

2026/FYUG/EVEN/SEM/
CHMDSC 351T/123

FYUG Even Semester Exam., 2026

CHEMISTRY

(6th Semester)

Paper Code : CHMDSC 351T

(Advance Materials)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions.*

UNIT—I

1. Answer any *two* of the following questions :

2×2=4

- (a) Define nanomaterials. How are nanomaterials different from bulk materials?
- (b) What are carbon nanomaterials? Give two examples of carbon nanomaterials.
- (c) What is surface area to volume ratio? How does it affect the properties of nanomaterials?

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(Turn Over)

2. Answer any *one* of the following questions : 10

- (a) (i) Discuss the classification of nano-materials on the basis of dimensionality. How does dimensionality influence the density of states (DOS)? 2+1=3
- (ii) What is quantum confinement? Explain how quantum confinement affects the electronic structure of nanomaterials. 3
- (iii) Explain how catalytic properties of nanomaterials are influenced by surface properties. 2
- (iv) Discuss the applications of nanomaterials in environmental remediation. 2
- (b) (i) What are nanowires? How are they different from nanoultrathin films? 1+2=3
- (ii) What are semiconducting nanomaterials? How are properties of semiconducting nanomaterials change with their size? Discuss the applications of semiconducting nanomaterials. 1+2+2=5
- (iii) Explain how nanomaterials are used in energy applications. 2

UNIT—II

3. Answer any *two* of the following questions :

2×2=4

- (a) Explain the sol-gel process of nano-synthesis. What are its advantages?
- (b) Name two characterization techniques used to determine the morphology of nanomaterials.
- (c) Write a short note on green synthesis of metal nanoparticles.

4. Answer any *one* of the following questions : 10

(a) (i) Write short notes on the following :

2+2=4

- (1) Laser Ablation technique for nanosynthesis
- (2) Solvothermal method of nano-synthesis

(ii) What is scanning electron microscopy (SEM)? Describe the instrumentation and working principle of SEM. How is SEM useful in nanomaterial characterization?

2+3+1=6

- (b) (i) Explain how metal oxide nanomaterials can be synthesized by green synthesis. 3
- (ii) Discuss the role of UV-vis spectroscopy in nanomaterial characterization. 3
- (iii) What is transmission electron microscopy (TEM)? Describe the advantages and limitations of transmission electron microscopy (TEM). 2+2=4

UNIT—III

5. Answer any *two* of the following questions :

2×2=4

- (a) What are composite materials? Describe the components of composite materials.
- (b) List two limitations of traditional monolithic materials that composite materials aim to overcome.
- (c) What is the key difference between thermosetting and thermoplastic polymer matrices?

6. Answer any *one* of the following questions : 10

(a) (i) Explain how the matrix materials contribute to the integrity and overall performance of composite. 3

(ii) Write short notes on the following :
2+2=4

(1) Polymer matrix composites (PMC)

(2) Metal matrix composites (MMC)

(iii) Discuss the applications of composite materials. 3

(b) (i) Compare and contrast polymer matrix composites (PMC) and metal matrix composites (MMC) in terms of their typical operating temperature, processing characteristics and general applications. 3

(ii) What are carbon fibre composites? Discuss their characteristics and applications. 3

(iii) Describe the main types of fibre reinforcement used in composites and outline their key properties and applications. 2+2=4

UNIT—IV

7. Answer any *two* of the following questions :

2×2=4

- (a) Define liquid crystal and explain what is meant by 'mesophase'.
- (b) Briefly explain the concept of 'anisotropy' in the context of liquid crystals.
- (c) What is an emulsifier? What is its function?

8. Answer any *one* of the following questions : 10

- (a) (i) Discuss the general characteristics of liquid crystals that distinguish them from both conventional solids and isotropic liquids. 3
- (ii) Explain the role of the rigid core and flexible tails in the molecular architecture of thermotropic liquid crystals. 3
- (iii) Compare and contrast anionic and nonionic surfactants, providing at least one example of each class. 2
- (iv) Briefly explain the hydrophobic effect in the context of micelle formation. 2

- (b) (i) Compare and contrast the Smectic A (SmA) and Smectic C (SmC) phases of liquid crystals in terms of their molecular arrangement and optical properties. 3
- (ii) Discuss the applications of liquid crystals. 2
- (iii) What is critical micelle concentration (CMC)? Discuss various factors that influence CMC. 3
- (iv) Explain the principle of emulsion formation. How do static and electrostatic stabilization work in emulsion formation? 2

UNIT—V

9. Answer any *two* of the following questions :

2×2=4

- (a) Differentiate between addition polymerization and condensation polymerization.
- (b) Name the monomers used for the preparation of Nylon-6,6.
- (c) What is meant by number-average molecular mass (M_n) and mass-average molecular mass (M_w)?

10. Answer any *one* of the following questions : 10

- (a) (i) Describe the free-radical mechanism for the addition polymerization of ethene. 4
- (ii) Discuss the classification of polymers based on tacticity with suitable examples. 3
- (iii) What are conducting polymers? What is the molecular basis for electrical conductivity of conducting polymers and how can it be enhanced through doping? 3
- (b) (i) Calculate the number average and mass average of a polymer sample containing 25% of polymer A and 75% of polymer B. The molecular weights of A and B are 5000 and 50000 respectively. $2+2=4$
- (ii) What is Ziegler-Natta catalysis? Discuss the mechanism of Ziegler-Natta catalysis by taking suitable example. Discuss the advantages of Ziegler-Natta catalysis. $1+3+2=6$

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