

**TYBSC**  
**SEM VI 2025**

T.Y. BA/BS

[ Time : 2 ½ Hours ]

[ Total marks: 75 ]

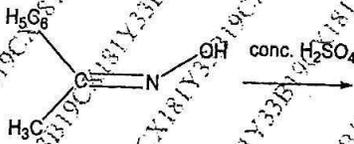
Sem-VI

Req

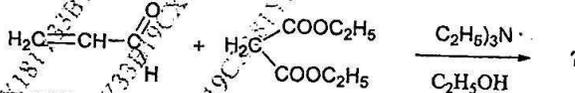
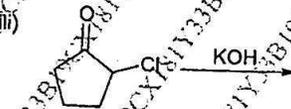
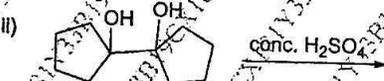
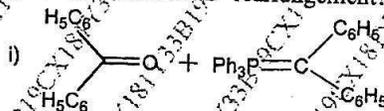
11/4/2025

- N.B. : (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.  
 (3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt Any Three of the following:
- A. Explain with mechanism the addition of bromine to but-2-ene as both stereospecific and stereoselective reaction. 15
  - B. a) Write a note on enantiotropic ligands. 5  
 b) Define stereoselective and stereospecific reactions. 3
  - C. Discuss the stereochemistry of base-induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. 2
  - D. a) What are acidic and basic  $\alpha$ -amino acids? Give one example of each. 5  
 b) Give the preparation of methionine by Strecker synthesis. 3
  - E. Explain Merrifield's solid phase peptide synthesis for the preparation of tripeptides. 2
2. Attempt Any Three of the following:
- A. Complete the following reaction. Give name of the reaction and discuss the mechanism and stereochemistry involved in it. 15



- B. a) What is molecular rearrangement? Complete the following reactions: 5



- C. a) Explain Killiani-Fischer synthesis with suitable example. 3  
 b) Give the stepwise methylation of  $\alpha$ -D-glucopyranose. 2

D. Convert following open chain Fischer projection formulae into Haworth formulae:

- i)  $\beta$ -D-Fructopyranose
- ii)  $\alpha$ -D-Ribopyranose

E. a) What is the action of the following reagents on D-glucose?

- i)  $\text{NaBH}_4$
- ii)  $\text{Br}_2$  in  $\text{H}_2\text{O}$
- iii)  $\text{HIO}_4$

b) What are glucosides? Give one example.

3. Attempt Any Three of the following:

A. a) Explain symmetrical and asymmetrical stretching vibrations.  
 b) Explain with reason whether carbon tetrachloride shows significant absorption peaks in IR spectrum.

B. a) Define Chemical Shift. Mention the unit in which it is expressed. What are the different scales in which it is measured?

b) What structural details can be determined from a Proton Magnetic Resonance (PMR) spectrum?

C. Describe controlled hydrolysis of nucleic acids.

D. An organic compound has the molecular formula  $\text{C}_8\text{H}_{10}\text{O}$ . Determine the index of its hydrogen deficiency and deduce its structural formula from the following spectral data. Also write the name of the compound and justify your answer.

IR ( $\text{cm}^{-1}$ ): 3500, 1600, 1570, 760 & 710

PMR ( $\delta$ -ppm): 1.6 (3H, doublet), 4.2 (1H, singlet,  $\text{D}_2\text{O}$  exchangeable), 4.9 (1H, quartet), 7.4 (5H, multiplet)

a) Give the structure of pyrimidine bases present in DNA.

b) Predict the number of signals and the splitting pattern in PMR spectra of the n-Propyl bromide.

4. Attempt Any Three of the following:

a) Define the following terms:

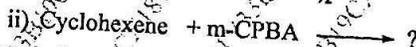
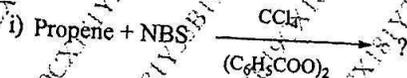
- i) Plastics
- ii) Resins
- iii) Elastomers

b) Enlist the biomedical uses of Polymers.

What is meant by tacticity of polymer? Explain the types of stereoisomers resulting from tacticity.

c. a) Explain Rosenmund reduction with a suitable example.

b) Complete the following reactions:



D. What is the action of  $\text{LiAlH}_4$  on the following compounds?

- i) Acetone
- ii) Methyl cyanide
- iii) Nitroethane
- iv) Cinnamaldehyde
- v) Acetyl chloride

- E. a) Discuss the preparation, properties and uses of Polypropylene.  
 b) Write a brief note on Diene polymerization.

5. Answer the following:

- A. Select whether the following statements are true or false (Any five)
- Glycine is an example of acidic  $\alpha$ -amino acid.
  - Cyclic osmic ester is formed in syn-hydroxylation of alkene.
  - Beckman rearrangement of ketoxime is highly stereospecific in nature.
  - All monosaccharides are non-reducing sugars.
  - Acetone gives two absorption bands in PMR spectrum.
  - Guanine and cytosine are bonded by three hydrogen bonds.
  - Phenol-Formaldehyde resin is a thermoplastic polymer.
  - LAH is used to reduce polar unsaturated groups.

B. Select the correct option and complete the following statements. (Any five)

- Transition state has ..... energy.
  - highest
  - moderate
  - lowest
  - equal
- The amino acids which are synthesized by human body are called .....  $\alpha$ -amino acids.
  - Essential
  - Acidic
  - Non-essential
  - basic
- ..... is an example of ketose.
  - Ribose
  - Fructose
  - Glucose
  - Arabinose
- Epimer of D-glucose is .....
  - D-Mannose
  - D-Fructose
  - D-Ribulose
  - D-Xylulose
- The acidic proton of a carboxylic acid is found at ..... ppm in NMR.
  - 0-2.0
  - 2.0-4.0
  - 8.0-10.0
  - 10.0-12.0
- Nucleic acids on complete hydrolysis give sugar, bases and .....
  - hydrochloric acid
  - nitric acid
  - phosphoric acid
  - acetic acid
- Natural rubber is a polymer of .....
  - Vinyl chloride
  - Styrene
  - Butadiene
  - Nylon 66
- ..... is an addition polymer.
  - Bakelite
  - Nylon 6
  - Polystyrene
  - Terylene

Match the column: (Any five)

- |                        |                        |
|------------------------|------------------------|
| a. $SN^2$ reaction     | i. Allylic bromination |
| b. $-CO-NH-$           | ii. Glycoside          |
| c. Salicin             | iii. IR Spectrum       |
| d. Arabinose           | iv. Single strand      |
| e. Finger Print Region | v. Aldopentose         |
| f. RNA                 | vi. Adipic acid        |
| g. Nylon 66            | vii. Ketopentose       |
| h. NBS                 | viii. One step         |
|                        | ix. Peptide linkage    |
|                        | x. Two step            |

[ Time : 2 ½ Hours]

[Total marks: 75]

- N.B. : (1) All questions are compulsory.  
(2) Figures to the right indicate full marks.  
(3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt Any Three of the following:

- Write three advantages and two limitations of dropping mercury electrode.
- With respect to polarography, explain the following terms,  
i) Residual current, ii) Diffusion current
- In the polarographic analysis of Pb(II) ions, the following results were obtained for a solution:  $i_d = 21.64 \mu\text{A}$ ,  $D = 9.8 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$ ,  $m = 3.4 \text{ mg s}^{-1}$ ,  $t = 4 \text{ s}$ . Calculate the concentration of Pb(II) in the sample solution
- Explain the interference of dissolved oxygen, with reactions involved in the normal polarographic analysis. How can the interference be removed?
- Explain the nature of amperometric titration curves when,  
i) Titrant is reducible but other species are not  
ii) Titrant is reducible but other species are not

2. Attempt Any Three of the following:

- Draw a schematic diagram of instrumentation in HPLC. Give any three requirements of high-pressure pumps used in HPLC.
- Explain the principle of HPTLC. Write a note on stationary phase used in HPTLC.
- Discuss any five applications of HPLC.
- What are ion exchange resins? How are they classified?
- Define ion exchange capacity. How is it determined for cation exchanger?

3. Attempt Any Three of the following:

- What is food processing? Explain the need for food processing and food preservation.
- Describe Lane-Eynon's method for the analysis of lactose in milk.
- Give the composition of tea? Explain the differences between green tea and mixed tea.
- What are the sensory properties of cosmetics? Differentiate between deodorant and antiperspirant.
- Describe the ash analysis of lipsticks with respect borate and zinc oxide.

4. Attempt Any Three of the following:

- Draw a neat and labelled diagram of thermobalance used in TGA analysis. Explain any three components of it.
- What is meant by DTA? Give any three characteristics of reference material used in DTA.
- Discuss the DTA curve of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  with the help of reactions involved in it.
- Discuss applications of thermometric titration 1) Neutralization titration of HCl vs. NaOH 2) Complexometric titration of Mixture of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  vs. EDTA.
- Give any five applications of neutron activation analysis (NAA).

5. Answer the following:

- A. Select whether the following statements are true or false (Any five):
- Helium gas is passed during electrolysis of an electrolyte in polarography.
  - Diffusion current is directly proportional to the concentration of metal ion.
  - Inert gas is used to degas the solvent to be used as mobile phase in HPLC.
  - The efficiency of strong ion exchanger is affected by pH.
  - Deodorants reduce perspiration.
  - Zinc oxide is added to face powder to increase its capacity.
  - TGA is a thermal method used to determine mass of substance against temperature.
  - NAA is not a radioanalytical method.

- B. Select the correct option and complete the following statements (Any five):
- Rotating platinum electrode is used in amperometric titration as \_\_\_\_\_ electrode.
    - reference
    - working
    - combined
    - inert
  - In DME when the drop gets detached, the current becomes \_\_\_\_\_.
    - maximum
    - zero
    - minimum
    - negative
  - \_\_\_\_\_ is an example of natural ion exchangers.
    - talc
    - clay
    - quartz
    - sand
  - \_\_\_\_\_ detector is used in HPLC.
    - Flame ionisation
    - Electron capture
    - Refractive index
    - Thermal conductivity
  - Pasteurisation of milk is carried out at \_\_\_\_\_.
    - 63° C and 72° C
    - 110° C and 180° C
    - 63° C and 130° C
    - 0° C and 5° C
  - Honey contains large quantity of \_\_\_\_\_ than glucose.
    - Sucrose
    - Fructose
    - Maltose
    - Lactose
  - Thermometric titration involves measuring \_\_\_\_\_ generated during chemical reaction.
    - Paramagnetic nature
    - Pressure
    - Heat
    - Fission
  - In \_\_\_\_\_ technique double pan are used to hold sample and reference material.
    - TGA
    - NAA
    - Thermometric titration
    - DTA

C. Match the column (Any five):

- A
- Triton X-100
  - Nitrogen gas
  - HPTLC
  - Polystyrene
  - Chicory
  - Irradiation
  - NAA
  - Phase Transitions

- B
- Physical method
  - Synthetic ion exchanger
  - DTA curve of sulphur
  - Maxima suppressor
  - Densitometer
  - Neutron flux
  - Remove oxygen
  - Additive in coffee
  - Chemical method
  - PMT

T.Y. B.Sc  
Sem - VI  
Reg.  
01418

Time: 2 ½ Hours

Total marks : 75

- N.B. : (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.  
 (3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt Any Three of the following:

- A. What is crystal field splitting? Explain with reference to tetrahedral complexes. 5
- B. Explain Jahn-Teller distortions in octahedral complexes with suitable example. 5
- C. How is  $10Dq$  value determined for an octahedral complex? 5
- D. Define Crystal field stabilisation energy. Calculate CFSE for the  $d^4$  and  $d^5$  configuration in strong field octahedral complexes. 5
- E. Explain the following factors affecting crystal field splitting:
  - i) Nature of the ligands. 5
  - ii) Position of metal in transition series.

2. Attempt Any Three of the following:

- A. Discuss the associative mechanism of ligand substitution reaction in metal complexes. 5
- B. Write a note on selection rules for electronic transitions. 5
- C. Draw a labelled molecular orbital diagram of  $[FeF_6]^{4-}$  complex and comment on its magnetic property. 5
- D. Explain the effect of charge and size of central metal ion on the stability of metal complexes. 5
- E. What is microstates? Calculate number of microstates for following configuration:
  - a)  $d^3$
  - b)  $d^2$

3. Attempt Any Three of the following:

- A. Write a note on Ionic organometallic compounds. 5
- B. Discuss the following chemical reaction of organometallic compounds of main group elements. 5
  - i) Reactions with protic solvent
  - ii) Alkylation reactions
- C. Discuss any five chemical properties of ferrocene. 5
- D. i) What is metallocene? Give the structure of any two metallocenes. 3  
 ii) Give any two physical properties of ferrocene. 2
- E. Distinguish between Homogeneous and Heterogeneous catalysis. 5

4. Attempt Any Three of the following:

- A. What is metallurgy? Write a brief note on the hydrometallurgy. 5
- B. Explain in detail electrolytic refining of copper. 5
- C. Give the preparation of Xenon difluoride and discuss its structure. 5
- D. Describe the isolation of Noble gases by Charcoal adsorption method. 5
- E. Discuss the mechanism of Sodium and Potassium ion pump in biological systems with suitable diagram. 5

## 5. Answer the following:

- A. Select whether the following statements are true or false. (Any five)
- Weak field ligands produce small degree of splitting.
  - CFT predicts abrupt changes in the magnetic properties of complexes.
  - $S_N^1CB$  mechanism in ligand substitution in complex involved acid hydrolysis.
  - Complex with chelating group are more stable than those with unidentate ligands.
  - The compound that possesses non-metal-halogen bond were broadly considered as organometallic compound.
  - The good catalysts are those which shows variable oxidation state.
  - Roasting involves the conversion of sulphide ores to their oxides by reaction with oxygen.
  - Neon lights are used in green house.

## B. Select the correct option and complete the following statements. (Any five)

- a. \_\_\_\_\_ is lower than  $\Delta_o$  in complexes.
- $\Delta_f$
  - $\Delta_{sp}$
  - $\Delta_E$
  - $\Delta_H$
- b. \_\_\_\_\_ is example of weak field ligand.
- CO
  - CN<sup>-</sup>
  - F<sup>-</sup>
  - SCN<sup>-</sup>
- c.  $S_N^1$  mechanism of ligand substitution reaction form ..... coordinate intermediate.
- 5
  - 3
  - 7
  - 8
- d. A metal chelate involves ..... ligands.
- unidentate
  - polydentate
  - ambidentate
  - monodentate
- e. \_\_\_\_\_ are electron deficient and behaves as Lewis acids
- Al(CH<sub>3</sub>)<sub>3</sub>
  - NH<sub>3</sub>
  - H<sub>2</sub>O
  - CH<sub>4</sub>
- f. In  $\beta$  hydride elimination hydrogen that is transferred is formally considered as --
- H<sup>+</sup>
  - H
  - H<sub>2</sub>
  - H
- g. \_\_\_\_\_ ore among the following is concentrated by froth floatation method.
- carbonate
  - sulphide
  - oxide
  - chlorate
- h. The Noble gas used for filling incandescent electric bulbs is -----
- Helium
  - Neon
  - Argon
  - Xenon

C. Match the column: (Any five )

- Column A**
- a.  $[\text{Fe}(\text{CN})_6]^{2-}$
  - b. ESR Spectrum of  $[\text{IrCl}_6]^{2-}$
  - c.  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
  - d. Intra-metal
  - e. Wilkinson's catalyst
  - f. Ferrocene
  - g. Copper pyrites
  - h. Azurin

- Column B**
- i.  $\text{CuFeS}_2$
  - ii.  $[\text{RhCl}(\text{PPh}_3)_3]$
  - iii. Blue copper protein
  - iv. Serrated curve
  - v. Low spin complex
  - vi. High spin complex
  - vii. Sandwich compound
  - viii. d-d transition
  - ix. Non blue protein
  - x. Smooth curve

\_\_\_\_\_

Time: 2 ½ Hours

Total marks: 75

- N.B. :** (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.  
 (3) Use of logarithmic table/non-programmable calculator is allowed.

**Physical Constants:**

$$N = 6.022 \times 10^{23}$$

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$R = 8.314 \text{ J/K mol}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$\frac{2.303 RT}{nF} = \frac{0.0592}{n} \text{ at } 298\text{K}$$

1. Attempt **Any Three** of the following:
- Write a note on liquid junction potential. Give functions of salt bridge. 5
  - Derive an expression for the emf of electrode concentration cell reversible to anions. 5
  - Define the following terms 5
    - Activity coefficient
    - Ionic strength
    - decomposition potential
    - Concentration cell
    - Overtoltage
  - Write a note on polarization. 5
  - In electrolysis of 1 N sulfuric acid, the hydrogen overvoltage at lead cathode was found to be 0.48 V at 298 K for a given current density. What will be the hydrogen overvoltage if the current density is increased eight times to its present value for the same cathode under same condition. (Given:  $b = 0.12$ ) 5
2. Attempt **Any Three** of the following:
- Give the classification of polymer based on its source and physical properties. 5
  - Write a note on Light emitting polymers. 5
  - Discuss use of viscometer in determination of molecular weight of polymer. 5
  - A sample of protein consists of 10% molecules of molecular weight 10,000 and 80% of 20,000 and 10% of 40,000. Calculate the number average and weight average molecular weights. 5
  - Explain the three-component system exhibiting the formation of two pair of partially miscible liquids. 5
3. Attempt **Any Three** of the following:
- Explain phenomenon of Black body radiation using Quantum mechanics and also give limitations of Classical mechanics in explaining it. 5
  - A microscope using suitable photon is employed to locate an electron in an atom within a distance of  $0.1 \text{ \AA}$ . What is the uncertainty involved in the measurement of its velocity? (Given,  $m_e = 9.1 \times 10^{-31} \text{ kg}$ ) 5
  - What is standing wave? Explain the boundary conditions. 5
  - Define renewable energy? Write advantages of hydrogen as energy medium. 5
  - Write short note on: 5
    - Concept of operator
    - Band gap theory

4. Attempt Any Three of the following: 5
- A. Comment whether following elements are NMR active or not? 5  
1)  $^1\text{H}$  2)  $^{13}\text{C}$  3)  $^{15}\text{N}$  4)  $^{16}\text{O}$  5)  $^3\text{He}$
  - B. Derive fundamental equation of NMR spectroscopy. 5
  - C. Explain the processes: i) Spin-Spin relaxation ii) Spin lattice relaxation 5
  - D. Draw schematic diagram of ESR spectrophotometer and describe various components of it. 5
  - E. Explain the hyperfine splitting ESR spectra of hydrogen. 5
5. Answer the following: 5
- A. Select whether the following statements are **true** or **false** (Any five) 5
    - a. In case of galvanic cells both half cells are chemically identical with differing concentrations
    - b. The cell represented as,  $\text{Ag} / \text{AgNO}_3 (a_1) \mid \text{AgNO}_3 (a_2) / \text{Ag}$  is an example of electrolyte concentration cell with transference reversible to cation.
    - c. PVC is a naturally occurring polymer.
    - d. Air is one component system.
    - e. The wave function should have numerous values.
    - f. Efficiency of solar cell is above 70%.
    - g. ESR spectra are observed in radio frequency region.
    - h. Carbon tetrachloride is ideal solvent for NMR spectrophotometer.
  - B. Select and write the appropriate answer. (Any five ) 5
    - a. For the HCl electrolyte the activity can be represented \_\_\_\_\_  
 a)  $a = (m_{\pm}\gamma_{\pm})^2$                       c)  $a = 4(m_{\pm}\gamma_{\pm})^2$   
 b)  $a = (m_{\pm}\gamma_{\pm})^3$                       d)  $a = 4(m_{\pm}\gamma_{\pm})^3$
    - b. The equation for Debye Hückel limiting law is given as \_\_\_\_\_  
 a)  $\log \gamma = -A Z_+ Z_- \sqrt{\mu}$                       c)  $\log \gamma = -A Z_+ Z_- \mu$   
 b)  $\log \gamma = A Z_+ Z_- \sqrt{\mu}$                       d)  $\log \gamma = A Z_+ Z_- \mu$
    - c. A monomer of PVC is \_\_\_\_\_  
 a) Vinyl chloride    b) Succinic acid    c) Vinyl acetate    d) Glycol
    - d. Which of the following phase transition indicate transformation of solid into a gas without intermediate liquid stage?  
 a) Melting    b) Boiling    c) condensation    d) Sublimation
    - e.  $8e^{4x}$  is an eigen function of the operator  $d/dx$ , the eigen value is -----  
 a) 8    b) 4    c) 32    d) 2
    - f. The fundamental equation of de Broglie's theory of wave-particle duality is  
 a)  $\lambda = hmv$     b)  $\lambda = h/mv$     c)  $\lambda = h/p^2$     d)  $E = hv$
    - g. For a free electron, the value of g-factor (Landes Splitting factor) is \_\_\_\_\_  
 a) 1.1900    b) 2.1000    c) 2.0023    d) 2.0050
    - h. Larmour precesional angular velocity is given by \_\_\_\_\_  
 a)  $\Omega = \gamma H$     b)  $\Omega = \frac{v}{H}$     c)  $\Omega = v (H-1)$     d)  $\Omega = v H$

## C. Match the column: (Any five)

- |                                     |   |
|-------------------------------------|---|
| a. Salt bridge                      | i. $\eta_{rel} - 1$                           |
| b. Concentration cells              | ii. $C - P - 2$                               |
| c. Specific Viscosity               | iii. Need of Photoelectric effect             |
| d. 'F' is                           | iv. Minimization of liquid junction potential |
| e. Threshold frequency of radiation | v. $E^0 = 0$                                  |
| f. AlN                              | vi. $E^0 \neq 0$                              |
| g. Spin angular momentum            | vii. Minute bar magnet                        |
| h. Spinning nucleus                 | viii. Binary semiconductor                    |
|                                     | ix. $\sqrt{I(I+1)} \cdot h/2\pi$              |
|                                     | x. Pure semiconductor                         |

\*\*\*\*\*



**TYBSC**  
**SEM VI 2024**

03/04/24

[ Time : 3Hours]

[Total marks :100]

N.B. : (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non-programmable calculator is allowed.

Physical Constants:

$$N = 6.022 \times 10^{23}$$

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$R = 8.314 \text{ J/K mol}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$\frac{2.303 RT}{nF} = \frac{0.0592}{n} \text{ at } 298 \text{ K}$$

1. Attempt any four of the following:

- A. Define activity and activity coefficient of an electrolyte. Give the expression for activity of the following electrolytes 5  
 i)  $\text{AlCl}_3$     ii)  $\text{CuSO}_4$     iii)  $\text{Na}_2\text{SO}_4$
- B. Explain the function of the salt bridge. Why is a saturated solution of KCl generally used in preparation of salt bridge? 5
- C. Derive an expression for the e.m.f of an electrode concentration cell of the following cell 5  
 $\text{Cd(Hg)}_{a_1} / \text{CdSO}_4(\text{aq}) / \text{Cd(Hg)}_{a_2}$
- D. Derive an expression for the e.m.f of an electrolyte concentration cell with transference reversible with anion 5
- E. Calculate the mean activity coefficient of NaCl in a solution containing  $0.02 \text{ mol/dm}^3$  of NaCl and  $0.05 \text{ mol/dm}^3$  of  $\text{CaCl}_2$  ( $A=0.509$  at 298K for water) 5
- F. Define hydrogen overvoltage. In the electrolysis of 2N sulphuric acid the hydrogen overvoltage at lead cathode was found to be 0.352V at 298 K for a given current density what will be the hydrogen overvoltage if the current density is increased six times its present value for the same cathode under the same conditions. (Given:  $b = 0.12 \text{ V}$  at 298 K) 5

2. Attempt any four of the following.

- A. Explain the terms 5  
 i) Monomer  
 ii) Polydispersity Index  
 iii) Degree of polymerization
- B. In a polymer sample 30% molecules have a molecular weight 20,000, 40% have molecular weight 30,000 and 30 % have 60,000. Calculate number average and weight average molecular weights for given polymer. 5
- C. Explain the classification of polymers on the basis of the structure. 5
- D. Explain the viscosity method for determination of molecular weight of polymers. 5
- E. Explain number average molecular weight and weight average molecular weight 5
- F. Describe advantages and applications of light emitting polymers. 5

3. Attempt any four of the following:
- Explain the Compton effect using Quantum mechanics and also give limitations of Classical mechanics in explaining it. 5
  - Find the eigen value and state whether the function is an Eigenfunction for then operator  $\frac{d^2}{dx^2}$  for the following function. 5
    - $6\cos 4x$
    - $3e^{5x}$
  - Write a note on: 5
    - Wave matter duality of matter
    - Heisenberg Uncertainty Principle
  - What is a commutative operator? Explain and prove it with an example. 5
  - Discuss the classification of conductor, semiconductor and insulator on the basis of band gap. 5
  - Explain production of hydrogen gas using electrolysis of water and mention advantages of hydrogen gas as fuel. 5

4. Attempt any four of the following:
- Explain the working of NMR Spectrometer with the help of a neat labelled diagram 5
  - Derive the fundamental equation of NMR spectroscopy 5
  - Explain the relaxation processes in NMR spectroscopy. 5
  - Explain the principle of ESR spectroscopy 5
  - Draw diagram of ESR spectrometer and explain functions of following in ESR spectrometer i) Klystron oscillator ii) Sample cavity iii) Crystal detector 5
  - Explain fine splitting and hyperfine splitting of hydrogen ESR spectrum. 5

5. Answer the following:
- Select whether the following statements are true or false (Any five) 5
    - For a concentration cell, the standard emf of the cell is unity
    - Reduction involves the decrease in the oxidation state of the metal ion
    - The deviation of an electrolyte solution from its ideal behaviour is called as activity
    - A plot of log of mean activity coefficient versus square root of ionic strength gives a positive slope
    - The value of liquid junction potential depends on the volume of the electrolyte in a galvanic cell
    - The minimum external potential that must be applied between electrodes in an electrolytic solution to bring continuous electrolysis is called as decomposition potential
    - The cause of polarization phenomenon in an electrolytic cell is due to back emf
    - Overvoltage is dependant on temperature

- Fill in the blank with appropriate words (Any five) 5
  - \_\_\_\_\_ is an example of natural polymer (nucleic acid, PVC, Rayon, polyester)
  - Thermoplast are the polymers which soften when heated and \_\_\_\_\_ when cooled. ( brittle, harden, blackned, colourless)

- c. Weight average molecular weight is defined by symbol \_\_\_\_\_  
 ( $\overline{M}_n, \overline{M}_w, \overline{M}_z, \overline{M}_v$ )
- d. Heating rubber with sulphur is called \_\_\_\_\_  
 (Galvanization, Vulcanization, Sulphonation, Bessmerisation)
- e. Which is a naturally occurring polymer \_\_\_\_\_  
 (polythene, protein, PVC, Polypropylene)
- f. In linear polymers monomeric units are \_\_\_\_\_ together (break up,  
 branched, cross linked, linked)
- g. PVC is an example of \_\_\_\_\_ polymer  
 (inorganic, organic, bio-organic, natural)

C. Select and write the appropriate answer. (Any five)

5

- a. According to Quantum mechanics, ejection of electrons from metal in Photoelectric effect is dependant on \_\_\_\_\_ of the radiation  
 a) Intensity                      b) Frequency                      c) temperature
- b. In Black body radiation as temperature of the body increases, \_\_\_\_\_ of the emitted radiation  
 a) wavelength and intensity increase  
 b) wavelength and intensity decrease  
 c) wavelength decreases, intensity increases
- c. The wave function defined for a system has to be \_\_\_\_\_  
 a) single valued                      b) infinite                      c) discontinuous
- d. Which of the following is not correct about standing waves?  
 a) amplitude vary with time      b) confined in a space      c) Do not propagate
- e. If operator satisfies,  $\hat{A} [f(x) + g(x)] = \hat{A} f(x) + \hat{A} g(x)$ , operator is said to be —  
 a) commutative                      b) linear                      c) harmonic
- f. Which of the following is a nonrenewable source of energy?  
 a) Tidal                      b) CNG                      c) Solar
- g. A solar cell works on the principle of  
 a) Photovoltaic effect              b) Photoelectric effect      c) Thermoelectric effect
- h. Which of the following is an advantage in using hydrogen as a future fuel?  
 a) transportation                      b) high calorific value      c) storage

D.

Match the column:

(Any five)

5

Column A

Column B

- |                                    |                                |
|------------------------------------|--------------------------------|
| a. $C_{12}^6$                      | i. 2.0023                      |
| b. Precessional angular frequency  | ii. $j = \frac{1}{2}$          |
| c. Degenerate energy level         | iii. Tetramethylsilane(TMS)    |
| d. $D_7^2$                         | vi. CO                         |
| e. $N_7^{15}$                      | v. $I = 1$                     |
| f. g value of free electron in ESR | vi. Absence of magnetic field  |
| g. Reference compound in NMR       | vii. 2.2003                    |
|                                    | viii. $I = 0$                  |
|                                    | ix. Presence of magnetic field |
|                                    | x. $I = \frac{3}{2}$           |

[ Time: 3 Hours]

[Total marks :100]

N.B.: (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt any four of the following:
  - A. What is crystal field splitting? Explain with reference to tetrahedral complexes. 5
  - B. Explain the following factors affecting crystal field splitting. 5
    - i] Nature of the ligands.
    - ii] position of metal in transition series.
  - C. Explain the term crystal field stabilization energy [CFSE]. Calculate CFSE for  $d^8$  and  $d^9$  configurations in strong field octahedral complexes. 5
  - D. Discuss any five merits of crystal field theory. 5
  - E. Explain Jahn-Teller distortions in octahedral complexes with suitable example. 5
  - F. Write a note on intensity of d-d transition as an evidence of covalent bonding in metal complex. 5
  
2. Attempt any four of the following:
  - A. Discuss molecular orbital diagram of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  complex and give its magnetic behaviour. 5
  - B. Write a note on Steric effect on the stability of metal complexes. 5
  - C. Explain charge transfer transitions in metal complexes. 5
  - D. Write a note on  $S_N1$  mechanism in ligand substitution reaction of octahedral metal complexes. 5
  - E. Distinguish between thermodynamic and kinetic stability in metal complexes. 5
  - F. Write a note on base hydrolysis in ligand substitution reaction of octahedral metal complexes. 5
  
3. Attempt any four of the following:
  - A. Define organometallic compound. Write a note on multicentred electron deficient organometallic compound. 5
  - B. Describe the method of preparation of organometallic compound by oxidative addition reaction. 5
  - C. Write a note on Complex formation reactions of organometallic compounds. 5
  - D. What is ferrocene? Explain structure of ferrocene according to valence bond theory. 5
  - E. Write a note on any five chemical reactions of ferrocene. 5
  - F. Differentiate between homogeneous and heterogeneous catalysis. 5

4. Attempt **four** of the following:
- Define metallurgy. Explain Hydrometallurgy with suitable example. 5
  - What are the different methods used for concentration of ore? Discuss in detail Hydraulic Classifier Method. 5
  - Name the steps involved in extraction of copper. Explain the electrolytic refining of copper. 5
  - How are inert gases isolated by Charcoal Adsorption methods. 5
  - Give the method of preparation and structure of following compound on the basis of VSEPR Theory: 5
    - $X_6$
    - $D_3$
  - Write note on importance of sodium potassium ion pump in biological system. 5

## 5. Answer the following:

- A. Select the correct option and complete the following statements: (any five) 5
- CFSE for strong field octahedral complexes with  $d^5$  configuration is -----  
-----  
a)  $0+4P$     b)  $-12Dq+3P$     c)  $-24Dq+3P$     d)  $-20Dq+2P$
  - In Octahedral complex, d-orbital of central metal degenerates into ----- energy levels  
a) 1    b) 3    c) 4    d) 2
  - Jahn-Teller distortions are more common among the octahedral complexes with ----- distribution of electrons.  
a) proportional    b) symmetric    c) asymmetric    d) equal
  - Crystal field splitting energy in square planar complex is denoted as -----  
a)  $\Delta$     b)  $\Delta_{sp}$     c)  $\Delta_q$     d)  $\Delta_o$
  - is a strong field ligand.  
a)  $S^{2-}$     b)  $Cl^-$     c) CO    d)  $F^-$
  - In transition metal complexes, d-orbitals of the metal are affected by -----  
-----  
a)  $Md$     b) Co-ions    c) Ligands    d) cations.
  - Colour observed for a complex is ----- to the colour that is absorbed.  
a) same    b) complimentary    c) alike    d) identical
  - Electron spin resonance spectra of  $[IrCl_6]^{2-}$  shows ----- curve  
a) Double hump    b) smooth    c) Serrated    d) linear
- B. State whether true or false: (any five) 5
- $[Ti(O)_6]^{3-}$  is low spin complex.
  - Number of microstates for  $p^1$  configuration is 21.
  - $\Delta E$  for this transition is Laporte allowed.
  - Ground state term for  $1s^1$  is  $^2S$ .
  - Complexes with polydentate ligands are more stable than those with unidentate ligands.
  - Associative mechanism for ligand substitution reaction forms seven coordinate intermediate with pentagonal bipyramidal structure.
  - $2S+1$  is called spin multiplicity.

- C. Fill in the blanks with correct alternatives given in the bracket : (any five) 5  
 (M – C, increases,  $\text{CH}_3\text{MgCl}$ , oxidation, heterogeneous, reductive elimination, 2  $\text{C}_5\text{H}_6$ , Mannich.)
- The essential requirement for an organometallic compound is the presence of at least one ..... bond
  - In preparation of organometallic compound by oxidative addition reaction, oxidation number of metal .....
  - ..... is the example of organometallic compound.
  - Condensation of ferrocene rings with formaldehyde and amine is called as ..... reaction.
  - During nitration ferrocene undergoes .....
  - $\text{Fe} + \dots \rightarrow (\text{C}_5\text{H}_5)_2\text{Fe} + \text{H}_2$
  - When the reactants and catalyst are in the different phase, catalyst is referred as .....
  - High formal positive charge on the metal and presence of bulky groups on the molecule, facilitates ..... reactions.

- D. Match the column: (Any five ) 5
- | Column A              | Column B                          |
|-----------------------|-----------------------------------|
| a. Grinding           | i. Source of $\beta$ radiation    |
| b. Frothing agent     | ii. Incandescent electric bulbs   |
| c. Acidic impurities  | iii. Iron Deficiency              |
| d. Bessemerisation    | iv. Source of $\alpha$ radiation  |
| e. Krypton Clathrates | v. Pulverization                  |
| f. Argon              | vi. Skin pigmentation             |
| g. Anaemia            | vii. Pine oil                     |
| h. Trypsinase         | viii. Used in treatment of cancer |
|                       | ix. Blister Copper                |
|                       | x. Basic Flux                     |
-

[Time: 3 Hours]

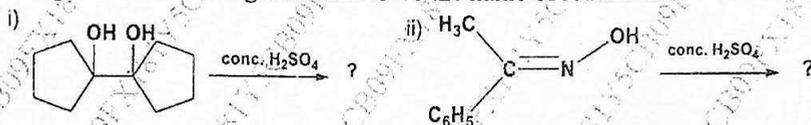
[Marks: 100]

- All questions are compulsory.
- All questions carry equal marks.
- Figures to the right indicate full marks.
- Use of log table/ non-programmable calculator is allowed.

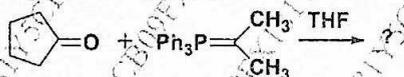
- Q.1 Attempt any four of the following.** 20
- A) Explain with mechanism the addition of bromine to but-2-ene is both stereospecific and stereoselective reaction? 5
- B) A chiral alcohol reacts with thionyl chloride. Write the reaction and its mechanism. Explain the stereochemistry involved in it. 5
- C) Explain the stereochemistry of  $\text{KMnO}_4$  oxidation of maleic acid and fumaric acid. 5
- D) Define Topicity. Explain the following with one example: 5
- Enantiotopic ligands
  - Diastereotopic ligands
- E) a) Explain isoelectric point with respect to  $\alpha$ -amino acids. 3
- b) Give preparation of alanine by Strecker synthesis. 2
- F) Explain in detail the preparation of a tripeptide by using the Merrifield solid phase peptide synthesis? 5

- Q.2 Attempt any four of the following.** 20

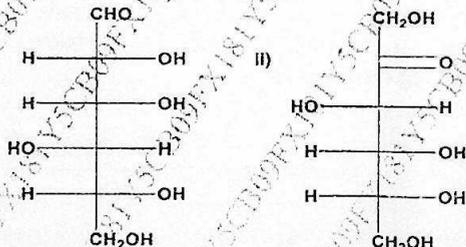
- A) What is Favorskii rearrangement? Explain with suitable example. 5
- B) a) Complete the following reactions. Give the name of reactions. 3



- b) Complete the reaction. 2



- C) a) Explain reducing and non-reducing sugars with suitable examples. 3
- b) Write appropriate reactions for acetylation of  $\alpha$ -D-glucopyranose. 2
- D) Convert the following Fischer projection formula to Haworth formulae. ( $\beta$ -furanose forms) 5

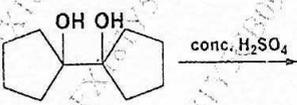
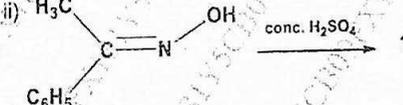
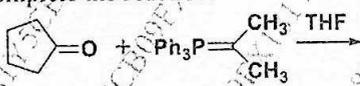
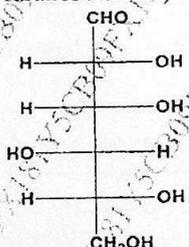
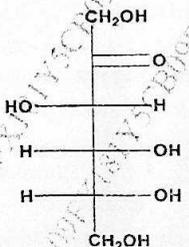


- E) a) Write the reactions for complete methylation of  $\alpha$ -D-glucopyranose in a stepwise manner. 3
- b) Draw chair conformations of  $\alpha$  and  $\beta$  forms of D-glucopyranose. 2
- F) a) How will you convert D-Glucose into D-Arabinose 3
- b) Write the reactions for oxidation of D-glucose using: 2
- Bromine water
  - Conc:  $\text{HNO}_3$

[Time: 3 Hours]

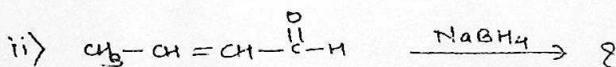
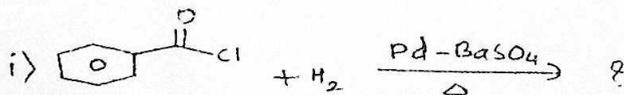
[Marks: 100]

- All questions are compulsory.
- All questions carry equal marks.
- Figures to the right indicate full marks.
- Use of log table/ non-programmable calculator is allowed.

- Q.1** Attempt any four of the following. 20
- A) Explain with mechanism the addition of bromine to but-2-ene is both stereospecific and stereoselective reaction? 5
- B) A chiral alcohol reacts with thionyl chloride. Write the reaction and its mechanism. Explain the stereochemistry involved in it. 5
- C) Explain the stereochemistry of  $\text{KMnO}_4$  oxidation of maleic acid and fumaric acid. 5
- D) Define Topicity. Explain the following with one example: 5
- Enantiotopic ligands
  - Diastereotopic ligands
- E) a) Explain isoelectric point with respect to  $\alpha$ -amino acids. 3
- b) Give preparation of alanine by Strecker synthesis. 2
- F) Explain in detail the preparation of a tripeptide by using the Merrifield solid phase peptide synthesis? 5
- Q.2** Attempt any four of the following. 20
- A) What is Favorskii rearrangement? Explain with suitable example. 5
- B) a) Complete the following reactions. Give the name of reactions. 3
- 
  - 
- b) Complete the reaction. 2
- 
- C) a) Explain reducing and non-reducing sugars with suitable examples. 3
- b) Write appropriate reactions for acetylation of  $\alpha$ -D-glucopyranose. 2
- D) Convert the following Fischer projection formula to Haworth formulae. ( $\beta$ -furanose forms) 5
- 
  - 
- E) a) Write the reactions for complete methylation of  $\alpha$ -D-glucopyranose in a stepwise manner. 3
- b) Draw chair conformations of  $\alpha$  and  $\beta$  forms of D-glucopyranose. 2
- F) a) How will you convert D-Glucose into D-Arabinose 3
- b) Write the reactions for oxidation of D-glucose using: 2
- Bromine water
  - Conc.  $\text{HNO}_3$

- Q.3. Attempt any four of the following.** 20
- A) Explain how IR spectrum is used to determine the following: 5
1. If the given compound is aromatic.
  2. The two given compounds are identical
- B) a) Explain the effect of magnetic anisotropy on aldehydic protons? 3  
 b) What is chemical shift? How is it expressed? 2
- C) a) Give the structure of the following pyrimidine bases present in nucleic acid? 3
1. Cytosine
  2. Uracil
  3. Thymine
- b) Draw the structure of sugars present in DNA & RNA. 2
- D) a) Explain the controlled hydrolysis of nucleic acids. 3  
 b) What are nucleosides? Draw the structure of Adenosine. 2
- E) An organic compound has the molecular formula  $C_4H_8O$ . Determine the index of its hydrogen deficiency and deduce its structural formula from the following spectral data: 2
- IR spectrum: It shows a sharp band at  $1740\text{ cm}^{-1}$   
 PMR spectrum: It shows a doublet at  $\delta$  1.1 ppm (6H), multiplet at  $\delta$  2.3 ppm (1H) and a doublet at  $\delta$  9.4 ppm (1H).
- F) An organic compound has the molecular formula M.F.  $C_8H_{10}O$ . Determine the index of its hydrogen deficiency and deduce its structural formula from the following spectral data. 5
- IR Spectrum ( $\text{cm}^{-1}$ ): 3500, 1600, 1570, 760 & 710.  
 PMR Spectrum (in  $\delta$  ppm): 1.6 (3H,d), 4.9 (1H,q), 7.4 (5H,m), 4.2 (1H,s, $D_2O$  exchangeable). Suggest a structure for the compound and justify your answer.

- Q.4 Attempt any four of the following.** 20
- A) a) What is Ziegler-Natta catalyst? Explain the stereoisomerism taking example of polypropylene. 3  
 b) Give the preparation and uses of PVC. 2
- B) a) Explain the following terms with example: 3
- i) Elastomers
  - ii) Fibres
  - iii) Plasticiser
- b) Give any two biomedical uses of synthetic polymers. 2
- C) a) Give the structure, properties and uses of polyurethane. 3  
 b) Write a note on vulcanisation of rubber. 2
- D) How is Raney-Ni prepared? Write its reduction reactions with following compounds? 2
- i) Alkenes
  - ii) Nitriles
  - iii) Nitro compounds
- E) a) What is the action of  $LiAlH_4$  on the following compounds: 5
- i) Acetone
  - ii) Methyl cyanide
  - iii) Nitro ethane
- b) Complete the following reactions 3



- F) a) What is epoxidation? What is the reagent used. Explain the selectivity in the reaction with a suitable example. 3  
 b) Write any two uses of  $SeO_2$ . 2

- Q.5 A) Select the correct option and complete the following statements: (any five) 5
- A carbon atom, to which enantiotopic ligands are attached, is called.....
    - Chiral centre
    - Prochiral centre
    - Ei mechanism
    - None of above
  - The stereochemical equivalence or non-equivalence of different atoms or groups in a molecule is called.....
    - Topocity
    - Distereoselectivity
    - Enantioselectivity
    - Stereoselectivity
  - $S_N1$  reaction proceeds via..... of configuration.
    - Retention
    - Inversion
    - Racemization
    - None of above
  - Meso tartaric acid has.....
    - Plane of symmetry
    - Centre of symmetry
    - Alternating axis of symmetry
    - None of above
  - Hydroxylation of alkene by  $KMnO_4$  is..... reaction.
    - Stereoselective
    - Stereospecific
    - Stereoselective and Stereospecific
    - None of above
  - The  $-CO-NH-$  linkage is called.....
    - Peptide bond
    - Aminine bond
    - Aldehyde bond
    - Ketone bond
  - ..... is used in Strecker synthesis.
    - K-phthalimide
    - Phthalimide
    - Aldehyde
    - Phenyl hydrazine
  - The amino acids which are synthesized by human body are called.....  $\alpha$ -amino acids:
    - Essential
    - Non-essential
    - Acidic
    - Basic

- Q.5 B) State whether true or false: (any five) 5
- D-glucose and D-galactose are epimers.
  - Alkyne is the product of Wittig reaction.
  - Beckmann rearrangement of ketoximes is stereospecific.
  - Pinacol rearrangement takes place in presence of base catalyst.
  - Glucose is a ketose.
  - Five moles of periodic acid are required per mole of D-Fructose.
  - Cellulose is a polysaccharide.

- Q.5 C) Fill in the blanks with correct alternatives given in the bracket: (any five) 5
- (out-of-plane bending, deshielding,  $1690-1720\text{ cm}^{-1}$ , polyphosphate chain, solvent, RNA,  $3200-3600\text{ cm}^{-1}$ , cytoplasm, in-plane bending, three, standard, nucleus.)
- Carbon-tetrachloride is used as a ----- in PMR spectroscopy.
  - helps in protein synthesis.
  - DNA is found in the ----- of the cell.
  - The backbone of nucleic acid molecule is a -----.
  - A broad absorption band due to  $-O-H$  stretching in alcohols appears in the region around -----.
  - For water molecule the number of possible modes of vibrations is ----.
  - The presence of electron withdrawing groups causes ----- effect on the adjacent protons..
  - Rocking is a type of ----- vibration.

Q.5 D) Match the columns: (any five)

Column A	Column B
a) Stabilizers	(i) Cold rubber.
b) Buna-S rubber	(ii) Chemoselective oxidising agent
c) Neoprene	(iii) CaO
d) PHBV	(iv) Allylic or benzylic bromination
e) Lindlar's catalyst	(v) Elastomers
f) Adam catalyst	(vi) Chloroprene.
g) NBS	(vii) Biodegradable polymer
	(viii) Partially reduction of alkynes
	(ix) $PtO_2$

\*\*\*\*\*

08/04/24 TYBSC - VI

(Time: 3 hours)

Total Marks: 100

- N.B.: (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.  
 (3) Use of log table/ non-programmable calculator is allowed.

- Q.1** Attempt any four of the following. 20
- A) (a) What is a polarogram? Draw a polarogram and label all the different regions.  
 (b) Explain half wave potential and its significance.
- B) Explain the construction and working of dropping mercury electrode with a neat labelled diagram.
- C) Explain the term polarographic maxima with a neat diagram. How is it eliminated?
- D) A  $5 \times 10^{-4}$  M solution of  $Ba^{2+}$  ion in 0.1 M KCl as a supporting electrolyte gave a diffusion current of  $4.1 \mu A$ . If the rate of flow of mercury drops and the drop time is  $1.5 \text{ mgs}^{-1}$  and 3 second respectively. Calculate diffusion coefficient of  $Ba^{2+}$  ion.
- E) Explain the nature of amperometric titration curves when,  
 i) titrant is reducible but other species are not.  
 ii) both titrant and titrand are reducible.
- F) Draw a labelled diagram of rotating platinum electrode.  
 Give the advantages and limitations of amperometric titrations.

- Q.2** Attempt any four of the following. 20
- A) Explain the following terms: i) retention time ii) retention volume
- B) Draw a neat and labelled schematic diagram of gas-liquid chromatography. Give any three requirements of carrier gas.
- C) Name the detectors used in gas chromatography. Explain any one detector with the help of a labelled diagram.
- D) What are ion exchange resins? What are the requirements of a good ion exchange resin?
- E) If the two separated components A and B have retention times 4.45 min. and 6.36 min. respectively. If the peak widths at half peak heights of A and B are 0.22 min. and 0.33 min. respectively. Calculate the number of theoretical plates for each peak.
- F) With reference to ion exchange chromatography explain the following applications-  
 1) Demineralisation of water  
 2) Separation of Amino acids

- Q.3.** Attempt any four of the following. 20
- A) Explain the physical method of food preservation with reference to  
 (i) Pasteurisation  
 (ii) Irradiation
- B) Give the composition of milk. Discuss the nutritive value of milk.
- C) Explain the Lowenthal's method to estimate tannin in tea.
- D) Give the composition of Coffee. What is the role of chicory in Coffee?

- E) Give the constituents of Face Powder. What are the characteristics of Face Powder?
- F) What are cosmetics? Give the differences between deodorant and antiperspirant.

Q.4

Attempt any four of the following.

20

- A) Give the applications of thermogravimetry.
- B) Draw a neat and labelled diagram of thermobalance. Discuss any three components of it.
- C) Explain the principle of DTA. Discuss DTA curve of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  with respect to curve, reactions and decomposition temperature.
- D) Give the characteristics of reference material used in DTA. Mentioned name of any four reference materials used in DTA.
- E) Define thermometric titration. Discuss the thermometric titration for Complexometric titration in determination of Calcium and Magnesium
- F) Discuss any five parameters used in method validation process.

Q.5

Select the correct option and complete the following statements: (any five) 05

- a) The electrode which has its own potential and cannot take up potential applied on it is called \_\_\_\_.
- i) dropping mercury electrode ii) non-polarizable electrode iii) rotating platinum electrode
- b) In polarography, KCl is used to \_\_\_\_ migration current.
- i) Eliminate ii) increases iii) maintain
- c) The potential at the point on the polarography wave where  $i = i_d/2$ , is termed as \_\_\_\_.
- i) Half wave current ii) Half wave potential iii) decomposition potential
- d) \_\_\_\_ is directly proportional to the concentration of metal ion.
- i) Diffusion current ii) Residual current iii) limiting current
- e) \_\_\_\_ is used as maxima suppressor in polarography.
- i) KCl ii) Gelatin iii) Pool of mercury
- f) Rotating platinum is used in amperometric titration as \_\_\_\_ electrode.
- i) reference ii) working iii) combined
- g) In amperometric titration of  $\text{Zn}^{2+}$  determined by titrating with \_\_\_\_.
- i) dimethyl glyoxime ii) silver nitrate iii) EDTA
- h) When titrand is reducible but titrant and product are not in amperometric titration shows \_\_\_\_.
- i) constant current till the equivalence point, then increases.  
ii) decrease in current till the equivalence point, then constant  
iii) increase in current till the equivalence point, then decreases

- Q.5 B) State whether true or false: (any five) 05**
- Separation of components in gas-liquid chromatography occurs by differential adsorption.
  - The choice of the detector does not depend on the carrier gas.
  - The smaller the magnitude of plate height, the higher is the efficiency of the column.
  - The response of the detector in gas chromatography should be linear.
  - An anion exchanger contains a carboxylic functional group.
  - Styrene on polymerization produces linear polymers.
  - The unit of ion exchange capacity is milliequivalent/gm.

- Q.5 C) Fill in the blanks with correct alternatives given in the bracket: (any five) 05**  
(glucose oxidase, 63°C and 72°C, Lipstick, magnesium silicate, quality, deodorant, methylene blue, irradiation)
- Food processing improves the \_\_\_\_\_ value of food.
  - Raw honey contains the enzyme \_\_\_\_\_
  - \_\_\_\_\_ prevents/controls body odour.
  - \_\_\_\_\_ is a physical method of food preservation.
  - Pasteurization of milk is carried out at \_\_\_\_\_
  - For determination of reducing sugars in honey, by Cole's ferricyanide method \_\_\_\_\_ is used as an internal indicator.
  - \_\_\_\_\_ mainly consists of an oily base material and colouring agent
  - Chemically talc is \_\_\_\_\_

- Q.5 D) Match the columns: (any five) 05**
- | A                              | B   |
|--------------------------------|---|
| i) Thermometric titration      | (a) $\Delta T$ plotted against sample temperature |
| ii) Thermogravimetric analysis | (b) Closeness of obtained value to true value     |
| iii) Double pan used           | (c) Reference standard                            |
| iv) Accuracy                   | (d) Exotherm                                      |
| v) DTA curve                   | (e) Weight change measurements                    |
| vi) MgO                        | (f) Adiabatic condition                           |
| vii) Air oxidation             | (g) DTA   |

\*\*\*\*\*

**TYBSC**  
**SEM VI 2023**

Time: 3 Hrs

Marks:100

Please check whether you have got the right question paper.

- N.B:** 1. All questions are compulsory.  
2. Figures to right indicates full marks

**Q.1 Answer ANY FOUR of the following:**

- A** Discuss whether the addition of bromine to 2-butene is stereospecific or stereoselective. **5**  
**B** Explain the mechanism and stereochemistry of  $S_N1$  reactions using suitable example. **5**  
**C** a) Write a note on enantiotopic ligands. **3**  
 b) Explain the term: Prochiral centre **2**  
**D** Explain the stereochemistry of  $KMnO_4$  oxidation of maleic acid and fumaric acid. **5**  
**E** a) What are  $\alpha$ -amino acids? How are they classified? **3**  
 b) Give preparation of alanine by Strecker synthesis. **2**  
**F** Explain stepwise synthesis of a tripeptide using Merrifield's solid phase synthesis method. **5**  
 Give two advantages of this method of synthesis.

**Q.2 Answer ANY FOUR of the following:**

- A** Complete the following reaction, identify it and explain its mechanism: **5**
- $$\begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{C}=\text{N}-\text{OH} \\ \diagup \\ \text{C}_6\text{H}_5 \end{array} \xrightarrow{\text{conc. H}_2\text{SO}_4} ?$$
- B** What is Michael reaction? Explain the mechanism of the reaction. Identify the intermediate. **5**  
**C** Give reactions for the following:  
 a) Conversion of D-Glucose into D-Arabinose **3**  
 b) Action of conc.  $\text{HNO}_3$  on D-Glucose and D-Fructose **2**  
**D** a) Write stepwise reactions to show the action of phenylhydrazine on D-Fructose? **3**  
 b) Explain the phenomenon of mutarotation in Glucose. **2**  
**E** a) Draw the Fischer projection of D-Fructose and convert to Haworth formula ( $\beta$ -pyranose form). **3**  
 b) What are epimers? Draw the structure of anyone epimer of D-Glucose. **2**  
**F** Draw structures for the following: **5**
- Enantiomer of D-Glucose
  - Open chain structure of Aldotriose
  - Product formed by action  $\text{NaBH}_4$  on D-Glucose
  - Chair conformation of  $\beta$ -D-Glucopyranose
  - Diastereomer of D-Glucose

**Q.3 Answer ANY FOUR of the following:**

- A** Explain the following terms: **5**
- Finger print region
  - Types of bending vibrations
- B** a) Explain how inductive effect plays an important role in deciding the value of chemical shift with a simple example? **3**  
 b) Why TMS is used as a standard in PMR spectroscopy? **2**  
**C** a) Give the structure of pyrimidine bases present in DNA? **3**  
 b) Distinguish between DNA & RNA? **2**  
**D** Explain the primary structure of nucleic acids? **5**

**E** An organic compound has the molecular formula M.F:  $C_8H_{10}O$ . Determine the index of hydrogen deficiency and deduce its structural formula from the following spectral data? **5**

IR Spectrum ( $cm^{-1}$ ): 3500, 1600, 1570, 760 & 710

PMR Spectrum: (in  $\delta$  ppm): 1.6(3H,d) , 4.2(1H, s,  $D_2O$  exchangeable) , 4.9 (1H,q) , 7.4 (5H,m) . Suggest a structure for the compound and justify your answer.

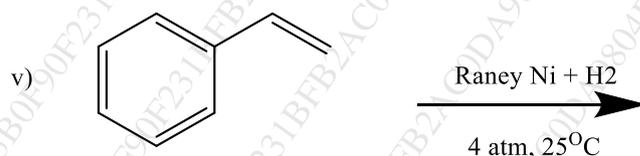
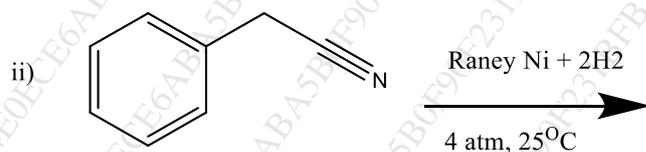
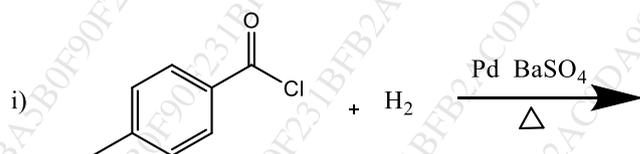
**F** An organic compound has the molecular formula M.F  $C_9H_{10}O_2$ . Determine the index of hydrogen deficiency and suggest a structure for the compound. Justify your answer? **5**

IR Spectrum ( $cm^{-1}$ ) : 3100 (broad), 1715, 1600, 750 & 710

PMR Spectrum: (in  $\delta$  ppm): 1.5(3H,d) , 3.7(1H,q), 7.5 (m, 5H) , 11.8 (1H, s)

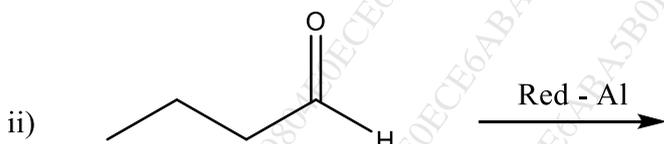
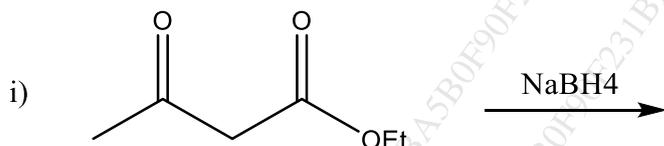
**Q.4** Answer ANY FOUR of the following:

**A** Complete the following reactions



**B** a) What is Lindlar's catalyst? Explain its use in partial reduction of alkynes and its selectivity? **3**

b) Complete the following reactions:



- C a) How are polymers classified on the basis of properties of polymers? **3**  
 b) Give the preparation and uses of Nylon 6,6? **2**
- D a) Explain the following terms with examples **3**  
 i) Plasticizers      ii) Stabilizer      iii) Fillers  
 b) Write the synthesis of Buna – S rubber. **2**
- E a) Explain reaction of epoxidation using m-CPBA. **3**  
 b) Explain the allylic and benzylic bromination using NBS **2**
- F a) Draw the structure and give one use of the following polymers- **3**  
 i) Neoprene      ii) Nylon 6      iii) Polyester  
 b) Write the structure and use of Ziegler Natta catalyst. **2**

- Q.5 A **State whether the following are true or false: (any five)** **5**  
 a) The two faces in ethyl methyl ketone are homotopic in nature.  
 b) E<sub>2</sub> elimination reaction requires antiperiplanar geometry of the two leaving groups of substrates.  
 c) Epoxide contains a three membered heterocyclic ring with one oxygen atom present in the ring.  
 d) All stereospecific reactions are not stereoselective in nature.  
 e) The reactions where only one diastereomer of all the possible diastereomers of the product is formed, are known as diastereoselective reactions.  
 f) A dipeptide is formed from two α-amino acids.  
 g) K-phthalimide is used as one of the reactants in Gabriel's synthesis of α-amino acids.  
 h) Proteins are formed by ester linkages between different α-amino acids.

- B Choose the most correct option to answer the following (ANY FIVE): **5**  
 a) What is the intermediate formed in Pinacol-Pinacolone rearrangement?  
 i) Carbocation      iii) Carbanion  
 ii) Nitrene      iv) Carbene  
 b) What is the base catalysed rearrangement of α-haloketones to carboxylic acid derivatives called?  
 i) Beckmann reaction      iii) Favorski reaction  
 ii) Wittig reaction      iv) Michael reaction  
 c) Which of the following is an aldotetrose?  
 i) Mannose      iii) Xylose  
 ii) Threose      iv) Arabinose  
 d) Identify the anomer of α-D-Fructofuranose.  
 i) α-D-Fructopyranose      iii) β-D-Glucopyranose  
 ii) β-D-Glucofuranose      iv) β-D- Fructofuranose.

- e) Identify the product/s formed on treating D-Fructose with  $H_2/Ni$ .
- |              |                          |
|--------------|--------------------------|
| i) Sorbitol  | iii) Sorbitol & Mannitol |
| ii) Mannitol | iv) Allitol              |
- f) How many moles of periodic acid are required per mole of D-Fructose?
- |       |        |
|-------|--------|
| i) 3  | iii) 5 |
| ii) 4 | iv) 6  |
- g) Identify the oligosaccharide.
- |             |             |
|-------------|-------------|
| i) Starch   | iii) Ribose |
| ii) Sucrose | iv) Idose   |

**C Fill in the blanks: ( Any five)**

**5**

- a) A sharp absorption band due to  $>C=O$  stretching in ketones appears in the region ---  
-----
- b) Nujol is -----
- c) The position of the signals in NMR represents the ----- of the protons.
- d) NMR is based on the property of -----
- e) In Tau scale the position of TMS signal is taken as ----- ppm
- f) The sugar component in DNA is -----
- g) Uracil is a derivative of -----
- h) A-T and C-G are called ----- base pairs

**D State whether the following are True or False: (any five)**

**5**

- a) Polyhydroxyalkanoates (PHAs) is biodegradable polymer.
- b) Lithium Aluminum hydride (LAH) is mild reducing agent.
- c) In isotactic polymer all the side chains are arranged on the same side of the polymeric backbone.
- d) Polycarbonates are used in bike helmets.
- e)  $RhCl(PPh_3)_3$  is Wilkinson's catalyst.
- f)  $SeO_2$  oxidises only active methyl or methylene group without affecting carbonyl group.
- g)  $\alpha$ - cyano acrylate can be used as artificial skin.

---

(Time: 3 hours)

Total Marks: 100

- N.B.:** (1) All questions are compulsory.  
 (2) Figures to the right indicate full marks.  
 (3) Use of log table/ non-programmable calculator is allowed.

**Q.1** Attempt any four of the following. **20**

- A) Draw a polarogram and label all the regions. Explain the role of supporting electrolyte used in polarographic analysis.
- B) Explain the term polarographic maxima with a neat diagram. How is it eliminated?
- C) In a polarographic determination of nickel, the wave heights determined for a series of solutions were as follows:

Conc. of Ni <sup>2+</sup> (mM)	0.25	0.5	0.75	1.0	unknown
Wave height (mm)	31.8	64.0	95.8	128.0	70.0

- D) Find the concentration Ni<sup>2+</sup> in unknown solution.
- E) With the help of labelled diagram, explain dropping mercury electrode. Give any one of its limitation.
- F) What are the advantages and limitations of amperometric titrations?
- G) Give the basic difference between amperometry and voltammetry. Explain the nature of amperometric titration curve when both titrand and titrant are reducible, and product is non-reducible.

**Q.2** Attempt any four of the following. **20**

- A) Draw schematic diagram of gas chromatograph and explain any two components.
- B) Explain electron capture detector in GC and write any one advantage.
- C) Give the applications of gas chromatography.
- D) In GC, components of A and B were found to have retention time of 16.30 min and 13.30 min respectively on a 30 cm column. The peak width at base for components A and B were 1.00 min and 1.30 min respectively. Calculate the average number of plates in the column and plate height of the column.
- E) Explain ion exchange capacity? How is it determined for cation exchanger.
- F) Explain any two applications of ion-exchange chromatography in detail.

**Q.3.** Attempt any four of the following. **20**

- A) What is food processing? Explain the need of food processing?
- B) Explain the Lane Eynon method for analysis of lactose in milk.
- C) What are objectives of pasteurization? Explain any two methods of pasteurization.
- D) Enlist the types of tea and explain any two in detail.
- E) Explain a method to estimate amount of calcium and magnesium in face powder complexometrically.

- F) Write constituents of lipstick and any three properties of antiperspirant.
- Q.4** **Attempt any four of the following.** **20**
- A) Draw a neat labelled diagram of thermobalance and write the function of any three of its components.
- B) Name the factors which influence the TG curve. Explain thermal decomposition of calcium oxalate.
- C) Distinguish between TGA and DTA
- D) Discuss thermometric titrations of:  
 1) HCl v/s NaOH  
 2) Boric acid v/s NaOH
- E) What are the important applications of DTA?
- F) Explain linearity and accuracy w.r.t. method validation.
- Q.5** **A) Select the correct option and complete the following statements: 05 (any five)**
- a) The diffusion of particles from bulk of the solution to the surface of DME due to the difference in concentration is called \_\_\_\_\_.  
 i) decomposition                      ii) electrical potential gradient  
 iii) concentration gradient
- b) The electrode which has its own potential and cannot take up potential applied on it is called \_\_\_\_\_.  
 i) dropping mercury electrode      ii) non-polarizable electrode  
 iii) rotating platinum electrode
- c) Oxygen dissolved in the electrolytic solutions is easily reduced at the DME produces polarogram consisting of \_\_\_\_\_ waves.  
 i) three                                  ii) four                                  iii) two
- d) In polarography the time that lapses between the detachment of two successive drops of mercury is called \_\_\_\_\_.  
 i) drop time                              ii) dead time                              iii) inactive time
- e) In polarographic analysis the diffusion current is proportional to the concentration of \_\_\_\_\_.  
 i) supporting electrolyte      ii) reducible ion                      iii) triton X-100
- f) When titrand is reducible but titrant and product are not in amperometric titration shows \_\_\_\_\_.  
 i) constant current till the equivalence point, then increases.  
 ii) decrease in current till the equivalence point, then constant  
 iii) increase in current till the equivalence point, then decreases
- g) In amperometric titration of  $\text{Ni}^{2+}$  determined by titrating with \_\_\_\_\_.  
 i) dimethyl glyoxime      ii) silver nitrate                      iii) iodine
- h) In rotating platinum electrode, the diffusion current is \_\_\_\_\_ times larger than in case of DME.  
 i) 100    ii) 400    iii) 20

**Q.5 B) State whether true or false: (any five) 05**

- The retention time of the mobile phase is called dead time.
- Nitrogen gas is used as carrier gas in gas chromatography.
- If a component A is more soluble in the stationary phase than component B, then A will come out of the column later than B.
- Eddy diffusion is a band broadening factor in chromatography caused by the non-equal path of the solute molecules.
- Diatomaceous earth is the commonly used solid support material in gas chromatography.
- Standard solution of sodium nitrate is used in the determination of capacity of an anion exchanger.
- In ion exchange chromatography, density of the resin should be less than that of the water.

**Q.5 C) Fill in the blanks with correct alternatives given in the bracket: 05**

**(any five)**

(Sensory, 8-hydroxy quinoline, dimethyl glyoxime,  $\text{TiO}_2$ , irradiation, caffeine, fructose, alkaline phosphatase, meats.)

- \_\_\_\_\_ is a physical method of food preservation.
- \_\_\_\_\_ enzyme is present in milk.
- \_\_\_\_\_ is the major pharmacologically active compound in coffee.
- \_\_\_\_\_ present in talcum powder has UV reflection properties.
- Honey contains large quantity of \_\_\_\_\_ than glucose.
- \_\_\_\_\_ properties are detected by the five sense organs.
- In estimation of Zinc from deodorants and antiperspirants \_\_\_\_\_ is used as a complexing agent.
- Nitrates and nitrites are generally used for preservation of \_\_\_\_\_.

**Q.5 D) Match the columns: (any five) 05**

	<b>A</b>	<b>B</b>
<b>i)</b>	Thermometric titration	a) Reference standard
<b>ii)</b>	TGA thermobalance	b) $\Delta H$
<b>iii)</b>	Plateau in TGA	c) Accuracy
<b>iv)</b>	SiC	d) No loss in mass
<b>v)</b>	Recovery study	e) single pan
<b>vi)</b>	Thermocouple	f) Analysis of polymer
<b>vii)</b>	Application of DTA	g) Ni-Cr Alloy

\*\*\*\*\*

[ Time : 3Hours]

[Total marks :100]

**N.B. : (1) All questions are compulsory.****(2) Figures to the right indicate full marks.****(3) Use of logarithmic table/non-programmable calculator is allowed .**

1. Attempt **any four** of the following:
- A. What is crystal field splitting? Explain with reference to square planar complexes. **5**
- B. Explain why  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  is a high spin and  $[\text{Fe}(\text{CN})_6]^{3-}$  is a low spin complex. **5**
- C. Explain the following with respect to the factors affecting crystal field splitting parameter.  
i) Geometry of the complex **21/2**  
ii) Nature of the ligands **21/2**
- D. Explain the term crystal field stabilization energy [CFSE]. Calculate CFSE for  $d^3$  and  $d^8$  configurations in strong field octahedral complexes. **5**
- E. Discuss in brief the merits and demerits of Crystal Field theory. **5**
- F. Discuss any two experimental evidences which proves covalent bonding in the metal complexes. **5**
2. Attempt **any four** of the following:
- A. Draw and explain a neat labelled molecular orbital diagram for hexacyanoferrate (II) ion.  $[\text{Fe}(\text{CN})_6]^{4-}$  **5**
- B. Discuss the effect of  $\pi$  bonding on  $\Delta_0$  values of octahedral complexes with ligands having filled  $\pi$  orbital. **5**
- C. What are chelating agents? Discuss their effect on stability of complexes. **5**
- D. Write a note on the Associative mechanism for ligand substitution reaction. **5**
- E. What is Russell-Saunders (*LS*) coupling? Explain with suitable example. **5**
- F. i. Calculate the ground state term for ' $d^1$ ' configuration of  $\text{Ti}^{3+}$ . **3**  
ii. Explain spin multiplicity for two electrons. **2**
3. Attempt **any four** of the following:
- A. Write a note on ionic organometallic compound. **5**
- B. How will you prepare organometallic compound by Transmetallation reaction? **5**
- C. Explain the complex formation reaction for the organometallic compound. **5**
- D. What is ferrocene? Explain structure of ferrocene according to valence bond theory. **5**
- E. Discuss homogeneous catalysis with suitable example. **5**
- F. Discuss the following steps involved in hydrogenation of alkene using Wilkinson's catalyst. a) oxidative addition      b) alkene coordination. **5**

4. Attempt **any four** of the following:
- What is meant by term metallurgy? Explain self-reduction process in pyrometallurgy. **5**
  - Define roasting. Explain different types of roasting methods used for extraction of ore. **5**
  - Describe electrolytic refining of copper with suitable diagram. **5**
  - Explain with suitable diagram Froth floatation process for concentration of ore. **5**
  - Discuss the structure of  $\text{XeOF}_4$  molecules on the basis of VSEPR theory. **5**
  - Give an account of  $\text{Na}^+ - \text{K}^+$  ion pump with suitable diagram. **5**
5. Answer the following:
- Select whether the following statements are **true** or **false** (Any five) **5**
    - Splitting of d - orbitals is maximum in tetrahedral complexes.
    - Triply degenerate set of  $d_{xy}$ ,  $d_{yz}$ ,  $d_{zx}$  are called as  $t_{2g}$  orbitals.
    - The value of  $10Dq$  does not depend on the nature of central metal atom.
    - In octahedral complexes, due to the crystal field splitting, orbital with maximum energy is  $d_{x^2 - y^2}$ .
    - In the absorption spectrum of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ , one transitions are possible.
    - In an octahedral complex, metal ion with  $d^2$  configuration has CFSE value  $- 8 dq$ .
    - Electrons prefer to pair up in  $e_g$  orbital when  $\Delta_0 < P$ .
    - The effect of ligands in expanding the d-electron cloud is called Jahn -Teller effect .
  - Fill in the blank with appropriate words given in the bracket (Any five ) **5**  
[weakening, isomerization, unpaired electrons, microstates, even and symmetrical, less stable, two, bonding ]
    - The term gerade corresponds to \_\_\_\_\_
    - If the matching orbitals overlap combines with maximum positive overlap, they form \_\_\_\_\_ molecular orbitals.
    - Presence of bulky ligands in a chelate results in \_\_\_\_\_ of metal ligand bond.
    - The complexes with forced configurations are \_\_\_\_\_
    - The reactions which involve structural changes are called \_\_\_\_\_ reactions.
    - With respect to octahedral complexes, dissociative mechanism can be considered as \_\_\_\_\_ step mechanism.
    - The allowed combinations of  $m_l$  and  $m_s$  for electrons are called \_\_\_\_\_
    - A transition is said to be spin forbidden, if it involves different number of \_\_\_\_\_

- C.** Select and write the appropriate answer . (Any five ) **5**
- \_\_\_\_\_ is the example of organometallic compound.  
a)  $\text{CH}_4$       b)  $\text{H}_2\text{O}$       c)  $\text{CH}_3\text{MgCl}$       d)  $\text{CH}_3\text{Cl}$
  - In preparation of organometallic compound by metallation reaction, Hydrogen from R-H is replaced by \_\_\_\_\_  
a) carbon      b) metal      c) non-metal      d) nitrogen
  - In the complex formation reaction of organometallic compound, organometallic compound acts as \_\_\_\_\_  
a) Lewis acid      b) Lewis base      c) Arrhenius acid      d) Arrhenius base
  - \_\_\_\_\_ is the best example of metallocene.  
a) Ferrocene      b) Ferric chloride      c) Ferrous sulphate      d) Ferric Hydroxide
  - According to valence bond theory, ferrocene is \_\_\_\_\_  
a) Diamagnetic      b) paramagnetic      c) ferromagnetic      d) antiferromagnetic
  - \_\_\_\_\_ is known as Wilkinson's Catalyst  $\text{Rh Cl}_3 (\text{PPh}_3)$   
a)  $\text{Rh Cl}_3 (\text{PPh}_3)$       b)  $\text{Rh Cl} (\text{PPh}_3)_3$       c)  $\text{Rh Cl}_2 (\text{PPh}_3)_2$       d)  $\text{Rh} (\text{PPh}_3)_4$
  - In Homogeneous catalysis, if reactants and products are in gaseous phase then catalyst may be in \_\_\_\_\_ phase only  
a) solid      b) liquid      c) gaseous      d) changing
  - Ferrocene can be prepared by oxidation of cyclopentadienyl Grignard Reagent with \_\_\_\_\_  
a)  $\text{KOH}$       b)  $\text{HCl}$       c)  $\text{FeCl}_3$       d)  $\text{NaCl}$

**D.** Match the column: (Any five ) **5**

<b>a.</b>	Azurite	<b>i.</b>	Pyramidal geometry
<b>b.</b>	Gangue	<b>ii.</b>	Calcium deficiency
<b>c.</b>	Smelting	<b>iii.</b>	Square Planar Geometry
<b>d.</b>	$\text{XeF}_4$	<b>iv.</b>	Used in electronic tubes
<b>e.</b>	$\text{XeO}_3$	<b>v.</b>	Pyrometallurgical reduction
<b>f.</b>	Krypton-85	<b>vi.</b>	Purification of metal
<b>g.</b>	Rickets	<b>vii.</b>	Copper Ore
<b>h.</b>	Oxygen transfer	<b>viii.</b>	Concentration of Ore
		<b>ix.</b>	Non-Metallic Impurities
		<b>x.</b>	Heamoglobin

\*\*\*\*\*

[Time: 3Hours]

[Total marks: 100]

**N.B. : (1) All questions are compulsory.****(2) Figures to the right indicate full marks.****(3) Use of logarithmic table/non-programmable calculator is allowed.****Physical Constants:**

$$N = 6.023 \times 10^{23}$$

$$F = 96500 \text{ coulombs}$$

$$c = 3 \times 10^8 \text{ m/s}$$

$$R = 8.314 \text{ J / K/mol}$$

$$h = 6.626 \times 10^{-34} \text{ J.s}$$

$$\text{Charge on electron} = 1.66 \times 10^{-19} \text{ C}$$

$$\text{Mass of an electron} = 9.1 \times 10^{-31} \text{ kg}$$

$$2.303RT / F = 0.05916 \text{ at } 298\text{K}$$

$$\pi = 3.142$$

1. Attempt **any four** of the following:

- |    |  |   |
|----|--|---|
| A. | Write a note on liquid junction potential. Give functions of salt bridge.  | 5 |
| B. | What are galvanic cells? Classify them.  | 5 |
| C. | Derive an expression for the emf of electrolyte concentration cell with transference reversible to cation.   | 5 |
| D. | Derive an expression for the emf of electrode concentration cell reversible to anion.  | 5 |
| E. | Explain the terms i) Polarization ii) Decomposition potential  | 5 |
| F. | Define overvoltage. In electrolysis of 2 N sulfuric acid, the hydrogen overvoltage at lead cathode was found to be 0.64 V at 298 K for a given current density. What will be the hydrogen overvoltage if the current density is increased to twice its present value for the same cathode under same condition. (Given: $b = 0.12$ ) | 5 |

2. Attempt **any four** of the following:

- |    |  |   |
|----|--|---|
| A. | How are polymers classified on the basis of physical properties?   | 5 |
| B. | Explain the method for determination of molecular weight of polymers.  | 5 |
| C. | Write a note on curing agents.   | 5 |
| D. | What are stabilisers? Explain with examples.   | 5 |
| E. | What is LEP? How are they prepared?  | 5 |
| F. | Equal weights of polymer molecules each of molecular weight 40,000 g/mol and 50,000 g/mol are mixed. Calculate $\bar{M}_n$ and $\bar{M}_w$ . | 5 |

3. Attempt **any four** of the following:

- A. What is an operator? How is multiplication of operators carried out? Show that the following pairs of operator commute. 5  
 $\frac{d^2}{dx^2}$  and  $\frac{d}{dx}$  on  $f(x) = \sin x$
- B. What are the salient features of a black body radiation? How does classical theory explain the variation of intensity with respect to Temperature? 5
- C. Explain the Planck's theory of quantisation. 5
- D. The work function of silver metal is 4.7 eV. Calculate the Kinetic energy and velocity of the electron ejected when a radiation of wavelength 300 nm is incident on the silver surface. Will photoelectrons be observed? 5
- E. Explain the Structure of Solar cell with the help of diagram. 5
- F. Explain how Hydrogen be generated by direct electrolysis of water. 5

4. Attempt **any four** of the following:

- A. Explain the term nuclear spin in NMR. 5
- B. Explain spin-spin and spin-lattice relaxation in NMR. 5
- C. Explain the principle and fundamental equation of NMR. 5
- D. Explain the principle of ESR spectroscopy. 5
- E. Write a note on ESR spectrometer. 5
- F. Explain the ESR spectra of hydrogen. 5

5. Answer the following:

- A. Select whether the following statements are true or false (**Any five**) 5
- For galvanic cells the value of  $E^\circ_{\text{cell}}$  is always greater than 1.
  - In case of concentration cells both half cells are chemically identical with differing in concentrations.
  - The value of the hydrogen overvoltage for lead cathode is less than platinum cathode under same conditions.
  - Liquid junction potential cannot be removed completely, but it can be minimised.
  - For sulfuric acid the activity can be represented as  $a = (m \cdot \gamma_{\pm})^2$
  - For ideal solution, the value of activity coefficient is always equal to one.
  - With change in pH of solution the value of overvoltage remains same.
  - The cell represented as,  $\text{Zn} / \text{ZnSO}_4 \parallel \text{AgNO}_3 / \text{Ag}$  is an example of chemical cell.
- B. Fill in the blank with appropriate words given in the bracket. (**Any five**) 5
- is a linear polymer.  
(Polyester, glycogen, bakelite, starch)
  - is a thermoplastic polymer.  
(PVC, starch, nylon, cellophane)
  - The repeated unit in a polymer is called-----  
(Monomer, elastomer, fibres, resin)
  - is used as adhesives.  
(Liquid resin, fibres, rubber, nylon)

- e. Polymers having long range elasticity are called-----  
(Elastomers, gum, nylon, protein)
- f. Weight average molar mass is denoted as-----  
( $M_w$ ,  $M_n$ ,  $M_z$ ,  $M_v$ )
- g. LED is made of -----material.  
(semi-conductor, nylon, terylene, rubber)

**C. Select and write the appropriate answer. (Any five)**

**5**

- a. Newton's law of mechanics is the backbone of
  - i. Quantum mechanics
  - ii. Classical mechanics
  - iii. Wave mechanics
  - iv. Body mechanics
- b. Total radiation emitted per unit surface area is called.
  - i. Energy
  - ii. Intensity
  - iii. Power
  - iv. Surface energy
- c. The waves which do not travel in vacuum.
  - i. Matter
  - ii. Translational
  - iii. Rotational
  - iv. vibrational
- d. A -wave function contains information about
  - i. Volume occupied by a particle.
  - ii. location and motion of particle
  - iii. area occupied by the particle.
  - iv. shape of the particle
- e. Schrodinger equation is a
  - i. First order differential equation.
  - ii. Second order differential equation.
  - iii. Partial differential equation.
  - iv. Nonlinear differential equation.
- f. Hamiltonian is given by.
  - i. Kinetic Energy
  - ii. Potential energy
  - iii. Sum of kinetic and potential energy
  - iv. momentum
- g. One of the ways to tap solar energy is
  - i. stark effect
  - ii. Photovoltaic effect
  - iii. Einstein effect
  - iv. Compton effect
- h. The band possessed by valence electrons is called
  - i. Valence band
  - ii. Conduction band
  - iii. Forbidden energy gap.
  - iv. Equivalent band

D.

Match the column (Any five )

5

- |    |                                  |       |                             |
|----|----------------------------------|-------|-----------------------------|
| a. | ${}^6\text{C}^{13}$              | i.    | $\infty$                    |
| b. | ${}^7\text{N}^{14}$              | ii.   | Solvent in NMR spectrometer |
| c. | Angular velocity                 | iii.  | $I=0$                       |
| d. | ${}^6\text{C}^{12}$              | iv.   | $I=1$                       |
| e. | $\text{CCl}_4$                   | v.    | ESR spectra                 |
| f. | Hyperfine splitting of deuterium | vi.   | $I=1/2$                     |
| g. | $\gamma$                         | vii.  | 2 peaks                     |
|    |                                  | viii. | 3 peaks                     |
|    |                                  | ix.   | Gyromagnetic ratio          |
|    |                                  | x.    | Spin quantum number         |

\*\*\*\*\*