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

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| --- | --- | --- | --- |
| **Course Code** | **18CH2001** | **Duration** | **3hrs** |
| **Course Title** | **ENVIRONMENTAL STUDIES** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Provide two most viable alternative energy sources currently available. | | CO1 | U | 1 |
| 2. | Provide the primary elements of the Earth's atmosphere. | | CO1 | R | 1 |
| 3. | Define desertification. | | CO2 | R | 1 |
| 4. | Relate public awareness and sustainability. | | CO3 | U | 1 |
| 5. | In an ecosystem, mention the organism classified as primary producers. | | CO3 | R | 1 |
| 6. | Mention the term that refers to the diversity of different species found within a particular area. | | CO6 | U | 1 |
| 7. | Mention are the primary causes of soil pollution. | | CO4 | U | 1 |
| 8. | Identify the primary consequences of thermal pollution. | | CO5 | A | 1 |
| 9. | Identify the measures outlined in the Water (Prevention and Control of Pollution) Act. | | CO5 | U | 1 |
| 10. | Define sustainable development. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast primary and secondary succession. | | CO1 | A | 3 |
| 12. | Discuss the components of an ecosystem. | | CO2 | U | 3 |
| 13. | Discuss the benefits and problems associated with dams. | | CO3 | A | 3 |
| 14. | Explain the main causes of water pollution. | | CO6 | U | 3 |
| 15. | List the major threats to biodiversity. | | CO4 | A | 3 |
| 16. | Differentiate between the population growth and population explosion. | | 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. | Discuss the causes and consequences of deforestation with case studies. | CO1 | A | 6 |
|  | b. | Explain the causes, effects, and management strategies for soil erosion. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Examine the causes, consequences, and control measures associated with the issue of water overutilization. | CO2 | An | 6 |
|  | b. | Discuss the environmental consequences of using non-renewable energy sources. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the role of producers, consumers, and decomposers in an ecosystem. | CO4 | A | 6 |
|  | b. | Design an ecosystem and describe its components and their functions. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the bio-geographical classification of India and examine the connections between India's climate and its specific bio-geographical classification. | CO4 | U | 6 |
|  | b. | Compare and contrast genetic diversity, species diversity, and ecosystem diversity, providing appropriate examples for each. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Assess the effectiveness of various biodiversity conservation strategies. | CO5 | An | 6 |
|  | b. | Describe the sustainable practices in solid waste management. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the principles of green chemistry. | CO3 | A | 6 |
|  | b. | Describe the main causes, effects, and control measures of climate change and ozone layer depletion. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the concept of rainwater harvesting and its significance in water conservation. | CO5 | A | 6 |
|  | b. | Analyze the role of individuals in the stewardship and sustainable management of natural resources. | CO1 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the role of information technology in improving human health and addressing environmental issues. | CO6 | An | 6 |
|  | b. | Define the following   1. Doubling time 2. Total Fertility rates 3. Zero population growth 4. Population Explosion 5. Demography | CO6 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the natural environment and its relationships with human activities. |
| **CO2** | Acquire practical skills for solving pollution related problems |
| **CO3** | Design and evaluate strategies and apply green technologies |
| **CO4** | Identify the methods for sustainable development and for the remediation or restoration of degraded environments |
| **CO5** | Integrate facts, concepts, and methods from multiple disciplines and apply to environmental and social problems |
| **CO6** | Analyze the connectivity between the manmade activities-Pollution-environmental issues-social problems-ecofriendly solutions |

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

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| --- | --- | --- | --- |
| **Course Code** | **20CH2013** | **Duration** | **3hrs** |
| **Course Title** | **NANOCHEMISTRY IN FORENSIC SCIENCE** | **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. | 1. Discuss the historical landmarks in the development of nanotechnology and evaluate the key terminology and scales used in nanotechnology. | CO1 | U | 10 |
|  | b. | Summarize the nanotoxicity effect from the environmental aspects in about 500 words. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | 1. Compare and contrast top down and bottom up approach in the synthesis of nanomaterials. | CO1 | U | 10 |
|  | b. | Assess the potential health risks and ethical concerns of nanomaterials. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | 1. Outline the two important steps of reaction in the sol-gel method for synthesizing nanoparticles. What are the advantages and disadvantages of using this technique compared to other synthesis methods? | CO2 | R | 10 |
|  | b. | Given a scenario where you need to synthesis nanomaterials to develop latent finger print, choose an appropriate synthesis method. Justify your choice based on the properties required for the application. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | 1. Narrate the concept of electrospinning method for the preparation of nanofibers. | CO2 | R | 10 |
|  | b. | Give the preparation of silver nanoparticles by reduction and point out the significance in the latent finger print characterization. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | 1. Identify the two types of carbon nanotubes and explain their unique properties and applications. | CO3 | R | 10 |
|  | b. | Assess the significance of soft lithography techniques in the nanoscale fabrication of devices. What are the potential advantages and limitations of using soft lithography over traditional lithography methods? | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Give real-time case studies using carbon nanotube (CNT) based nanosensors in the detection of explosives/drugs or hazardous materials. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain how nanotechnology is revolutionizing drug delivery systems, especially in the treatment of cancer. | CO4 | A | 10 |
|  | b. | Evaluate the impact of **nanotechnology** in modern **electronics.** What are its advantages and limitations? | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain how **nanomaterial** be integrated into **biosensors** for detecting diseases at an early stage. | CO5 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | 1. Evaluate the forensic analysis of physical evidence in forensic finger prints on metal/glass surfaces and hidden finger prints using nanomaterials over traditional materials. | CO6 | E | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | know the evolution of nanotechnology |
| CO2 | understand the classification of nanomaterials |
| CO3 | understand the various types of synthesis of nanomaterials |
| CO4 | characterize the nanomaterials |
| CO5 | know the applications of nanomaterials |
| CO6 | understand the application of nanomaterials in forensic science |

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

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| --- | --- | --- | --- |
| **Course Code** | **20CH3048** | **Duration** | **3hrs** |
| **Course Title** | **INSTRUMENTAL METHODS OF ANALYSIS-II** | **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. | Discuss the classification of chromatographic techniques. | CO1 | R | 10 |
|  | b. | Discuss the principles, instrumentation, and forensic applications of gas chromatography. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | What is chromatography? Discuss the principle and forensic significance of thin-layer chromatography. | CO1 | U | 10 |
|  | b. | Discuss the principles, instrumentation, and forensic applications of High-Performance Liquid Chromatography. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the suitable chromatography method for analyzing questioned documents and ink samples. | CO2 | A | 10 |
|  | b. | Assess the principles and forensic applications of supercritical fluid chromatography. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the principles of Capillary Electrophoresis and discuss how it is applied in the field of forensic science. | CO3 | An | 10 |
|  | b. | Clarify the principle and forensic applications of the following.   1. ICP-MS (Inductively Coupled Plasma Mass Spectrometry) 2. Atomic Mass Spectrometry | CO3 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the principle of one hyphenated technique and its application in forensic toxicology. | CO4 | An | 10 |
|  | b. | Clarify the principles, instrumentation, and forensic applications of Scanning Electron Microscopy. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the principles and applications of the following microscopes in the context of document examination and latent fingerprint analysis.   1. Stereo-zoom microscope 2. Fluorescence microscope. | CO5 | A | 10 |
|  | b. | Elaborate on the principles, instrumentation, and forensic applications of a Transmission Electron Microscope. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the relationship between signal-to-noise ratio and sensitivity, providing an illustration. | CO4 | An | 10 |
|  | b. | Evaluate the effectiveness of various analytical techniques in fingerprint analysis, trace evidence analysis, and handwriting analysis. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | How does mass spectrometry contribute to both qualitative and quantitative analysis in forensic investigations? Can you provide a relevant case study to illustrate its application? | CO3 | An | 10 |
|  | b. | Examine a case study in which chromatography played a crucial role in solving a crime. | CO1 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the principles and forensic applications of two thermal methods. | CO6 | An | 10 |
|  | b. | Explain the principles and forensic science applications of X-ray diffraction techniques. Provide a case study. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Summarize the types of chromatographic techniques |
| CO2 | Realize the importance of High Performance Liquid Chromatography |
| CO3 | Apply the principles of mass spectrometry in forensic science |
| CO4 | Realize the importance of hyphenated techniques |
| CO5 | Realize the use of microscopic techniques in forensic science |
| CO6 | Utilize the role of X-ray diffraction techniques in forensic science |

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

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| **Course Code** | **22CH2001** | **Duration** | **3hrs** |
| **Course Title** | **BIOCHEMISTRY** | **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. | Explain the types of nucleotides with their structure. | CO1 | R | 10 |
|  | b. | Describe the process of DNA replication with a well labeled diagram. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the classification of amino acids. Give examples of each. | CO2 | R | 10 |
|  | b. | Explain methods for determination of amino acid composition from N- terminal. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Classify proteins based on their functions. Give one example of each. | CO3 | R | 10 |
|  | b. | Define mutation. Explain types of mutation. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Define enzymes. Explain their characteristics and biological activities. | CO4 | U | 10 |
|  | b. | Explain the kinetics of enzymes. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Write a note on amino acid analyzer. | CO5 | A | 10 |
|  | b. | Describe the physio-chemical properties of amino acids. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define antibodies. Explain its structure with a well labeled diagram. | CO3 | R | 10 |
|  | b. | Explain the process of translation in detail. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain different types of RNA found in cell with diagram. | CO2 | R | 10 |
|  | b. | Explain the process of amino acid determination on the basis of C-terminal. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the process of DNA sequencing. | CO6 | U | 10 |
|  | b. | Explain different types of enzymes assay techniques. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the steps of PCR with a well labeled diagram. | CO6 | R | 10 |
|  | b. | Explain the classification of electrophoresis. Give its forensic application. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Classify the various types of biomolecules |
| CO2 | Summarize the role of amino acids in forensic science |
| CO3 | Predict the composition of proteins |
| CO4 | Analyze the enzyme action |
| CO5 | Demonstrate the role of nucleic acids in forensic science |
| CO6 | Describe the principles of electrophoresis |

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

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| **Course Code** | **23CH1001** | **Duration** | **3hrs** |
| **Course Title** | **ENVIRONMENTAL STUDIES** | **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. | Define renewable and non-renewable resources with examples. | CO1 | R | 10 |
|  | b. | Explain the problems related to over-utilization of groundwater and deforestation. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | List any five alternate sources of energy and explain their environmental benefits. | CO1 | R | 10 |
|  | b. | Describe soil erosion and desertification. Suggest any two conservation strategies. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Define an ecosystem. Illustrate and explain the structure of an ecosystem. | CO2 | U | 10 |
|  | b. | Explain the threats to biodiversity and give any two case studies. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a short note on the food chain and food web with examples. | CO2 | U | 10 |
|  | b. | Explain in-situ and ex-situ methods of biodiversity conservation. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Define air and water pollution. Explain two control measures for each. | CO3 | R | 10 |
|  | b. | Discuss the role of green chemistry in pollution prevention. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe nuclear hazards. List the causes and effects with examples. | CO3 | U | 10 |
|  | b. | Write any two case studies on pollution and suggest solutions. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain solid waste management and e-waste problems in urban areas. | CO4 | U | 10 |
|  | b. | Discuss the impact of ozone depletion and global warming with examples. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe any three environmental protection acts and their significance. | CO5 | R | 10 |
|  | b. | Define sustainable development. Suggest simple eco-friendly solutions. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the effects of population explosion on the environment. | CO6 | U | 10 |
|  | b. | Explain disaster management strategies for any two natural disasters. | CO6 | An | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the natural environment and its relationships with human activities. |
| CO2 | Acquire practical skills for solving pollution related problems |
| CO3 | Design and evaluate strategies and apply green technologies |
| CO4 | Identify the methods for sustainable development and for the remediation or restoration of degraded environments |
| CO5 | Integrate facts, concepts, and methods from multiple disciplines and apply to environmental and social problems |
| CO6 | Analyze the connectivity between the manmade activities-Pollution-environmental issues-social problems-ecofriendly solutions |



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

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| --- | --- | --- | --- |
| **Course Code** | **23CH1003** | **Duration** | **3hrs** |
| **Course Title** | **APPLIED CHEMISTRY FOR FOOD PROCESSING TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give an example of plasticiser used in biopolymer. | | CO1 | U | 1 |
| 2. | Draw the molecular structure of PCl. | | CO1 | R | 1 |
| 3. | **Provide an example for coordinate bond molecule.** | | CO2 | R | 1 |
| 4. | The shape of ‘sp3’hybridized orbital is \_\_\_\_\_\_\_\_\_\_\_ | | CO2 | R | 1 |
| 5. | Homolytic cleavage leads to form \_\_\_\_\_\_\_\_\_ | | CO3 | U | 1 |
| 6. | Organic compounds with an electronegative atomgroup bonded to a \_\_\_\_\_\_\_\_ carbon undergo substitution or elimination reactions | | CO3 | R | 1 |
| 7. | The hydrogen electrode potential is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | CO4 | U | 1 |
| 8. | The oxidation state of carbon in CH4 is \_\_\_\_\_\_\_\_\_ | | CO4 | R | 1 |
| 9. | A chemical kinetics is the part of chemical science dealing with the study of \_\_\_\_\_\_\_\_\_\_ reactions. | | CO5 | U | 1 |
| 10. | UV light range is from \_\_\_\_\_\_\_nm to \_\_\_\_\_\_\_\_\_\_\_\_\_\_nm | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Highlight any three advantages of biopolymer. | | CO1 | U | 3 |
| 12. | Prepare a brief report on Hyper conjugation. | | CO2 | A | 3 |
| 13. | Differentiate the SN1 and SN2 reaction. | | CO3 | An | 3 |
| 14. | Finout the oxidized and reduced reaction in following reaction.  **Cu(s) + 2AgNO3(aq) 🡪 Cu(NO3 )2(aq) + 2Ag(s)** | | CO4 | U | 3 |
| 15. | Explain the first order reaction in chemical kinetics. | | CO5 | R | 3 |
| 16. | Draw the schematic diagram of UV-VISIBLE spectroscopy. | | 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. | a. | Enumurate the synthesis methods PCL and PLA. | CO1 | R | 6 |
|  | b. | Classify the biopolymer based on sources. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the +M and –M effect with an example. | CO2 | U | 6 |
|  | b. | Illustrate the types of Chemical Bonds with an Example. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the SN1reaction mechanism with an example. | CO3 | R | 6 |
|  | b. | Analyze the postulate the aromatic electrophilic substitution reaction with schematic representation. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Derive Nernst equation of an electrode. | CO4 | E | 6 |
|  | b. | Illustrate the rusting of iron mechanism with help of electrochemical theory of corrosion. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Highlights the kinetics of zero, second and third order reactions with an example. | CO5 | R | 6 |
|  | b. | Discuss the reaction rate in accordance with Arrehenius theory. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare and contrast of sp2 and sp3 hybridization with an example each. | CO2 | An | 6 |
|  | b. | Enumerate the impressed current and sacrificial anodic methods with neat diagram. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the compounding of plastics with suitable example. | CO1 | U | 6 |
|  | b. | Distinguish E1 and E2 mechanism with suitable examples. | CO3 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the principle of IR spectroscopy and its application. | CO6 | U | 6 |
|  | b. | Highlight the principle and instrumentation of atomic absorption spectroscopy with neat diagram. | CO6 | R | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Distinguish between biopolymers and polymers. |
| **CO2** | Identify the effects of functional groups on the stability of molecules. |
| **CO3** | Develop the organic reaction mechanism |
| **CO4** | Test different types of corrosion |
| **CO5** | Predict the order and rate of a chemical reaction |
| **CO6** | Validate the principles of spectroscopy in food technology. |

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

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| **Course Code** | **23CH2002** | **Duration** | **3hrs** |
| **Course Title** | **PHYSICAL CHEMISTRY FOR FORENSIC SCIENCE** | **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. | What are the common sources of water and their associated impurities? | CO1 | R | 10 |
|  | b. | Explain the procedure for determining hardness using the EDTA method. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define caustic embrittlement. Explain its causes and how can it be prevented. | CO1 | U | 10 |
|  | b. | Describe the steps to determine dissolved oxygen in water. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Define surface tension and explain how it can be determined using a stalagmometer. | CO2 | R | 10 |
|  | b. | Discuss the effect of temperature on viscosity and refractive index. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a note on optical activity and molar refraction. | CO2 | U | 10 |
|  | b. | Explain the principle and working of Abbe's refractometer. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Define electrode potential. Explain how it is calculated using Nernst Equation. | CO3 | U | 10 |
|  | b. | List and explain any three corrosion control methods. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define electrochemical cell. Explain how EMF is measured. | CO3 | R | 10 |
|  | b. | Discuss the factors influencing corrosion of metals. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Compare dry cell, lead-acid battery, and hydrogen-oxygen fuel cell. | CO5 | U | 10 |
|  | b. | Write a note on the working and applications of microbial biobatteries. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain how energy is generated from food waste using biobatteries. | CO5 | A | 10 |
|  | b. | Describe the principle of enzymatic biobatteries and their applications. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | State Grothaus Draper and Stark-Einstein’s Laws of photochemistry. | CO6 | R | 10 |
|  | b. | Differentiate between fluorescence, phosphorescence, and Internal Conversion. | CO6 | An | 10 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on water technology |
| CO2 | Examine various properties of liquid |
| CO3 | Correlate knowledge on electrochemistry to forensic science |
| CO4 | Differentiate types of corrosion |
| CO5 | Summarize the applications of bio batteries |
| CO6 | Apply the principles of photochemistry in forensic science domain |

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

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| **Course Code** | **23CH2004** | **Duration** | **3hrs** |
| **Course Title** | **FORENSIC CHEMISTRY** | **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. | Recall the concepts of forensic chemistry and define petroleum products with examples. | CO1 | R | 10 |
|  | b. | Describe the examination of petroleum products, highlighting key methods and forensic significance. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Classify and explain different fire patterns, analyzing their causes and forensic significance. | CO2 | U | 10 |
|  | b. | Explain how a fire scene is analyzed to determine the cause and origin of a fire. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Identify the given image and explain it.  Examples of melted copper wire beads caused by exposure to fire without...  | Download Scientific Diagram | CO3 | A | 10 |
|  | b. | Explain TNT, PETN & RDX. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the post blast residue collection in detail. | CO4 | An | 10 |
|  | b. | Distinguish between stimulants & depressants. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the broad classification of psychotropic substances. | CO5 | E | 10 |
|  | b. | Describe TLC and UV-Visible techniques. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the analysis of fire debris. | CO6 | U | 10 |
|  | b. | Elaborate on Natural narcotic drugs. | CO6 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the collection and preservation of drug evidence. | CO3 | R | 10 |
|  | b. | Explain the different types of explosions with examples. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize adulteration and how to check for adulteration in petrol and diesel. | CO5 | U | 10 |
|  | b. | Discuss presumptive tests for drug detection. | CO5 | R | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the different methods of petroleum product analysis. | CO4 | C | 10 |
|  | b. | Compare Synthetic and Natural drugs. | CO2 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the basic properties of Petroleum products. |
| CO2 | Interpreting the methods of analyzing trace amounts of petroleum products in crime scene evidence. |
| CO3 | Determining the method of searching, collecting, preserving and analyzing arson evidence. |
| CO4 | Explain the process of post-fire analysis of materials. |
| CO5 | Realize the classification of explosives, including the synthesis and characterization of representative analogs. |
| CO6 | Apply the techniques of locating hidden explosives and directing the significance of bomb scene management. |

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

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| **Course Code** | **23CH2011** | **Duration** | **3hrs** |
| **Course Title** | **ANALYTICAL CHEMISTRY FOR FORENSIC SCIENCE** | **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. | Enumerate the methods of minimizing Errors with suitable example. | CO1 | U | 10 |
|  | b. | Write short notes on the following: i) Accuracy ii) Precision iii) Absolute error iv) Relative Error | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the handling methods used in acids and ethers. | CO1 | A | 10 |
|  | b. | Justify different heating and stirring methods were required to be applied effectively in chemical processes with suitable diagram and illustrate their applications. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the testing of chemical compounds through TLC and column chromatography method. | CO2 | A | 10 |
|  | b. | Describe the techniques used in the extraction of organic compounds. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Elaborate the different purification methods for solid-state chemicals based on their efficiency and principles. | CO2 | An | 10 |
|  | b. | Highlight the different types of distillation techniques used for purification of liquid chemicals. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Describe the primary and secondary standards, and the criteria for primary standards. | CO3 | R | 10 |
|  | b. | Design an experiment using complexometric titration to estimate the calcium ion concentration in a milk solution. Explain its principle and the stepwise experimental procedure. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the methods of expressing concentrations of chemical solution. | CO3 | U | 10 |
|  | b. | Highlight the limitation and advantages of the volumetric analysis. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Analyse the principle of gravimetric titrations and compare with the different examples based on their precipitation and accuracy. | CO4 | An | 10 |
|  | b. | Determine the solubility and solubility product of a given salt through experimental analysis with interpretations. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | How will you determine the chloride samples by the Volhard’s method? | CO5 | An | 10 |
|  | b. | Illustrate the factors affecting the TGA and DTA curves. | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Apply Thermogravimetric Analysis (TGA) and Differential Thermal Analysis (DTA) techniques to analyse material decomposition, phase transitions, and thermal stability. | CO6 | A | 10 |
|  | b. | Apply the principle of electrogravimetry to determine metal ion concentration and explore its applications in quantitative analysis. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | know the methodology to handle chemicals, heating methods and error analysis |
| CO2 | understand the principle of techniques used for the purification of compounds |
| CO3 | know about importance of various titrimetric methods |
| CO4 | get knowledge about solubility criteria, precipitation titrations and gravimetric analysis |
| CO5 | receive the importance of thermogravimetric, differential thermal and electrogravimetry analysis |
| CO6 | understand the basics of analytical chemistry for application in forensic science |

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

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| **Course Code** | **23CH2012** | **Duration** | **3hrs** |
| **Course Title** | **INSTRUMENTAL METHODS OF ANALYSIS** | **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. | Discuss the instrumentation of Atomic Absorption Spectrometry (AAS) with a neat diagram, explaining the function of each component. | CO1 | U | 10 |
|  | b. | Explain applications and instrumentation of atomic fluorescence spectrometry with neat diagram. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Enumerate the principle and instrumentation of atomic emission spectrometry with neat diagram | CO1 | R | 10 |
|  | b. | Explain the principle of Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) and describe its main components. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the principle of UV-Visible Spectroscopy and how it is used to determine the concentration of a substance in a solution. | CO2 | U | 10 |
|  | b. | Explain the theory of fluorescence and phosphorescence, highlighting the differences between the two phenomena in terms of electronic transitions and lifetimes. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compare and contrast the instrumentation used in fluorescence and phosphorescence spectroscopy. | CO2 | A | 10 |
|  | b. | Explain the theory and instrumentation of UV-Visible Spectroscopy | CO2 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Enumerate the theory and instrumentation of Infrared Spectroscopy with an example. | CO3 | R | 10 |
|  | b. | Explain the principle behind Photoacoustic IR Spectroscopy and how it detects sample information. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the role of IR Spectroscopic methods in forensic science and evaluate their effectiveness in the identification and analysis of evidence. | CO3 | An | 10 |
|  | b. | Evaluate the advantages and limitations of using Raman Spectroscopy for material analysis compared to other spectroscopic techniques. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 7. |  | Enumerate the principles and components of Nuclear Magnetic Resonance (NMR) Spectrometry. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss working and applications of Nuclear Magnetic Resonance Spectrometry. | CO4 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain Isotope Dilution Methods with examples | CO5 | U | 10 |
|  | b. | Enumerate thermo gravimetric analysis (TGA) with neat diagram. | CO6 | R | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Memorize the principles of atomic spectroscopy |
| CO2 | Differentiate between IR and Raman Spectroscopy |
| CO3 | Apply the principles of electronic spectroscopy |
| CO4 | Infer the principles of NMR spectroscopy |
| CO5 | Evaluate the importance of radiochemical methods in forensic science |
| CO6 | Adapt electrochemical methods in forensic science |

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

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| **Course Code** | [**23CH3004**](https://eduserve.karunya.edu/Academics/Attendance/MarkAttendance.aspx?Date=13%20Oct%202023&BATCHID=43324&Hour=7) | **Duration** | **3hrs** |
| **Course Title** | **QUANTUM CHEMISTRY AND GROUP THEORY** | **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. | Discuss the following   1. Disadvantages of classical mechanism 2. Advantages of quantum mechanics | CO1 | R | 10 |
|  | b. | Describe the postulates of quantum mechanics with suitable example. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the Compton effect with illustrating suitable diagram. | CO1 | An | 10 |
|  | b. | Discuss the photo electric effect with appropriate diagram. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Deduce the Schrodinger equation for a one dimensional potential box. | CO2 | A | 10 |
|  | b. | Explain perturbation theory with an example | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Deduce the Schrodinger equation for a three dimensional potential box with a neat diagram. | CO2 | An | 10 |
|  | b. | Explain variation theory with an example. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate the theory of linear conjugated systems of ethylene. | CO3 | An | 10 |
|  | b. | Explain Wood ward Hoffman’s rules with an example. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the Born – Oppenheim approximation theory with an example. | CO3 | A | 10 |
|  | b. | Explain the Pauli‘s exclusion principle with an example. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss improper rotation Sn and Reflection Description: σ - Wiktionary, the free dictionary with examples. | CO4 | R | 10 |
|  | b. | Describe the axis of symmetry operation associated with H2O molecule. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Draw and explain the point group flowchart for linear and non-linear molecules. | CO4 | An | 10 |
|  | b. | Deduce the point group and group multiplication table of H2O molecule. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the IR and Raman Active, translational, vibrational modes associated with water molecule using GOT. | CO6 | An | 10 |
|  | b. | Identify the missing point group of the following table   |  |  |  |  | | --- | --- | --- | --- | |  | E | 2C3 | 3Sigma greek sign Royalty Free Vector Image - VectorStockv | | A1 | 1 | 1 | 1 | | A2 | ? | ? | ? | | E | 2 | -1 | 0 |     Find the missing symmetry operation using the Mulliken symbols and characters   |  |  |  |  |  | | --- | --- | --- | --- | --- | | i | A1 | 1 | -1 | 1 | | ii | A2 | 1 | -1 | -1 | | iii | B1 | 1 | 1 | -1 | | iv | B2 | 1 | -1 | 1 | | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the importance and application of quantization in molecular energy levels |
| CO2 | Explain the shape, energy of atomic orbitals and molecular orbitals and the bond formation between atoms |
| CO3 | Know about LCAO, MO and VB treatments of hydrogen molecule |
| CO4 | Illustrate the shape, energy of atomic orbitals and molecular orbitals and the bond formation between atoms |
| CO5 | Appreciate the symmetry in molecules and in nature |
| CO6 | Identify and group the objects or molecules of same category based on the symmetry elements. |

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

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| **Course Code** | **23CH3005** | **Duration** | **3hrs** |
| **Course Title** | **COORDINATION CHEMISTRY** | **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. | Compare and contrast the different types of structural isomerism found in octahedral complexes with suitable examples. | CO1 | U | 10 |
|  | b. | Discuss the factors that influence the stability constant of coordination compounds. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the optical isomerism in octahedral metal complexes with relevant examples. | CO1 | U | 10 |
|  | b. | Derive the overall stability constant for the formation of the complex [ML6]²⁺ from [M(H₂O)₆]²⁺ | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the process of d-orbital splitting in octahedral complexes and how to determine the crystal field stabilization energy. | CO3 | U | 10 |
|  | b. | Describe a method for determining the magnetic moment in a metal complex. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss the various types of magnetic behavior with suitable examples. | CO3 | U | 10 |
|  | b. | Discuss the following   1. Spectrochemical series 2. Jahn-Teller distortion | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Describe the various types of electronic transitions that take place in coordination complexes. Additionally, discuss the significance of the molar extinction coefficient in relation to these transitions. | CO4 | An | 10 |
|  | b. | Draw the Orgel diagrams for the electronic configurations d6 and d2 in both octahedral and tetrahedral geometries. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the classification of substitution mechanisms in octahedral complexes | CO5 | U | 10 |
|  | b. | Define and state the applications of the following   1. Trans effect 2. Eigen–Wilkins mechanism 3. Anation reaction | CO5 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the concepts of labile and inert complexes. Also, discuss the significance of Taube’s rule concerning lability and inertness. | CO2 | An | 10 |
|  | b. | Demonstrate the mechanism of outer-sphere electron transfer in coordination metal complexes with an example. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the mechanism of inner sphere electron transfer reactions in transition metal complexes with an example. | CO4 | A | 10 |
|  | b. | Explain the relationship between the rate of electron transfer and the free energy change using the Marcus-Hush equation. | CO5 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the structure and function of haemoglobin and myoglobin. | CO6 | An | 10 |
|  | b. | Explain the structure and functions of Iron-sulphur proteins. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the theory of coordination chemistry |
| CO2 | Teach the structure and stability of coordination complexes |
| CO3 | Describe the bonding and magnetic properties of coordination complexes |
| CO4 | Understand the electronic spectra of coordination complexes |
| CO5 | Summarize the reaction mechanism of coordination compounds |
| CO6 | Relate the bio-inorganic chemistry with coordination chemistry |

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

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| **Course Code** | **23CH3006** | **Duration** | **3hrs** |
| **Course Title** | **ORGANIC TRANSFORMATIONS AND REAGENTS** | **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. | Describe the Suzuki Coupling with catalytic cycle and its applications. | CO1 | A | 10 |
|  | b. | Illustrate the various stages of organometallic coupling reactions with examples. | CO1 | An | 10 |
|  |  | OR |  |  |  |
| 2. | a. | Narrate the Stille Coupling with its steps in the catalytic cycle and its advantages. | CO1 | An | 10 |
|  | b. | Discuss Glacier coupling and its applications. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the any two DMSO based oxidations with mechanism. | CO2 | An | 10 |
|  | b. | Give the examples of the reduction reactions using NaBH4, DIBAL-H, NaCNBH3, and Pd/C. | CO2 | A | 10 |
|  |  | OR |  |  |  |
| 4. | a. | Give an account of PCC and Oppeneur oxidation for the chemical conversions. | CO2 | E | 10 |
|  | b. | Discuss the reduction reactions of LAH and Li/liq.NH3 for aromatic ring reduction with examples. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Narrate the NBS and *m*-CBPA mediated reactions with mechanism. | CO3 | An | 10 |
|  | b. | Draw the mechanism of UGI reactions and its applications. | CO3 | A | 10 |
|  |  | OR |  |  |  |
| 6. | a. | Describe the usage of DCC and DDQ reagents in the organic synthesis with examples. | CO4 | An | 10 |
|  | b. | How will you prepare amino acid synthesis by Strecker’s reaction? | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss any two rearrangements involving 1,2-shift to electrophilic carbon | CO4 | E | 10 |
|  | b. | Give an outline the Baeyer Villiger Oxidation and Dakin reaction. | CO5 | A | 10 |
|  |  | OR |  |  |  |
| 8. | a. | Illustrate any two rearrangements involving the intermediate isocyanate. | CO5 | E | 10 |
|  | b. | Explain Beckmann rearrangement with mechanism. | CO5 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Evaluate the retrosynthetic approach and apply for the protecting group strategy. | CO6 | E | 10 |
|  | b. | Elaborate one group disconnection approach with Linear and Convergent Synthesis. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Elucidate the importance of metal-assisted coupling reactions in synthesis. |
| CO2 | Summarize the reagents used for oxidation and reduction reactions. |
| CO3 | Apply modern synthetic reagents in organic synthesis. |
| CO4 | Demonstrate and analyze the use of multi-component coupling in synthesis. |
| CO5 | Predict and identify the product formed in molecular rearrangements |
| CO6 | Utilize the retrosynthetic approach to create complex target molecules. |

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

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| **Course Code** | **23CH3017** | **Duration** | **3hrs** |
| **Course Title** | **MOLECULAR SPECTROSCOPY** | **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. | Explain electromagnetic radiation and its regions with examples. | CO1 | R | 10 |
|  | b. | Explain the term “Born-Oppenheimer approximation.” Explain its importance in spectroscopy. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe molecular term symbols. Explain how they are derived, citing out two examples. | CO1 | U | 10 |
|  | b. | State and explain Franck–Condon principle in electronic spectroscopy. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe harmonic and anharmonic oscillators in vibrational spectroscopy. | CO2 | R | 10 |
|  | b. | Explain Fermi resonance with an example. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Differentiate between infrared and Raman spectroscopy. | CO2 | U | 10 |
|  | b. | Explain the mutual exclusion principle with respect to Raman and IR activity. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the principle of Mossbauer spectroscopy. | CO3 | R | 10 |
|  | b. | Explain the principles of X-ray photoelectron spectroscopy. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain hyperfine splitting in Mossbauer spectroscopy. | CO3 | U | 10 |
|  | b. | Explain Auger electron spectroscopy and its uses. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss chemical shift in NMR spectroscopy. List the factors that affect it. | CO4 | R | 10 |
|  | b. | Explain spin-spin splitting in proton NMR with examples. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain spin-spin and spin-lattice relaxation in NMR spectroscopy. | CO5 | U | 10 |
|  | b. | Write short notes on spectra of simple organic radicals in ESR. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Draw the Jablonski diagram and explain fluorescence and phosphorescence. | CO6 | U | 10 |
|  | b. | Explain Forster resonance energy transfer (FRET) and its application. | CO6 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Memorize the principles of spectroscopic techniques |
| CO2 | Summarize the unique properties of the different spectroscopy techniques |
| CO3 | Identify the technique required for a particular problem |
| CO4 | Analyze the samples using the spectroscopy techniques |
| CO5 | Predict the nature and properties of molecules using spectroscopy |
| CO6 | Utilize the spectroscopic techniques in solving the real level problems |

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

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| **Course Code** | **23CH3018** | **Duration** | **3hrs** |
| **Course Title** | **NUCLEAR CHEMISTRY AND SOLID STATE CHEMISTRY** | **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. | Describe the factors affecting nuclear stability with suitable example. | CO1 | R | 10 |
|  | b. | Write a short note on nuclear tunneling effect and nuclear cross section. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | **Classify different types of nuclear reactions with suitable diagrams and explain their significance.** | CO1 | A | 10 |
|  | b. | Highlight the salient features of breeder reactor. | CO1 | U | 5 |
|  | c. | **Assess the advantages of radioisotopes in diagnosing and treating brain tumors and bone fractures, considering their effectiveness and medical impact.** | CO1 | E | 5 |
|  |  |  |  |  |  |
| 3. | a. | **Analyse the Sterile Insect Technique (SIT) with a detailed explanation and a relevant example.** | CO2 | A | 10 |
|  | b. | Highlight the application of carbon dating in water and petroleum. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the thermo nuclear reaction with proton - proton and CNO cycle. | CO2 | U | 10 |
|  | b. | Write a note on Q value and transuranium. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | Describe the types of crystals structures with suitable example. | CO3 | U | 10 |
|  | b. | Highlight the elements of crystal in cubic crystal. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | **Compare the principles and applications of photoelectric effect and Peltier effect with suitable examples.** | CO3 | An | 10 |
|  | b. | **Distinguish the diamagnetic, paramagnetic, ferromagnetic, and ferrimagnetic materials based on their properties and applications.** | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Briefly discuss the co precipitation and sol gel method of preparation of solid state reactions. | CO4 | U | 10 |
|  | b. | Highlight the advantage of high pressure synthesis method for the preparation of solid state materials. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the principle and instrumentation of XRD technique. | CO5 | U | 10 |
|  | b. | Write short notes on intercalation and deintercalation. | CO5 | R | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the preparation of nanomaterials through ball milling and chemical vapor deposition method. | CO6 | R | 10 |
|  | b. | What is the requirement to prepare a coordination polymer and state the applications of coordination polymers? | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basic concepts of nuclear chemistry |
| CO2 | Summarize the applications of radioisotopes |
| CO3 | Outline the band theory of solids |
| CO4 | Classify the various types of solid state reactions |
| CO5 | Categorize the nanomaterials |
| CO6 | Demonstrate the applications of coordination polymers |

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

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| **Course Code** | **23CH3028** | **Duration** | **3hrs** |
| **Course Title** | **WASTE TO ENERGY** | **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. | a. | Describe the chemical properties of Municipal Solid Waste (MSW). Find out total energy of MSW. | CO1 | U | 10 |
|  | b. | Calculate the energy content of solid waste having following composition using modified Dulongs formula: Carbon is 36.5%, Hydrogen is 7.3%, Oxygen is 51.1%, Nitrogen 0.5%, Sulfur is 0.1% and Ash is 4.7%. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 2. | a. | Explain briefly the top-down and bottom-up method for synthesizing catalysts. | CO2 | A | 10 |
|  | b. | Explain the synthetic method of homogeneous catalyst with suitable schematic diagram. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 3. | a. | Highlight the principle and instrumentation of Gas Chromatography. | CO3 | R | 8 |
|  | b. | Explain the mechanism of the trans-esterification reaction for the biodiesel production. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Describe the construction and working model of floating dome biogas plant. | CO4 | R | 10 |
|  | b. | Explain the steps involved in the production of biogas and highlight the mechanism of each stages. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 5. | a. | Define the biomass pyrolysis. Explain the heat rate involved in pyrolysis process. | CO5 | U | 10 |
|  | b. | Highlight the application of activated charcoal. | CO5 | R | 6 |
|  |  |  |  |  |  |
| 6. | a. | Describe the catalysis mechanism for heterogeneous catalysts and include a schematic diagram to illustrate the process. | CO2 | R | 10 |
|  | b. | Write short notes on physical and chemical properties of biodiesel. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the issue of the energy crisis and evaluate how biodiesel can be a solution. Explain the importance of biodiesel in addressing energy challenges. | CO4 | An | 10 |
|  | b. | Explain the supercapacitor mechanism with Helmholtz electrode double layer. | CO5 | U | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Briefly discuss the construction and working method for the fixed bed gasifier. | CO6 | U | 10 |
|  | b. | Apply your knowledge on the gasification systems and explain the benchmark performance of the parameters in a gasifier. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concept of waste to energy conversion, based on its properties |
| CO2 | Select the conditions for biomass pyrolysis. |
| CO3 | Develop a small size biomass gasifier. |
| CO4 | Prepare biodiesel and analyze its performance. |
| CO5 | Understand the current research scenario in waste to energy application |
| CO6 | Design a community biogas plant. |

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

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| **Course Code** | **23CH3031** | **Duration** | **3hrs** |
| **Course Title** | **FORENSIC TOXICOLOGY** | **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 barbiturates. Explain the mechanism of action of barbiturates and give its medico-legal significance. | CO1 | U | 10 |
|  | b. | Describe the clinical features, treatment and medico-legal aspects of Phencyclidine. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define doping. Explain the procedure for conducting dope tests. | CO2 | U | 10 |
|  | b. | Classify prohibited substances in sports. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Define absolute alcohol. Explain the absorption, metabolism and excretion of alcohol in detail. | CO3 | U | 10 |
|  | b. | Differentiate between illicit liquor and country made liquor. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe active principles present in strychnine. Explain its post mortem findings and medico-legal significance. | CO4 | U | 10 |
|  | b. | Write a note on copper poisoning. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Define distillation. Explain different types of distillation used for extraction of poisons. | CO5 | R | 10 |
|  | b. | Give color test used for detection of opium. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the relationship between drug abuse and crime. | CO1 | An | 10 |
|  | b. | Describe the tolerance, addiction and withdrawal symptoms of narcotic drugs and psychotropic substances. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Define proof spirit. Explain the estimation of ethyl alcohol from blood. | CO3 | A | 10 |
|  | b. | Write a note on consequences of drunken driving. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe color test for diacetyl morphine. | CO6 | R | 10 |
|  | b. | Describe spot tests for detection of cocaine and nicotine. | CO6 | R | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe different instrumental methods used for the identification of drugs used in sports. | CO6 | U | 10 |
|  | b. | Describe color test used for detection of Barbiturates. | CO6 | R | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Enumerate the chemical composition and properties of narcotics, drugs, and psychotropic substances |
| CO2 | Describe the Issue of Substance Abuse in Sports. |
| CO3 | Compute the various contaminants present in alcoholic beverages. |
| CO4 | Infer the analysis of toxicological aspects and poisons. |
| CO5 | Choose an assessment on the extraction process of drugs from diverse matrices. |
| CO6 | Speculation of drugs using various methods. |

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

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| **Course Code** | **23CH3037** | **Duration** | **3hrs** |
| **Course Title** | **CHROMATOGRAPHY** | **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. | Explain the role of polarity in Thin Layer Chromatography and Column Chromatography. | CO1 | U | 10 |
|  | b. | Assess the efficiency of Column Chromatography in complex mixture separation. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Demonstrate the application of silica gel mesh in chromatography for effective separation. | CO1 | A | 10 |
|  | b. | Compare Thin Layer Chromatography and Column Chromatography in chemical analysis. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Examine different types of detectors used in Gas Chromatography and determine their advantages and limitations. | CO2 | An | 10 |
|  | b. | List the components of a Gas Chromatography (GC) system and explain their functions. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the application of Gas Chromatography in the separation of volatile compounds. | CO2 | A | 10 |
|  | b. | Assess the effectiveness of Gas Chromatography in forensic and environmental analysis. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | **Implement** the role of different detectors in HPLC for analyzing unknown chemical compounds. | CO3 | A | 10 |
|  | b. | Investigate the differences between HPLC, UHPLC, and UPLC in terms of efficiency and performance. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | **Use** the principles of HPLC to develop a method for separating complex mixtures in pharmaceutical analysis. | CO3 | A | 10 |
|  | b. | Explain the working principles and components of an HPLC system. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | **Examine** the role of CO₂ as a carrier phase in SFC and its impact on method development and cost estimation. | CO4 | An | 10 |
|  | b. | **Utilize** the principles of Supercritical Fluid Chromatography (SFC) to develop a preparative approach for pharmaceutical compound separation. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | **Implement** the chromatogram obtained from different chromatographic techniques to determine the purity and composition of a given sample. | CO5 | A | 10 |
|  | b. | Rate the accuracy and reliability of chromatograms from different techniques. | CO5 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | **Describe** the semi-preparative approach and method development in Flash Chromatography. | CO6 | A | 10 |
|  | b. | **Explain** the principles and instrumentation of Flash Chromatography. | CO6 | U | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Illustrate the principles of chromatographic techniques. |
| CO2 | Distinguish between different chromatographic techniques. |
| CO3 | Apply the appropriate technique for separation of complex compounds |
| CO4 | Identify the exact chromatography technique to purify the synthesized compound |
| CO5 | Interpret the chromatogram obtained from various techniques. |
| CO6 | Familiarize the chromatography skills in the laboratory. |