

Reg No : Name :

**MAR ATHANASIUS COLLEGE OF ENGINEERING, KOTHAMANGALAM**

(Govt. Aided Autonomous Institution)

First Semester B.Tech. Degree (SAY) Examination, February, 2026

Course Code: B24CY1T01A

Course Name: Engineering Chemistry (A)

(Common for EC, CS, DS & AI Branches)

Max. Marks: 100

Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)**Answer all questions**

1. How SiO_2 nanoparticles are prepared by sol-gel method?
2. Explain the structural features of graphene that contribute to its exceptional strength.
3. Calculate the wavenumber in cm^{-1} of the O-H bond, if the force constant is 770 Nm^{-1} and the reduced mass is $1.563 \times 10^{-27} \text{ kg}$.
4. Why electronic spectrum appears to be broad?
5. Sketch calomel electrode. Write the electrode representation.
6. Construct a cell using Cu/Cu^{2+} and Al/Al^{3+} electrodes. Write the cell reactions and cell representations of the cell. Given that $E^0_{\text{Al}^{3+}/\text{Al}} = -1.66 \text{ V}$, $E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$.
7. Write any three challenges in the storage and transportation of hydrogen.
8. Why sodium is preferred over lithium for constructing secondary cells?
9. What are chemical sensors? Give examples.
10. Define smart materials. Provide examples.

PART - B: 70 Marks (5 Qns x 14 Marks)**Answer any one full question from each module.****Module 1**

11. a. What is top-down approach for the synthesis of nanomaterials? Explain the (8 Marks) process involved in mechanical milling.
b. Differentiate nanomaterials and bulk materials. (6 Marks)

OR

12. a. What are nanomaterials? Describe any three important properties of (8 Marks) nanomaterials.
- b. Discuss the process involved in laser ablation for the synthesis of (6 Marks) nanomaterials.

Module 2

13. a. Explain the various types of electronic transitions possible in UV-visible (8 Marks) spectroscopy. Give an example for each transition. Draw the energy level diagram to represent these transitions.
- b. Discuss the different regions in the IR spectrum. How can we differentiate (6 Marks) inter and intramolecular hydrogen bonding by IR spectroscopy?

OR

14. a. What is the condition for IR activity? Calculate and sketch the vibrational (8 Marks) modes for CO_2 and H_2O and select the IR active modes.
- b. State Beer Lambert's law. A solution of a compound has an absorbance of 0.60 (6 Marks) when measured at a wavelength 500 nm. Calculate the concentration of the solution, when the molar absorptivity is $600 \text{ mol}^{-1}\text{Lcm}^{-1}$ and the path length of the cuvette is 2 cm.

Module 3

15. a. Explain electroplating of copper and anodising of aluminium. (8 Marks)
- b. Define cathodic protection. Discuss sacrificial anodic protection and impressed (6 Marks) current cathodic protection.

OR

16. a. Determine the E^0_{cell} and concentration of Cd^{2+} ions in the following (8 Marks) electrochemical cell, $\text{Fe}/\text{Fe}^{2+} (0.1 \text{ M})//\text{Cd}^{2+} (x \text{ M})/\text{Cd}$. Write the cell reactions. Given $E_{\text{cell}} = -0.02 \text{ V}$, $E^0_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$ and $E^0_{\text{Cd}^{2+}/\text{Cd}} = -0.40 \text{ V}$ at 25°C .
- b. Describe electrochemical series (ECS). How ECS can be used to calculate the (6 Marks) equilibrium constant and to predict the spontaneity of a reaction?

Module 4

17. a. Explain the construction and working of PEMFC. Give its advantages. (8 Marks)
- b. What are supercapacitors? Explain the construction. (6 Marks)

OR

18. a. Explain the working of Li-ion battery. What materials are typically used for the anode and cathode in Li-ion battery? (8 Marks)
- b. List the advantages and applications of H_2 - O_2 fuel cells. (6 Marks)

Module 5

19. a. Explain the chemical and electrochemical synthesis of polypyrrole with equations. Give any two applications. (8 Marks)
- b. Explain the construction of OLED with a neat diagram. (6 Marks)

OR

20. a. Why doping is important for conducting polymers? How is polyacetylene doped using a Lewis acid and a Lewis base? (8 Marks)
- b. Draw the band structures for UF resin, Germanium and Silver. How conjugation affects the band gap in a polymer? (6 Marks)
