylindrical pipe of diameter 1.5m and thickness 1.5cm is subjected to an internal fluid pressure of 1.2N/mm2. Determine circumferential stress developed in the pipe. | | CO5 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. Determine (i) The stress at elastic limit. (ii) Young’s modulus. (iii) Percentage elongation. (iv) Percentage reduction in area. (v) Ultimate tensile stress. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A steel cube block of 50mm side is subjected to a force of 6kN( Tension), 8kN( Compression) and 4kN( Tension) along x, y and z directions respectively. Determine the change in volume of the block. Young’s modulus = 200GPa and poisson’s ratio =0.3 | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A beam of 8m span simply supported at its end carries loads of 2kN and 5kN at a distance of 3m and 6m from right support respectively (a shown in Figure 1). In addition, the beam carries a UDL of 4kN/m for its entire length. Sketch the shear force and bending moment diagram. Also determine the maximum bending moment.    Figure1 | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the maximum bending stress induced in a cast iron pipe of external diameter 40mm, internal diameter 20mm and length 4m. The pipe is supported at its ends and carries a point load of 80N at its centre. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | A solid steel shaft has to transmit 75kW at 200rpm. Taking allowable shear stress as 70MN/m2, evaluate the shaft diameter, if the maximum torque transmitted on each revolution exceeds the mean by 30%. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | A tensile load of 60kN is applied suddenly to a circular bar of 4cm diameter and 5m long. Evaluate   1. Maximum instantaneous stress induced 2. Instantaneous elongation in the rod 3. Strain energy absorbed in the rod   Take Young’s modulus =2 x105N/mm2 | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Determine the change in diameter, change in length, change in volume of a thin cylindrical shell of 125 cm diameter, 1.2cm thick and 6m long when subjected to internal pressure of 2N/mm2. Take Young’s modulus =2 x105N/mm2 and poisson’s ratio as 0.3. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A steel rod 5 m long and of 40 mm diameter is used as a column. Evaluate the crippling load by Euler’s formula, when the given column is used with the following conditions.   1. Both the ends are hinged 2. One end is fixed and the other end is free 3. Both the ends are fixed 4. One end is fixed and the other end is hinged   Take Young’s modulus =2 x105N/mm2 | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze various types of stress and strains at different loading conditions. |
| **CO2** | Apply shear force and bending moment diagrams for different types of beams subjected to diverse loading conditions. |
| **CO3** | Evaluate bending stresses in beams with varying cross-sectional geometries. |
| **CO4** | Analyze shear stresses, angles of twist in shafts experiencing torsion, and the strain energy stored in elastic materials. |
| **CO5** | Predict deflection behavior of beams and determine stresses in cylindrical and spherical shells. |
| **CO6** | Apply pertinent theories and principles to proficiently assess and design columns and struts. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23ME2012** | **Duration** | **3hrs** |
| **Course Title** | **KINEMATICS AND DYNAMICS OF MACHINERY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define degrees of freedom of a mechanism. | | CO1 | R | 1 |
| 2. | Describe a ternary link. | | CO1 | U | 1 |
| 3. | State the direction of radial acceleration in a rotating link. | | CO2 | R | 1 |
| 4. | Name any two type of motions of the follower in cam mechanisms. | | CO3 | R | 1 |
| 5. | Define 'base circle' in cam terminology. | | CO4 | R | 1 |
| 6. | Describe ‘dedendum’ in gear terminology. | | CO4 | U | 1 |
| 7. | **Indicate the purpose of a bevel gear.** | | CO5 | U | 1 |
| 8. | **State the condition for complete balancing of a rotating system.** | | CO5 | R | 1 |
| 9. | **Define "effort" in a governor.** | | CO6 | R | 1 |
| 10. | **Describe the effect of a gyroscopic couple on an airplane making a left turn.** | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between lower pair and higher pair. | | CO1 | U | 3 |
| 12. | Describe Klein’s construction for slider-crank acceleration analysis. | | CO2 | U | 3 |
| 13. | **Differentiate between radial and cylindrical cam.** | | CO3 | U | 3 |
| 14. | **Differentiate between simple and compound gear trains.** | | CO4 | U | 3 |
| 15. | **Explain the effects of unbalanced forces in high-speed rotating machinery.** | | CO5 | U | 3 |
| 16. | **Distinguish centrifugal and spring-controlled governors with examples.** | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Sketch and explain the following inversions: (a) Scotch yoke mechanism; (b) Watt’s indicator mechanism. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | In the figure, the angular velocity of the crank OA is 600 r.p.m. Analyze the linear velocity of the slider D, when the crank is inclined at an angle of 75° to the vertical. The dimensions of various links are: OA = 28 mm; AB = 44 mm; BC 49 mm; and BD = 46 mm. The centre distance between the centres of rotation O and C is 65 mm. The path of travel of the slider is 11 mm below the fixed point C. The slider moves along a horizontal path and OC is vertical. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | A cam is to be designed for a knife edge follower with the following data:   * Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion. * Dwell for the next 30°. * During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion. * Dwell during the remaining 180°.   Sketch the profile of the cam when the line of stroke of the follower passes through the axis of the cam shaft. The radius of the base circle of the cam is 40 mm. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Two gears in mesh have a module of 10 mm and a 25° pressure angle. The pinion has 20 teeth and the gear has 52 teeth. The addendum on both the gears is equal to one module. Compute the number of pairs of teeth in contact. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Four masses A, B, C and D as shown below are to be completely balanced.    The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°. B and C make angles of 210° and 120° respectively with D in the same sense. Evaluate the magnitude and the angular position of mass A. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | In an epicyclic gear of the ‘sun and planet’ type shown in figure, the pitch circle diameter of the internally toothed ring is to be 224 mm and the module 4 mm. When the ring D is stationary, the spider A, which carries three planet wheels C of equal size, is to make one revolution in the same sense as the sunwheel B for every five revolutions of the driving spindle carrying the sunwheel B. Estimate the numbers of teeth for gears B and D. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | The mass of a turbine rotor of a ship is 8000 kg and has a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise when looking from the stern. Determine the gyroscopic couple and its effects in the following cases:  1. If the ship travelling at 100 km/h, steers to the left in a curve of 75 m radius, 2. If the ship is pitching and the bow is descending with maximum velocity. The pitching is simple harmonic, the periodic time being 20 seconds and the total angular movement between the extreme positions is 10°. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, estimate the range of speed of the governor. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply different mechanisms to devise solutions for real-world engineering challenges. |
| **CO2** | Analyze and resolve relative motion problems in kinematics and dynamics. |
| **CO3** | Design CAM mechanisms for input/output motion transmission. |
| **CO4** | Design various types of gears to diverse applications. |
| **CO5** | Implement various balancing techniques to mitigate vibration and enhance the efficiency of dynamic systems. |
| **CO6** | Design governors and gyroscopes to analyze stability control, navigation systems, and the  regulation of machinery speed in vehicles. |



**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23ME2013** | **Duration** | **3hrs** |
| **Course Title** | **APPLIED THERMODYNAMICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write one advantage of using an air pre-heater in a boiler plant. | | CO1 | R | 1 |
| 2. | Define efficiency of boiler. | | CO1 | R | 1 |
| 3. | Sketch the Temperature – Entropy diagram of a Rankine cycle. | | CO2 | R | 1 |
| 4. | Sketch the P-v diagram of the Diesel Cycle. | | CO2 | R | 1 |
| 5. | Write the relation to find the exit velocity of steam nozzle. | | CO3 | R | 1 |
| 6. | Dryness fraction of steam along the saturated liquid line is \_\_\_\_\_\_\_\_\_\_\_\_ | | CO3 | U | 1 |
| 7. | Write the relation to find the blade velocity coefficient in an impulse steam turbine. | | CO4 | R | 1 |
| 8. | Difference between the total and swept volume in an air compressor is known as\_\_ | | CO5 | U | 1 |
| 9. | Define volumetric efficiency of the air compressor. | | CO5 | R | 1 |
| 10. | Write the COP relation for the vapour compression refirigeration cycle. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss the significance of boiler trials in evaluating boiler performance. | | CO1 | U | 3 |
| 12. | Derive the efficiency relation for steam power Rankine cycle. | | CO2 | A | 3 |
| 13. | Determine the relation to find the exit velocity of the steam flowing in a convergent nozzle. | | CO3 | A | 3 |
| 14. | Write any three differences between the impulse and reaction turbine. | | CO4 | U | 3 |
| 15. | Derive the expression for work in a single stage reciprocating air compressor. | | CO5 | U | 3 |
| 16. | Sketch the P-v and T-S diagram of a vapour compression refrigeration cycle with the condition of the refrigerant as dry and saturated after compression. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | In a boiler trail, the following observations were made:  Pressure of steam = 10 bar; Mass flow rate of steam = 540 kg/hr; Fuel used = 60 kg/hr;  Moisture in fuel = 2% by mass; Mass of dry flue gasses = 9 kg/kg of fuel; Calorific value of the fuel = 32,000 kJ/kg; Temperature of the flue gasses = 325oC; Temperature of the boiler house = 28oC; Feed water temperature = 50oC; Mean specific heat of flue gas = 1 kJ/kgK; Specific heat of super-heated steam = 2.1 kJ/kgK; Dryness fraction of steam = 0.95. Draw up the heat balance sheet of the boiler. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0.4 bar. Calculate the Rankine cycle efficiency. Neglect the pump work. | CO2 | An | 6 |
|  | b. | Determine the air standard efficiency relation of the Otto Cycle with P-v and T-S diagrams. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Steam enters a nozzle at 1 MPa and 250°C and expands isentropically to a pressure of 10 kPa. The mass flow rate of the steam is 1 kg/s, and the inlet velocity is negligible. Determine the following: (i) The quality of the steam at the nozzle exit, (ii) The velocity of the steam at the exit, and (iii) The exit area of the nozzle. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | In a De Laval turbine steam is supplied from the nozzle with the velocity of 1200 m/s. The nozzle angle is 20o and the mean blade velocity is 400 m/s. The inlet and outlet angles of the blades are equal and the mass of the steam leaving the turbine is 1000 kg/hr. Calculate (i) Blade angles, (ii) relative velocities, (iii) Tangential force on blades, (iv) power developed, (v) Blade efficiency. Take the blade velocity coefficient as 0.8 | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the pressure and velocity compounding in an impulse turbine and explain the reasons for variations in the pressure and velocity with the neat sketch. | CO4 | A | 6 |
|  | b. | Describe the pressure and velocity compounding in an reaction turbine and explain the reasons for variations in the pressure and velocity with the neat sketch. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Determine the relation to find the work done on a single stage, single acting reciprocating air compressor without the clearance volume. | CO5 | A | 6 |
|  | b. | Determine the relation for the volumetric efficiency of the single stage reciprocating air compressor with clearance volume | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Derive the air standard efficiency relation of the Brayton Cycle with P-v and T-S diagrams. | CO2 | A | 6 |
|  | b. | Explain the working of a regenerative Rankine cycle and derive the expression to find the thermal efficiency of the cycle. | CO2 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the working principle of a vapor compression refrigeration system with a neat sketch. Using the T-s and P-h diagrams, illustrate the vapor compression refrigeration cycle and derive the equations for the following:   1. Work input to the compressor, 2. Heat rejected in the condenser, 3. Heat absorbed in the evaporator, and 4. Coefficient of Performance (COP) of the system. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Evaluate boiler efficiency by conducting heat balance calculations and identifying heat losses. |
| **CO2** | Apply Rankine cycle concepts to assess performance and efficiency in systems with superheat, reheat, and regeneration. |
| **CO3** | Evaluate the thermal efficiency of air standard cycles, including Otto, Diesel, Dual, and Brayton cycles |
| **CO4** | Assess the impact of intercooling on reciprocating compressor performance and determine minimum work requirements. |
| **CO5** | Design and optimize nozzle performance for various applications |
| **CO6** | Analyze the vapour compression refrigeration cycle, considering superheat and sub cooling in performance calculations. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23ME2014** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING ECONOMICS AND OPERATIONS RESEARCH** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the method to calculate marginal cost. | | CO1 | R | 1 |
| 2. | Name any two causes for depreciation. | | CO1 | R | 1 |
| 3. | Explain the importance of balance sheet. | | CO2 | U | 1 |
| 4. | Infer the method to calculate Return On Investment. | | CO2 | A | 1 |
| 5. | Name the applications of Operations Research. | | CO3 | R | 1 |
| 6. | Compare ‘decision variable’ with ‘slack variable’. | | CO3 | U | 1 |
| 7. | State the three methods to arrive initial solution in transportation problem. | | CO4 | R | 1 |
| 8. | Compare ‘assignment model’ with ‘transportation model’. | | CO4 | U | 1 |
| 9. | List the applications of assignment models. | | CO5 | R | 1 |
| 10. | Define ‘Activity’ and ‘Event’ in Network Analysis. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare fixed cost with variable cost. | | CO1 | A | 3 |
| 12. | Discuss the applications of Profit and Loss Statement. | | CO2 | U | 3 |
| 13. | Compare the ‘unbounded solution space’ with ‘bounded solution space’ of LPP graphical problem. | | CO3 | A | 3 |
| 14. | Interpret the method to resolve degeneracy in transportation problem. | | CO4 | A | 3 |
| 15. | Compute allocation in the following table (Operators I,II and III and Machines P,Q and R).   |  |  |  |  | | --- | --- | --- | --- | |  | P | Q | R | | I | 0 | 15 | 2 | | II | 5 | 0 | 3 | | III | 17 | 8 | 0 | | | CO5 | An | 3 |
| 16. | Determine the critical path of the following project using a network diagram.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 3-4 | 4-5 | | Immediate  Predecessor | Nil | Nil | 1-2 | 1-3 | 2-4 and 3-4 | | Duration(Weeks) | 3 | 4 | 5 | 2 | 7 | | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Illustrate the scope and application of engineering economics | CO1 | A | 6 |
|  | b. | Explain the various types of price elasticity with suitable graphs | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Infer the importance and application of financial statements | CO2 | A | 6 |
|  | b. | Summarise the construction of a Break-even chart and its application | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Solve the following LPP by using Graphical Method.  Maximize Z = 3X1+2X2  Subjected to  X1-X2 ≥ 1  X1+X2 ≥ 3  With non-negative restrictions X1, X2 ≥ 0 | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A food manufacturing company has 2 processing plants P1 and P2; three fruit cultivators are willing to supply fruits in the following quantities. Cultivator C1 is willing to supply 190 quintal at the rate of Rupees 100 per quintal, Cultivator C2 is willing to supply 290 quintal at the at the rate of Rupees 90 per quintal, Cultivator C3 is willing to supply 390 quintal at the rate of Rupees 80 per quintal. Cost of transportation from cultivator to plants is given below.   |  |  |  | | --- | --- | --- | |  | P1 | P2 | | C1 | 20 | 26 | | C2 | 9 | 16 | | C3 | 49 | 31 |   Plant requirements and labour costs are as follows   |  |  |  | | --- | --- | --- | | Details | Plant P1 | Plant P2 | | Requirement in Quintal | 440 | 360 | | Labour cost (Rupees/Quintal) | 30 | 22 |   Processed fruits are sold at the rate of Rupees 480 per quintal .objective of this problem to maximize profit, Infer the initial solution by North-west corner method. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | In a small machine shop, there are 4 operators available to assign jobs for the day. There are 5 jobs and profit in rupees for each operator on each job is represented in the table   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | JI | J2 | J3 | J4 | J5 | | O 1 | 6.30 | 5.90 | 6.80 | 10.20 | 7.40 | | O 2 | 8.00 | 10.10 | 9.00 | 8.50 | 7.30 | | O 3 | 8.70 | 8.80 | 9.10 | 7.60 | 6.50 | | O 4 | 7.30 | 8.30 | 6.40 | 7.70 | 8.00 |   Determine the optimal assignment and find out which job is to be rejected | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | There are three factories located at places P,Q and R. These factories supply products to whole sale agents located at places S, T and W. The weekly capacities of factories P,Q and R are 76,82 and 72 units respectively. Weekly requirements of agents S, T and W are 72,102 and 41 units respectively. The unit transportation cost in rupees from P to S, T and W are5,8 and 8 respectively, from Q to S,T and W are16,25 and 15 respectively and R to S,T and W are 9,16 and 25 respectively. Use least cost method to arrive initial solution. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | C:\Users\raja mech\Desktop\PERT DIAGRAM.png  Various activities and their duration of a project is represented in the above network. Determine the different paths and their duration and also critical path and its duration | CO6 | A | 4 |
|  | b | Activities involved in a small project are in the table. Duration is  expressed in days   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-3 | 2-4 | 2-3 | 3-5 | 4-6 | 5-6 | | Duration(Days) | 6 | 8 | 3 | 4 | 6 | 10 | 3 |   (i) Draw the network and develop forward scheduling and backward scheduling for this project (2)  (ii) Identify Early Start (ES) , Early Finish (EF), Late Start (LS) and Late Finish (LF) for all the activities (2)  (iii) Construct Total Float (TF) and Free Float(FF) for all the activities (4) | CO6 | A | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The activities of a project with their respective time estimates (in weeks) are given in the following table   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Activities | 1-2 | 1-6 | 2-3 | 2-4 | 3-5 | 4-5 | 6-7 | 5-8 | 7-8 | | Optimistic time | 3 | 2 | 6 | 2 | 5 | 3 | 3 | 1 | 4 | | Most Probable Time | 6 | 5 | 12 | 5 | 11 | 6 | 9 | 4 | 9 | | Pessimistic time | 15 | 14 | 30 | 8 | 17 | 15 | 27 | 7 | 28 |   i) Draw the network of this project and compute duration, variance and standard deviation of the project (6)  ii) Find the probability of completing the project within 42 weeks(2)  iii) Find the probability of NOT completing the project within 40 weeks (4) | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Evaluate the project feasibility and financial decisions. . |
| **CO2** | Analyze financial statements, including balance sheets, income and cash flow statements. |
| **CO3** | Apply graphical and simplex methods to solve linear programming problems. |
| **CO4** | Develop transportation models for minimizing transportation costs or maximizing efficiency. |
| **CO5** | Evaluate and compare different approaches within assignment models. |
| **CO6** | Demonstrate PERT, CPM, and scheduling techniques to manage project schedules efficiently |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23ME2015** | **Duration** | **3hrs** |
| **Course Title** | **PIPING DESIGN AND INSTRUMENTATION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define pipe and schedule number. | | CO1 | R | 1 |
| 2. | List the objectives of P & I diagram. | | CO1 | R | 1 |
| 3. | Recall the term ‘Pipe sizing’. | | CO2 | R | 1 |
| 4. | Why controllers are used in the industry? | | CO2 | U | 1 |
| 5. | Define instrumentation. | | CO3 | R | 1 |
| 6. | What are primary and secondary transducers? | | CO3 | R | 1 |
| 7. | State two advantages of closed loop control system. | | CO4 | U | 1 |
| 8. | How can vibration be controlled in instrumentation system? | | CO4 | U | 1 |
| 9. | Give any two examples of pressure measuring instruments. | | CO5 | U | 1 |
| 10. | Compare one key point of static and dynamic equipment. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the Bernoulli’s equation and define all the terms in it. | | CO1 | U | 3 |
| 12. | Outline various safety and regulatory compliance in piping design. | | CO2 | U | 3 |
| 13. | Write in short about Safety Instrumented Systems (SIS) in Piping Systems. | | CO3 | R | 3 |
| 14. | List the steps in cost benefit analysis for instrumentation. | | CO4 | R | 3 |
| 15. | Outline the importance of leakage and fluid containment evaluation in industrial piping systems. How does it impact safety and operational efficiency? | | CO5 | A | 3 |
| 16. | Discuss the impact of valve and fitting selection on the performance, efficiency, and safety of an industrial piping system. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain various guidelines to be followed in drawing a piping and instrumentation diagram according to industry codes and standards. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Interpret the key factors that influence pipe sizing in a piping system layout. | CO1 | A | 6 |
|  | b. | Given a required flow rate of 15 liters per second in an industrial piping system, Illustrate the steps involved in selecting a suitable pipe diameter. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Analyze the essential objectives and criteria for material selection in piping systems. Explain how factors such as pressure, temperature, stress, and structural integrity impact material choice. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the working of distributed control system with a neat sketch. | CO3 | U | 08 |
|  | b. | List any six types of process control valves along with their functions. | CO3 | U | 04 |
|  |  |  |  |  |  |
| 21. |  | Analyze and interpret the selection of instrumentation devices for the oil and gas industry based on environmental conditions, reliability, and maintenance considerations. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Elaborate in detail about any one temperature control and flow control instruments used in industries. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss the role of heat transfer and insulation enhancement in optimization of performance enhancement for industrial piping systems. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the impact of Human-Machine Interface (HMI) and SCADA systems in industrial automation by developing a case study based on an industry of your choice. | CO3 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Design piping systems and instrumentation for oil and gas industries. |
| **CO2** | Assess piping design layouts for oil and gas industries. |
| **CO3** | Evaluate the performance of control systems in piping for reliability and compatibility. |
| **CO4** | Optimize industrial process control systems. |
| **CO5** | Analyze and troubleshoot issues to enhance both system efficiency and safety. |
| **CO6** | Optimize piping system designs for performance assessment. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24ME1001** | **Duration** | **3hrs** |
| **Course Title** | **APPLICATIONS OF DRONE TECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define a drone and list its primary components. | | CO1 | U | 1 |
| 2. | Identify two major regulations for drone operation. | | CO1 | R | 1 |
| 3. | List the major power sources used in drone propulsion systems. | | CO2 | R | 1 |
| 4. | List the key characteristics of a battery. | | CO2 | R | 1 |
| 5. | List the sources of loss of communication during operations. | | CO3 | U | 1 |
| 6. | List the subsystems incorporated by mission planning and control station. | | CO3 | R | 1 |
| 7. | Differentiate between dispensable and non-dispensable payloads. | | CO4 | U | 1 |
| 8. | Identify the factors considered when integrating payloads into drone design. | | CO4 | R | 1 |
| 9. | Identify a key advantage of using drones for crop monitoring. | | CO5 | U | 1 |
| 10. | Define aerial reconnaissance. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Summarize the key safety considerations when operating a drone. | | CO1 | An | 3 |
| 12. | Explain the materials used in drone construction and their advantages. | | CO2 | U | 3 |
| 13. | Analyze how integration of control, navigation, and communication systems enhances drone performance. | | CO3 | An | 3 |
| 14. | Explain the working principle of LiDAR and analyze its advantages in mapping and surveying. | | CO4 | U | 3 |
| 15. | Explain the process of using drones for land surveying and analyze their advantages over traditional methods. | | CO5 | An | 3 |
| 16. | Summarize the current and potential applications of drones in commercial industries. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Compare different types of drones based on their structure, functionality and usage. Evaluate their suitability for various industries. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the critical design factors affecting drone stability and maneuverability. | CO2 | An | 6 |
|  | b. | Analyze the construction techniques used in drone manufacturing. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Discuss various navigation and positioning techniques used in drones and assess their effectiveness in different environments. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Compare camera-based sensors, thermal imaging, and LiDAR in drones and evaluate their effectiveness for different applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the process of drone data collection and assess its impact on agricultural and surveying decision-making. | CO5 | An | 6 |
|  | b. | Analyze the opportunities and limitations of drone applications in agriculture and surveying, and evaluate their future potential in these fields. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. |  | Compare different drone communication and telemetry systems and evaluate their advantages in real-time data transmission. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the classification of dispensable and non-dispensable payloads and evaluate their applications in defense, agriculture, and logistics. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the regulatory framework for drones and assess the challenges and opportunities for businesses adopting drone technology. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall the historical development and classify unmanned aerial vehicle systems (UAS). |
| **CO2** | Summarize the design parameters, aerodynamics and airframe configurations of Unmanned Aerial Vehicle (UAV). |
| **CO3** | Apply the principles of flight control dynamics, avionics and various sensors onboard using UAVs. |
| **CO4** | Analyze crop monitoring, land surveying and mapping using drones. |
| **CO5** | Create professional/high-quality photos and videos for various applications. |
| **CO6** | Categorize future trends and develop new technology in line with the government regulations |