

QUESTION BANK

Section: CSA, 1st semester
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Course: CHEMISTRY OF SMART MATERIALS AND DEVICES (Category: Professional Core Course) Stream:CS (Theory and Practice)	
Unit-I	8 Hrs
Sustainable chemistry and E-waste management: Biomaterials: Introduction, bio-degradable and bio-compatible polymeric materials: synthesis and applications (Polymers and hydrogels in drug delivery). Green Chemistry: Introduction, 12 principles with real life examples, validation of greenness. E-waste: Hazards and toxicity, segregation and recycling (Hydrometallurgy, pyrometallurgy and direct recycling). Extraction of valuable metals from E-waste. Battery waste management and recycling, circular economy- case studies.	
Unit-V	9 Hrs
Advanced energy systems: Battery technology: Introduction to electrochemistry, characteristics of battery, Lithium-ion battery, metal air batteries. Battery technology for e-mobility.	

Questions

- 1) What is bio-degradable polymers?
- 2) Name the enzymes used to break C-C, C-O, C-N, P-N bonds in biodegradable polymers.
- 3) Explain the mechanism of degradation of polymers by microorganisms.
- 4) List the factors influencing the degradation of polymers.
- 5) What are the characteristics of biodegradable polymers?
- 6) What is PLA? How it is prepared?
- 7) What is Lactide? Write the three possible isomers of Lactide?
- 8) How do you convert corn to lactic acid?
- 9) Explain the different synthetic routes to prepare PLA.
- 10) Name the coupling agents used in PLA synthesis.
- 11) Name the catalyst used in direct condensation polymerization of lactic acid to low molecular weight PLA.
- 12) Propose the microbial/enzymatic degradation of PLA.
- 13) Discuss the degradation mechanisms of PLA in acidic and basic medium.
- 14) List the biomedical applications of PLA.
- 15) Discuss the synthesis of PHBV with suitable chemical reactions.
- 16) List the biomedical applications of PHBV.
- 17) What are hydrogels? Discuss different types with suitable examples.
- 18) Highlight the applications of hydrogels.
- 19) Explain the principles of green chemistry (GC) with suitable examples.
- 20) Give an example for GC3 (Less Hazardous Chemical Synthesis) and GC4 (Designing Safer Chemicals) and highlight their significance.

- 21) Calculate the atom economy for the following reactions:
- 22) Calculate the atom economy for the reaction involving the reduction of ferric oxide to metallic iron using CO gas. Fe = 56; C = 12, O = 16 Ans: 46%
- 23) Calculate the atom economy for the reaction involving fermentation of glucose to yield ethanol. Ans: 51%
- 24) Calculate the atom economy for the reactions involving:
 - (i) the reduction of CuO to Cu with methane gas : Ans – 76%
 - (ii) the reduction of CuO to Cu with hydrogen gas: Ans – 78%
- 25) Identify the safer solvents as per green chemistry principle 5 among: (a) Benzene Vs Water, (b) Ethanol Vs Toluene, (c) Pyridine vs Acetone.
- 26) Explain the importance of designing the experiments considering the energy efficiency according to green chemistry principle with suitable example.
- 27) Discuss the significance of green chemistry principle no GC7: Use of Renewable Feedstock, with a suitable example.
- 28) Explain the importance of GC8: (Reduce Derivatives), GC9: (Catalysis), and GC10. (Design For Degradation).
- 29) Highlight the significance of GC11. (Real-Time Analysis for Pollution Prevention) and GC12. (Inherently Safer Chemistry For Accident Prevention)
- 30) Discuss the steps involved in the hydrometallurgical extraction of copper from E-waste.
- 31) What is leaching? Highlight their importance in hydrometallurgy.
- 32) Discuss the steps involved in the recycling of lead from lead-acid battery.
- 33) How do separate the ferrous and non-ferrous metals from e-waste.
- 34) What is smelting and explain its significance in pyrometallurgy.
- 35) Discuss the steps involved in the pyrometallurgical extraction of cobalt and lithium from spent batteries.
- 36) Discuss the circular economy approach for E-waste management taking a case study.
- 37) What is an electrode and an electrode potential?
- 38) What is galvanic cell? Give an example.
- 39) Explain the important components of battery and their significance.
- 40) Discuss the types of battery with suitable examples.
- 41) With a neatly labelled diagram, explain the construction, working and redox reactions of the Li-CoO₂ battery during discharging and charging.
- 42) What is secondary battery? Write a short note of voltage, energy density, and cycle life of the battery.
- 43) Define capacity, voltage and shelf life of battery?
- 44) Why does, the Li ion battery demands non-aqueous electrolyte?
- 45) Explain the construction and working principle of Li-Air battery with reactions.
- 46) Write a note on EV Battery Technology.