R4583

Sub. Code
25MPC2C1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

INORGANIC CHEMISTRY – II

(CBCS – 2025 onwards)

Time : Three Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. The denticity and number of double bonds, respectively, present in porphyrin is (CO1, K2)

   (a) tetradentate and 11 double bonds

   (b) tridentate and 9 double bonds

   (c) bidentate and 9 double bonds

   (d) pentadentate and 9 double bonds

2. Which among the following molecular type exhibit facial and meridional isomerism? (CO1, K2)

   (a) square planar MA_2B_2

   (b) octahedral MA_3B_3

   (c) tetrahedral MA_2B_2

   (d) octahedral MA_2B_4

3. In an octahedral field, the maximum CFSE exhibited by (CO2, K2)

(a) high-spin d^5 (b) d^3

(c) d^8 (d) d^1

4. The orbital contribution to magnetic moment is significant in the case of (CO2, K2)

(a) first-row transition metal complexes

(b) diamagnetic complexes

(c) second- and third-row transition metal complexes

(d) d^0 complexes

5. Hund's first rule states that (CO3, K2)

(a) lowest energy corresponds to minimum spin multiplicity

(b) lowest energy corresponds to maximum spin multiplicity

(c) lowest energy corresponds to maximum L

(d) lowest energy corresponds to minimum L

6. The $f \rightarrow f$ transitions in lanthanide ions are (CO3, K2)

(a) Laporte allowed

(b) spin forbidden

(c) charge–transfer transitions

(d) parity forbidden but become weakly allowed

7. Water exchange in $[Cr(H_2O)_6]^{3+}$ occurs through __________ Mechanism. (CO4, K2)

(a) A (b) D

(c) Ia (d) Id

8. Which among the following ligand commonly acts as a bridge in inner-sphere reactions? (CO4, K2)

(a) NH_3 (b) CN^-

(c) H^2O (d) CO

9. In general, the first step in most of the homogeneous organometallic catalytic cycles is (CO5, K2)

(a) p-Hydride elimination

(b) oxidative addition

(c) reductive elimination

(d) migratory insertion

10. The oxidation state of rhodium in Wilkinson's catalyst is (C05, K2)

(a) 0 (b) +1

(c) +2 (d) +3

Part B $(5 \times 5 = 25)$

Answer **all** questions not more than 500 words each.

11. (a) Write note on step-wise and overall stability constants and their importances. (CO1, K3)

Or

(b) Analyse the absolute stereochemistry of $[Co(II)(en)_3]$ complex using CD and ORD spectroscopic techniques. Where, en = ethylenediamine. (CO1, K3)

12. (a) Elaborate on static and dynamic Jahn-Teller distortion and their impact on electronic absorption spectral properties of complexes. (CO2, K5)

Or

(b) Explain nephelauxetic effect and factors affecting it. (CO2, K5)

13. (a) (i) List out the limitations of Orgel diagram.

(ii) Distinguish d-d and LMCT transition and give examples. (CO3, K3)

Or

(b) Give a comparative account on the electronic absorption spectral properties of transition metals and lanthanides. Give examples. (CO3, K3)

14. (a) Critically analyse the mechanism of S_N 1cB reaction taking place in coordination complexes and give example. (CO4, K4)

Or

(b) Explain how the trans effect controls the product formation in the stepwise substitution of ligands in square–planar Pt(II) complexes. (CO4, K4)

15. (a) List out the advantages and disadvantages of both homogenous and heterogenous catalysts. (CO5, K4)

Or

(b) Sketch and explain on the mechanism of Wacker process. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Discuss, in detail, the factors affecting the stability of the complexes. (CO1, K4)

Or

(b) How would you determine the formation constant of complexes using the Bjerrum's half and Job's methods? (CO1, K4)

17. (a) (i) Draw the d-orbital splitting diagram of metal complexes under square pyramidal and square planar coordination environment.

(ii) Write a note on the factors affecting the CFSE. (CO2, K5)

Or

(b) Sketch and explain the sigma and pi bond formation in octahedral complexes using MOT. (CO2, K5)

18. (a) (i) Using L-S coupling, arrive the possible energy terms of p^2 and d^2 free ions.

(ii) How spin-orbit and vibronic couplings affect the UV-vis spectral features of the complexes? (CO3, K5)

Or

(b) Draw and explain the Tanabe—Sugano diagram for a d^7 ion in octahedral field, and discuss its features in weak-field and strong-field cases. (CO3, K5)

19. (a) (i) Elaborate on Marcus-Hush theory of electron-transfer and its applications.

(ii) Distinguish inner- and outer–sphere electron–transfer reactions. (CO4, K4)

Or

(b) Discuss, in detail, the mechanism and energy profile diagrams of associative and dissociative ligandsubstitution reactions. (CO4, K4)

20. (a) Discuss, in detail, the polymerisation of olefins and Monsanto acetic acid processes. (CO5, K5)

Or

(b) Elaborate on Reppe's and ZSM-5 catalysts and the reactions catalysed by them. (CO5, K5)

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R4584

Sub. Code
25MPC2C2

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

ORGANIC CHEMISTRY II

(CBCS – 2025 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. When an alkene is treated with I_2 and silver benzoate (C_6H_5COOAg) in anhydrous (dry) benzene, followed by hydrolysis, the major product is (CO1, K2)

   (a) A syn-1,2-diol (cis-diol)

   (b) An anti-l,2-diol (trans-diol)

   (c) A vicinal di-iodide

   (d) An epoxide

2. Which of the following describes the electronic configuration of a singlet carbene? (CO1, K2)

   (a) The carbon atom is sp hybridized with a linear geometry

   (b) The two non-bonding electrons have opposite spins and occupy the same sp2 hybrid orbital

   (c) The carbon atom has an octet of electrons

   (d) The two non-bonding electrons have parallel spins and occupy two different orbitals

3. Which of the following molecules will undergo a homocoupling Benzoin Condensation in the presence of ethanolic KCN? (CO2, K1)

(a) CH_3CHO

(b) C_6H_5CHO

(c) CH_3COCH_3

(d) $C_6H_5CH_2CHO$

4. What is the key four-membered cyclic intermediate formed during the Wittig reaction mechanism? (CO2, K1)

(a) Epoxide

(b) Betaine

(c) Oxaphosphetane

(d) Enolate

5. E1cB mechanism is followed in the reaction of (CO3, K2)

(a) 2-Bromopentane with t-BuOK to give pent-2-ene

(b) Nitromethane with benzaldehyde in the presence of KOH to give Beta nitrostyrene

(c) Bromobenzene with $NaNH_2$ to give aniline

(d) Para-Chloronitrobenzene with NaOMe to give para-nitroanisole

6. Which of the following bases would most likely lead to a Hofmann product as the major organic species in an E2 reaction with 2-bromo-2-methylbutane? (CO3, K2)

(a) NaOH (b) $NaOCH_3$

(c) KO-t-Bu (d) NaOEt

7. The Pinacol rearrangement is an example of which type of reaction mechanism? (CO4, K1)

(a) E1

(b) Nucleophilic unimolecular rearrangement

(c) Free radical substitution

(d) SN^2

8. The regioselectivity of the Shapiro reaction usually favors the formation of (CO4, K2)

(a) The less substituted alkene (Hofmann product)

(b) The more substituted alkene (Zaitsev product)

(c) A mixture of 50% cis and 50% trans

(d) An alkyne

9. In the mechanism of DDQ oxidation, the rate-determining step usually involves (CO5, K2)

(a) Coordination of DDQ to a metal catalyst

(b) Formation of a free radical

(c) Loss of a proton (H^+) from the substrate

(d) Transfer of a hydride ion (H^-) to the DDQ oxygen

10. Which of the following solvents is most appropriate for a reaction involving DIBAL-H? (CO5, K1)

(a) Water (b) Toluene

(c) Ethanol (d) Acetic Acid

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Discuss about the Woodward Oxidation. Write the reagents used and explain its mechanism with a suitable example. How does it differ from the Prevost reaction? (CO1 K3)

Or

(b) Explain the Michael Addition reaction with a suitable mechanism with example. (CO1, K4)

12. (a) Write the reaction, mechanism and its one application of Stobbe condensations. (CO2, K5)

Or

(b) Write the reaction and its mechanism of Darsen glycidic ester reaction. (CO2, K2)

13. (a) Explain pyrolytic elimination reactions with mechanism. (CO3, K4)

Or

(b) Using example discuss the mechanism of Chugaev and Cope elimination. (CO3, K4)

14. (a) Explain the Dienone-phenol rearrangement with an example. highlighting why aromatization is a driving force. (CO4, K4)

Or

(b) Brief about dieckmann cyclization with proper mechanism and its importance. (CO4, K4)

15. (a) Give any two applications of Jones and PDC reagents. (CO5, K5)

Or

(b) Elaborate the importance of $NaBH_4$ and Red-AL reducing agents. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain the structure, generation and stability of singlet and triplet carbenes and discuss the mechanism of the Reimer-Ticmann reaction which involving carbene as intermediate? (CO1, K5)

Or

(b) What is Sharpless Asymmetric Epoxidation? Elaborate with its significance, catalytic system, stereochemistry, and its mechanism. (CO1, K4)

17. (a) What are the major applications of the Mannich reaction in organic synthesis and industry? Explain how Mannich bases are used to prepare other functional groups, such as α-methylene ketones. (CO2, K5)

Or

(b) Explain the reaction mechanism of Corey's olefination reaction and give its applications. (CO2, K4)

18. (a) Predict the favorable substrate, structure, solvent, and base for elimination. (CO3, K5)

Or

(b) Explain E2 elimination in cyclohexane ring. Give one example. (CO3,K5)

19. (a) Brief Wagner Meerwin and Benzidine rearrangement with mechanism. Give two synthetic applications. (CO4, K4)

Or

(b) Elaborate the mechanism of Claisen and cope rearrangement with two examples. (CO4, K6)

20. (a) Discuss the oxidation reactions using IBX and DMP reagents. How it is useful in synthetic chemistry. (CO5, K4)

Or

(b) How Selectrides and DIBAL-H are useful in reduction reaction, give two applications. (CO5, K4)

R4585

Sub. Code
25MPC2C3

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

PHYSICAL CHEMISTRY – II

(CBCS – 2025 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following objective type questions by choosing the correct option.

1. Recall how the energy of a particle in a one-dimensional box of length L depends on the quantum number (n) and the box length (CO1, K1)

   (a) n/L (b) n^2/L^2

   (c) n/L^2 (d) n^2/L

2. Identify the essential mathematical requirements that a wave function (ψ) must satisfy according to the postulates of quantum mechanics. (CO1, K1)

   (a) Complex and imaginary

   (b) Single-valued, finite, and continuous

   (c) Zero everywhere

   (d) Always positive

3. The bond order of the H_2^+ molecule ion, according to simple MO theory, is (CO2, K1)

(a) 0 (b) 1/2

(c) 1 (d) 2

4. According to Pauli's exclusion principle, a Slater determinant ensures (CO2, K2)

(a) Electrons are distinguishable

(b) Wave function is symmetric with respect to electron exchange

(c) Wave function is antisymmetric with respect to electron exchange

(d) All electrons have the same spin

5. Interpret the selection rule for vibrational transitions in a harmonic oscillator mode (CO3, K2)

(a) $\Delta v = \pm 1$ (b) $\Delta v = \pm 2$

(c) $\Delta v = 0, \pm 1$ (d) $\Delta v =$ any integer

6. Apply your knowledge of vibrational-rotational spectroscopy to determine the origin of the P,Q and R branches in a spectrum (CO3, K3)

(a) Transitions between different electronic states

(b) Simultaneous vibrational and rotational transitions

(c) Isotopic substitution

(d) Fermi resonance

7. Select the appropriate light sources used in atomic absorption spectroscopy (CO4, K1)

(a) Tungsten lamp

(b) Deuterium lamp

(c) Hollow cathode lamp

(d) Xenon arc lamp

8. In coulometry the quantity of electricity passed is related to the amount of analyte by (CO4, K2)

(a) Beer-Lambert law

(b) Faraday's laws of electrolysis

(c) Nernst equation

(d) Ohm's law

9. In Thermogravimetric analysis, the measured parameter is (CO5, K2)

(a) Heat flow (b) Mass change

(c) Dimension change (d) Modulus change

10. In Differential Thermal Analysis, the endothermic or exothermic events are recorded as (CO5, K2)

(a) Weight loss steps

(b) Temperature difference (Δ T) vs. temperature

(c) Heat capacity change

(d) Current change

Part B $(5 \times 5 = 25)$

Answer **all** questions not more than 500 words each.

11. (a) Derive the time-independent Schrödinger wave equation from the classical wave equation, clearly stating the assumptions involved. (CO1, K4)

Or

(b) Explain the five fundamental postulates of quantum mechanics and discuss their physical significance. (CO1, K2)

12. (a) Analyze Pauli's exclusion principle and explain how Slater determinants ensure antisymmetry in many-electro wave functions. (CO2, K4)

Or

(b) Apply the Russell-Saunders (L-S) coupling scheme to derive term symbols and explain their significance in atomic spectroscopy. (CO2, K3)

13. (a) Analyze the non-rigid rotor model and evaluate the effect of centrifugal distortion on rotational spectra. (CO3, K4)

Or

(b) Analyze the theory of rotational Raman spectroscopy, state the selection rules. and derive the expression for Raman shifts. (CO3, K4)

14. (a) Explain the principle and instrumentation of amperometric titrations and interpret the different types of titration curves with suitable examples. (CO4, K3)

Or

(b) Explain the principle of Energy Dispersive X-ray Analysis and discuss its applications in materials characterization. (CO4, K2)

15. (a) Explain the principle and instrumentation of thermogravimetric analysis. (CO5, K2)

Or

(b) Analyze a typical thermogravimetric curve and interpret the information obtained from different regions of the curve. (CO5, K4)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Explain Heisenberg's uncertainty principle using a commutator. Illustrate the operators $A = \frac{d}{dx}$ and $B = 3$, whether they commute each other or not, for the function of $f(x) = x^2 + 3e^x$. (CO1, K4)

Or

(b) Apply the Schrödinger time-independent wave equation to a particle confined in a three-dimensional box and derive the allowed wave functions, quantized energy levels, and normalized wave functions. (CO1, K4)

17. (a) State and prove the variation theorem, and apply the variation method using an appropriate trial wave function to estimate the ground state energy of the helium atom. Compare the result with the experimental value. (CO2, K5)

Or

(b) Analyze time-independent non-degenerate perturbation theory and apply it to determine the first-order correction to the ground state energy of helium atom. (CO2, K4)

18. (a) Analyze the theory of microwave spectroscopy for diatomic molecules and derive expressions for the rotational constant and bond length from the observed spectrum. (CO3, K4)

Or

(b) Analyze the vibrational spectra of diatomic molecules, taking anharmonicity into account. Explain the concepts of overtones and Fermi resonance, providing suitable examples to illustrate each. (CO3, K4)

19. (a) Analyze the different types of currents observed in polarography and explain the origin and suppression of maxima. (CO4, K4)

Or

(b) Analyze the principle of X-ray Photoelectron Spectroscopy and discuss binding energy, chemical shifts, and how XPS provides information about oxidation states and chemical environment. (CO4, K4)

20. (a) Explain the principle and instrumentation of Scanning Tunnelling Microscopy and illustrate the constant current and constant height modes of operation. (CO5, K3)

Or

(b) Analyze Thermogravimetric Analysis, including its principle, instrumentation, factors affecting TGA curves, and applications in polymer degradation and compositional analysis. (CO5, K4)

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R4586

Sub. Code
25MPC2C4

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

PHYSICAL CHEMISTRY OF POLYMERS

(CBCS – 2025 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 1 = 10)

Answer **all** the following objective type questions by choosing the correct option.

1. The predominant intermolecular force responsible for the high tensile strength and structural stability of cellulose is (CO1, K1)

   (a) Van der Waals forces

   (b) Tonic bonding

   (c) Hydrogen bonding

   (d) Metallic bonding

2. A copolymer consisting of regularly alternating styrene and butadiene units is structurally classified as a (CO1, K1)

   (a) Random copolymer

   (b) Alternating copolymer

   (c) Block copolymer

   (d) Graft copolymer

3. For a polymer sample with a broad molecular weight distribution, which statement is true? (CO2, K1)

(a) $M_n = Mw$ (b) $M_n > Mw$

(c) $Mw > M_n$ (d) $Mv = M_n$

4. Which of the following is the correct mathematical expression for the number average molecular weight ($\overline{M}_n$) of a polymer sample? (CO2, K1)

(a) $\overline{M}_n = \frac{\Sigma N_i M_i^2}{\Sigma N_i M_i}$ (b) $\overline{M}_n = \frac{\Sigma N_i M_i}{\Sigma N_i}$

(c) $\overline{M}_n = \frac{\Sigma N_i}{\Sigma N_i M_i}$ (d) $\overline{M}_n = \frac{\Sigma N_i M_i^3}{\Sigma N_i M_i}$

5. Which colligative properly method is NOT typically used for polymers? (CO3, K2)

(a) Osmometry (b) Ebulliometry

(c) Cryoscopy (d) All are commonly used

6. In Gel Permeation Chromatography (GPC), the largest molecules elute (CO3, K2)

(a) First, because they cannot enter the pores

(b) Last, because they are retained in the pores

(c) At the same time as small molecules

(d) Their elution is independent of size

7. Which factor generally increases the Tg of a polymer? (CO4, K2)

(a) Addition of a plasticizer

(b) Decreasing molecular weight

(c) Introduction of bulky side groups

(d) Increasing chain flexibility

8. The glass transition temperature is best described as the temperature at which (CO4, K1)

(a) A crystalline polymer melts into a liquid

(b) An amorphous polymer changes from a hard, glassy state to a rubbery, leathery state

(c) The polymer begins to degrade chemically

(d) All polymer chains become perfectly aligned

9. In a DSC thermogram, the glass transition appears as (CO5, K2)

(a) A sharp exothermic peak

(b) A sharp endothermic peak

(c) A step change in heat capacity

(d) A weight loss step

10. For detecting a subtle glass transition in a highly cross-linked thermoset polymer, which technique is most sensitive? (CO5, K2)

(a) Dilatometry

(b) DSC at high heating rates

(c) DMA in tension mode

(d) Refractive index measurement

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Define and briefly explain the following terms as used in polymer chemistry (CO1, K2)

(i) Monomer

(ii) Polymer

(iii) Degree of Polymerization

(iv) Repeating Unit.

Or

(b) Explain the concept of monomer functionality and its role in determining linear and cross-linked polymer structures. (CO1, K4)

12. (a) Define number-average molecular weight $\left(\overline{M}_n\right)$ and weight-average molecular weight $\left(\overline{M}_w\right)$. Differentiate between them. (CO2, K3)

Or

(b) Define the critical molecular weight for entanglement (Mc). Describe its significance in polymer processing. (CO2, K3)

13. (a) Explain the principle of universal calibration in Gel Permeation Chromatography (GPC). (CO3, K4)

Or

(b) Outline the basic principle of light scattering in polymer molecular weight determination. (CO3, K5)

14. (a) Explain the method for predicting the glass transition temperature (Tg) of a random copolymer and outline the assumption involved in this prediction. (CO4, K4)

Or

(b) Explain how Tg is identified from a DSC thermogram. Define onset, midpoint and endpoint Tg. (CO4, K4)

15. (a) List the components of a Differential Scanning Calorimeter (DSC) and state their functions. (CO5, K2)

Or

(b) Discuss the storage modulus and loss modulus in Dynamic Mechanical Analysis. (CO5, K2)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Classify polymers based on origin, molecular architecture, and thermal behavior. Provide suitable examples and compare their structural characteristics. (CO1, K4)

Or

(b) Discuss the different types of intermolecular forces in polymers and analyze how they influence tensile strength, melting temperature, and stiffness. (CO1, K5)

17. (a) Describe the various models of molecular weight distribution. Explain the polymerization conditions under which each distribution is obtained. (CO2, K4)

Or

(b) Establish the relationship between degree of polymerization, molecular weight, and monomer functionality in step-growth polymerization. Include relevant equations. (CO2, K5)

18. (a) Explain the instrumentation and working principle of Gel Permeation Chromatography. Discuss how it provides a complete molecular weight distribution. (CO3, K4)

Or

(b) Discuss the light scattering method for determining molecular weight. Derive the expression used to calculate the weight-average molecular weight. ($\overline{M}_w$). (CO3, K5)

19. (a) Define glass transition temperature (Tg). Discuss in detail the factors affecting Tg, including backbone rigidity, side groups, molecular weight, hydrogen bonding, and plasticization. (CO4, K4)

Or

(b) Compare the Tg behavior of random, block, and graft copolymers. Explain the role of phase separation and composition. (CO4, K5)

20. (a) Describe the instrumentation of a modern DSC. Differentiate between heat-flux and power-compensated DSC. Explain how heat capacity is determined. (CO5, K4)

Or

(b) Discuss the theory of Dynamic Mechanical Analysis. Explain complex modulus, storage modulus, loss modulus, phase angle, and their relation to viscoelastic behavior. (CO5, K5)

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R4587

Sub. Code
25MPC2E1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

Elective: APPLIED POLYMER CHEMISTRY

(CBCS – 2025 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the following questions by choosing the correct option.

1. Contact adhesives are also known as (CO1, K2)

   (a) Hot-melt adhesives

   (b) Film adhesives

   (c) Epoxy adhesives

   (d) Anaerobic adhesives

2. Rubber-based adhesives show adhesion mainly due to (CO1, K2)

   (a) Crystallinity   (b) Elasticity

   (c) Brittleness   (d) High Tg

3. Roller coating is best suited for (CO2, K2)

   (a) Irregular surfaces

   (b) Flat substrates

   (c) Powder application

   (d) Electroplating

4. Powder coatings are applied using (CO2, K2)

(a) Solvent evaporation

(b) Electrostatic spray

(c) Dip coating

(d) Spin coating

5. Glass fibres are commonly used because of (CO3, K2)

(a) High cost

(b) Low strength

(c) Good strength-to-weight ratio

(d) Poor adhesion

6. Aramid fibres are known for (CO3, K2)

(a) Low impact resistance

(b) High toughness

(c) Low thermal stability

(d) High density

7. Latex particles are typically stabilized by (CO4, K2)

(a) Fillers (b) Surfactants

(c) Plasticizers (d) Antioxidants

8. The size of latex particles is usually in the range of (CO4, K2)

(a) mm (b) μm

(c) nm (d) cm

9. Agglomeration in recycling helps in (CO5, K2)

(a) Increasing brittleness

(b) Improving handling of flakes

(c) Reducing melting point

(d) Chemical degradation

10. Thermal recycling includes (CO5, K2)

(a) Washing (b) Sorting

(c) Pyrolysis (d) Shredding

Part B (5 × 5 = 25)

Answer **all** questions not more than 500 words each.

11. (a) Explain pressure-sensitive adhesives with examples. (CO1, K3)

Or

(b) Discuss hot-melt adhesives and their advantages. (CO1, K3)

12. (a) Describe solvent-based coatings and their limitations. (CO2, K3)

Or

(b) Explain high-solid coatings with applications. (CO2, K3)

13. (a) Classify polymercomposites based on reinforcement. (CO3, K3)

Or

(b) Explain polymer—metal and polymer—ceramic composites. (CO3, K3)

14. (a) Explain the methods used to investigate latex properties. (CO4, K3)

Or

(b) Discuss the stability of polymer latex. (CO4, K3)

15. (a) Explain identification techniques used in plastic recycling. (CO5, K3)

Or

(b) Describe waste disposal options for polymeric materials. (CO5, K3)

Part C (5 × 8 = 40)

Answer **all** questions not more than 1000 words each.

16. (a) Analyze the structure—property relationship of different types of adhesives. (CO1, K4)

Or

(b) Evaluate the selection criteria for industrial adhesives. (CO1, K4)

17. (a) Discuss coating selection based on substrate and service conditions. (CO2, K5)

Or

(b) Analyze advantages of power coating over conventional coatings. (CO2, K5)

18. (a) Explain in detail the properties and applications of fibre-reinforced polymer composites. (CO3, K4)

Or

(b) Evaluate fabrication techniques of polymer composites. (CO3, K4)

19. (a) Analyze the differences in properties of latex polymers formed by emulsion polymerization. (CO4, K5)

Or

(b) Evaluate applications of polymer latex in coatings and adhesives. (CO4, K5)

20. (a) Critically analyze different recycling techniques of polymers. (CO5, K6)

Or

(b) Design a sustainable polymer recycling process considering environmental impact. (CO5, K6)

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R4588

Sub. Code
25MPC2S1

M.Sc. DEGREE EXAMINATION, APRIL – 2026

Second Semester

Polymer Chemistry

ANALYSIS & INTERPRETATION OF NANOMATERIALS

(CBCS – 2025 onwards)

Time : Three Hours Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** the questions by choosing the correct option.

1. Which equation is primarily used to calculate the crystallite size from XRD peak broadening? (CO1, K2)

   (a) Bragg's Law

   (b) Scherrer Equation

   (c) Kubelka-Munk Function

   (d) Tauc's Equation

2. In an XRD pattern, the Miller indices (hkl) represent (CO1, K2)

   (a) Atomic weight

   (b) Lattice planes

   (c) Grain boundary

   (d) Micro strain

3. In SAED pattern analysis, a continuous ring pattern indicates that the material is (CO2, K2)

(a) Single crystalline

(b) Amorphous

(c) Polycrystalline

(d) Liquid

4. The scale bar in an SEM image is essential for determining: (CO2, K2)

(a) Chemical composition

(b) Feature size and magnification

(c) Crystallinity

(d) Conductivity

5. Which function is used to convert reflectance data into absorption coefficient for band gap finding? (CO3, K2)

(a) Gaussian function

(b) Lorentzian function

(c) Kubelka-Munk function

(d) Fourier transform

6. In Tauc's plot for a direct band gap semiconductor, the exponent 'n' in the equation $(\alpha h v)^n$ is (CO3, K2)

(a) 1/2 (b) 2

(c) 3/2 (d) 3

7. Gaussian peak fitting is commonly applied to which type of spectra to analyze peak parameters? (CO4, K2)

(a) UV-Vis spectra

(b) Raman spectra

(c) XRD spectra

(d) EDX spectra

8. Raman spectroscopy is highly effective in identifying the layer thickness of (CO4, K2)

(a) 0D nanomaterials

(b) 2D nanomaterials

(c) Bulk metals

(d) Liquids

9. Cyclic Voltammetry (CV) is primarily used to analyze (CO5, K2)

(a) Optical properties

(b) Magnetic properties

(c) Electrochemical properties

(d) Thermal stability

10. Specific capacitance is typically estimated from the area under the curve of (C5, K2)

(a) Tauc's plot

(b) Raman spectrum

(c) CV curve

(d) XRD pattern

Part B $(5 \times 5 = 25)$

Answer **all** questions not more than 500 words each.

11. (a) Calculate the d-spacing for a peak occurring at $2\theta = 45^{\circ}$ using Bragg's Law $(\lambda = 1.54 \text{Å})$. Explain the significance of the result. (CO1, K4)

Or

(b) Describe the procedure for indexing XRD peaks with Miller indices. (CO1, K3)

12. (a) Explain how to interpret a SAED pattern to distinguish between amorphous and crystalline materials. (CO2, K4)

Or

(b) Discuss the significance of scale bar data analysis in SEM and TEM studies. (CO2, K3)

13. (a) Explain the steps to find the band gap energy using the Kubelka-Munk function. (CO3,K4)

Or

(b) Differentiate between direct and indirect band gaps with relevant Tauc's plots. (CO3, K5)

14. (a) Describe the Gaussian fit function and its application in Raman spectra data analysis. (CO4, K3)

Or

(b) Explain how Raman spectroscopy is useful in identifying 1D and 2D nanomaterials. (CO4, K4)

15. (a) Outline the process of estimating specific capacitance from cyclic voltammetry (CV) data. (CO5, K5)

Or

(b) Explain the concept of Rietveld refinement and its use in band structure analysis. (CO5, K4)

Part C $(5 \times 8 = 40)$

Answer **all** the following questions not more than 1000 words each.

16. (a) Elaborate on the calculation of grain size, micro strain, and dislocation density from XRD data using relevant formulas. (CO1, K4)

Or

(b) Analyze the importance of JCPDS cards in the identification of unknown crystalline phases in nanomaterials. (CO1, K4)

17. (a) Evaluate the methods used for the estimation of d-spacing and hkl values from TEM/SAED data. (CO2, K4)

Or

(b) Discuss in detail the interpretation of nano–morphologies using SEM and TEM scale bar analysis. (CO2, K4)

18. (a) Analyze the procedure for constructing a Tauc's plot from optical spectra to determine the band gap of a semiconductor. (CO3, K5)

Or

(b) Discuss the relationship between nano-size and band gap energy (Quantum Confinement Effect). (CO3, K5)

19. (a) Demonstrate the method of multiple peak fitting using Raman spectra and intensity calculation. (CO4, K4)

Or

(b) Evaluate the role of Gaussian peak fitting in improving the resolution and accuracy of Raman spectral analysis. (CO4, K4)

20. (a) Discuss the electrochemical data analysis for supercapacitor device applications, focusing on CV curves. (CO5, K6)

Or

(b) Propose a method to analyze electron density maps and band structures for different nanomaterials using Rietveld refinement. (CO5, K6)
