Total number of printed pages–12

3 (Sem–5/CBCS) CHE HE4/HE5/HE6

2024

CHEMISTRY

(Honours Elective)

Answer the Questions from any one Option.

OPTION – D

(Novel Inorganic Solids)

Paper : CHE–HE–5046

OPTION – E

(Polymer Chemistry)

Paper : CHE–HE–5056

OPTION – F

(Instrumental Methods of Chemical Analysis)

Paper : CHE–HE–5066

Full Marks : 60

Time : Three hours

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

Contd.

OPTION – D

Paper : CHE–HE–5046

(Novel Inorganic Solids)

1. Answer the following as directed : 1×7=7

   (a) Quartz is an acidic refractory.

   (State True ***or*** *False)*

   (b) Insertion compound formation is the basis of '_____'.

   (Fill in the blank)

   (c) What is ideal solid electrolyte ?

   (d) Carbon nanotubes are also known as _____. *(Fill in the blank)*

   (e) What are fullerides ?

   (f) The colour gold nanoparticles is

   (i) yellow

   (ii) orange

   (iii) red

   (iv) variable

   (Choose the correct option)

   (g) Give an example of an one-dimensional metal.

2. Answer the following questions : ***(any four)*** 2×4=8

   (a) What is hydrothermal method ?

   (b) What is the amount (%) of carbon in pure iron, cast iron and steel ?

   (c) Write *two* differences between organic and inorganic pigments.

   (d) Distinguish between natunal and artificial nanoparticles.

3. Answer the following question : ***(any three)*** 5×3=15

   (a) What are the classifications of composite materials ?

   (b) Discuss a method for the synthesis of silver nanoparticles. What is the colour of silver nanoparticles ? 4+1=5

   (c) Write a note on sol-gel method.

   (d) Based on the composition, how are ceramic materials classified ? Discuss each of them. 2+3=5

   (e) What is carbon tool steel ? Give its composition and discuss its applications. 2+3=5

4. Answer the following questions : ***(any three)*** 10×3=30

(a) Discuss the environmental effects on composites and give applications of composites. 5+5=10

(b) Give brief descriptions of the following : 2½×4=10

(i) Bio-nanocomposites

(ii) Matrix material

(iii) Thermoplastics

(iv) Molecular magnets

(c) Write the characteristics and applications of various types of cast irons. 4+6=10

(d) What is DNA nanotechnology ? Write a brief note on biological applications of DNA nanomaterials. 3+7=10

(e) Discuss the advantages and disadvantages of solid state synthesis.

(f) Discuss the various methods used in the synthesis of inorganic solids.

OPTION – E

Paper : CHE–HE–5056

(Polymer Chemistry)

1. Answer the following questions : 1×7=7

(a) Which of the following is not a classification scheme for polymers ?

(i) By source

(ii) By structure

(iii) By colour

(iv) By thermal properties

(b) The degree of polymerization is related to

(i) the molecular weight of the monomer

(ii) the number of repeating units in a polymer

(iii) the thermal stability of the polymer

(iv) the crystallinity of the polymer

(c) Which type of polymerization involves reacting monomers with two or more functional groups ?

(i) Chain growth polymerization

(ii) Step growth polymerizaion

(iii) Coordination polymerization

(iv) Ionic polymerization

(d) The melting point of a crystalline polymer is influenced by its molecular weight. *(True **or** False)*

(e) The _____ temperature is a critical point that signifies the transition from a brittle to a rubbery state in polymers. *(Fill in the blank)*

(f) Polydispersity index (PDI) indicates the distribution of molecular weights in a given polymer sample. *(True **or** False)*

(g) Flory-Huggins theory is primarily concerned with

(i) polymer crystallinity

(ii) polymer solubility

(iii) polymer mechanical properties

(iv) polymer synthesis

2. Answer the following questions : 2×4=8

(a) Explain the significance of functionality in synthetic polymer formation.

(b) Describe the difference between cationic and anionic polymerization mechanisms.

(c) What factors affect the glass transition temperature (Tg) of polymers ?

(d) Calculate the degree of polymerization (DP) of a polymer if the average molecular weight of the polymer is $10000\ g/mol$ and the molecular weight of the repeating unit is $100\ g/mol$.

3. Answer of the following questions :
(any three) 5×3=15

(a) Discuss the mechanism and kinetics of step-growth polymerization.

(b) A polymer sample has a number average molecular weight (M_n) of $50000\ g/mol$ and a weight-average molecular weight (M_w) of $100000\ g/mol$. Calculate the polydispersity index (PDI) of the polymer. Estimate the number of polymer chains in each molecular weight category, assuming the chains are distributed in a 1:2:3 ratio (low : medium : high molecular weights) and the total weight of the polymer sample is $150000\ g$. 2+3=5

(c) Describe the thermodynamics of polymer solutions and the significance of entropy and enthalpy.

(d) Outline the properties of polyolefins and their applications.

(e) Derive the expression for the degree of polymerization (DP) in terms of the number-average molecular weight (M_n) and the molecular weight of the repeating unit (M_o). Explain how variations in DP can affect the thermal and mechanical properties of the polymer. 3+2=5

4. Answer of the following questions : **(any three)** 10×3=30

(a) Compare and contrast various polymerization techniques, focusing on their advantages and limitations in the synthesis of polymers.

(b) Elaborate on the factors affecting the crystallinity and melting point of crystalline polymers, including practical applications.

(c) Discuss the preparation, structure, properties and applications of poly (vinyl chloride) and related polymers.

(d) Write down Williams-Landel-Ferry (WLF) equation and explain various terms involved in it. Discuss the implications of the WLF equation in determining the glass transition temperature (Tg) of polymers. 3+7=10

(e) Provide a detailed account of conducting polymers, including their synthesis, properties and applications in modern technology.

(f) Discuss the classification of polymers based on their physical, thermal and mechanical properties, providing examples for each category.

———

OPTION – F

Paper : CHE–HE–5066

(Instrumental Methods of Chemical Analysis)

1. Answer the following questions : 1×7=7

   (a) What is the basic difference between qualitative analysis and quantitative analysis ?

   (b) How many significant figures are there in 0·00200 ?

   (c) Define transmittance of a medium.

   (d) In gas-liquid chromatography the mobile phase is an unreactive gas.

   (State True **or** *False)*

   (e) Define molecular partition function for a system.

   (f) What information can be obtained from the radiochemical analysis method ?

   (g) What is voltametry ?

2. Answer the following questions : 2×4=8

   (a) Distinguish between emission and absorption spectra.

   (b) What do you understand by the term 'selection rules' in spectroscopy ?

   (c) What is spin-spin coupling in NMR spectroscopy ?

   (d) What is fragmentation process in mass spectroscopy ?

3. Answer of the following questions : ***(any three)*** 5×3=15

   (a) With the help of suitable examples, explain briefly how you will detect aldehydes and ketones by IR-spectroscopic method.

   (b) Discuss briefly different quantitative analytical methods used in the laboratory.

   (c) Explain the immunoassay technique in clinical laboratory.

   (d) Write a note on X-ray photoelectron spectroscopy.

   (e) Discuss the basic theory of mass spectroscopy.

4. Answer the following questions : ***(any three)*** 10×3=30

   (a) Describe various selection rules in spetroscopy. What are the bases of spectroscopy selection rules ? Explain with the help of suitable examples.

   (b) Discuss the advantages and disadvantages of single-beam and double-beam UV-visible spectrometers.

Contd.

(c) Give the principle of column chromatographic technique. Describe the factors which determine effectiveness of separation of a mixture by column chromatography. 4+6=10

(d) (i) What is potentiometric titration ? Discuss the basic theory of potentiometric titration between strong acid weak base titration. 5

(ii) Explain the variation of emf against volume of alkali added in strong acid weak base titration. How is the equivalence point determined by a differential plot ? 5

(e) (i) Explain the theory of NMR spectroscopy. 5

(ii) What is meant by chemical shift ? Discuss the factors affecting chemical shifts. 5

(c) Give the principle of column chromatographic technique. Describe the factors which determine effectiveness of separation of a mixture by column chromatography. 4+6=10

(d) (i) What is potentiometric titration ? Discuss the basic theory of potentiometric titration between strong acid weak base titration. 5

(ii) Explain the variation of emf against volume of alkali added in strong acid weak base titration. How is the equivalence point determined by a differential plot ? 5

(e) (i) Explain the theory of NMR spectroscopy. 5

(ii) What is meant by chemical shift ? Discuss the factors affecting chemical shifts. 5
