

CENTRAL UNIVERSITY OF HARYANA
End Semester Examinations June. 2022

Programme: Integrated B.Sc.- M.Sc. Chemistry
Semester: 4th
Course Title: Physical Chemistry-IV
Course Code: SBS CH 020403 C 4004

Session: 2022-23
Max. Time: 3 H
Max. Marks: 70

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and a half Marks.
2. Questions no. 2 to 5 have three parts and students need to answer any two parts of each question. Each part carries seven marks.

Q 1. Answer the following in brief: (4×3.5=14)

- a) Explain Arrhenius's theory of electrolytic dissociation. How does it relate to the concept of conductivity and equivalent conductivity?
- b) Calculate the transference number of Na⁺ ions in a 0.1 M solution of NaCl at 25°C, given that its specific conductance is 0.018 S cm⁻¹ and the molar conductivity of NaCl at infinite dilution is 126.4 S cm² mol⁻¹.
- c) Discuss Debye-Falkenhagen effect and Walden's rules.
- d) Define the term "liquid junction potential" and explain its significance in the measurement of EMF of a cell. Also, discuss the determination of activity coefficients and transference numbers in concentration cells.
- e) Describe the applications of cellulose in the production of paper and textiles.
- f) What is the Lorenz-Lorentz equation? How does it relate to the electrostatics of dielectric media?
- g) Explain the classification of polymers based on their synthesis method.

Q 2. Answer the following in brief: (2×7=14)

- a) Derive the expression for the transport number of an ion using the migration of ions in an electric field. Also, explain the significance of the transport number in the determination of the concentration of ions in a solution.
- b) Discuss the significance of Walden's rules and explain their limitations. Also, explain the effect of temperature and pressure on the conductivity of electrolyte solutions.
- c) Discuss the concept of transference number and its determination using the Hittorf's and Moving Boundary methods. Also, explain the limitations of these methods.

Q3. Answer the following: (2×7=14)

- a) Discuss the significance of the Faraday constant in electrochemistry and explain how it is used to calculate the amount of substance produced in an electrolysis reaction. Also, explain the importance of electrolysis in metallurgy and industry.
- b) Discuss the concept of concentration cells and explain how the EMF of a concentration cell depends on the concentration of the electrolyte. Also, derive an expression for the EMF of a concentration cell.
- c) A concentration cell is made by connecting two hydrogen electrodes, one in contact with a solution of HCl of concentration 0.1 M and the other in contact with a solution of HCl of concentration 1.0 M. Calculate the emf of the cell at 25°C and determine the direction of the flow of current.

Q 4. Answer the following: (2×7=14)

- a) Derive the Clausius-Mosotti equation for a dielectric medium, and explain its significance in electrostatics.
- b) Explain the phenomenon of diamagnetism, and give an example of a diamagnetic material. How is the magnetic susceptibility of a diamagnetic material measured?
- c) Describe the concept of molecular polarizability, and how it relates to the dielectric constant of a material. What factors affect the polarizability of a molecule?

Q 5. Answer the following: (2×7=14)

- a) Describe the concept of molecular polarizability, and how it relates to the dielectric constant of a material. What factors affect the polarizability of a molecule?
- b) What are the applications of conducting polymers in the field of electronics and energy storage? Explain the concept of doping in conducting polymers and its effects on their conductivity.
- c) Explain the concept of functionality in polymers. How is it related to the degree of polymerization? Give examples of high functionality polymers and their applications.

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations June 2022

Programme: M.Sc. Chemistry

Session: 2021-22

Semester: Semester-IV

Max. Time: 3 Hours

Course Title: Inorganic Chemistry-VI

Max. Marks: 70

Course Code: SBS CH 010411 SE 4004

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.
2. Question no. 2 to 5 have three parts and students need to answer any two parts of each question. Each sub part carries seven marks.

Question No. 1.

(4X3.5=14)

- (a) What do you mean by nanomaterials? How the properties of bulk scale materials changes drastically on reducing to nanoscale?
- (b) Discuss Langmuir model of adsorption for the characterization of nanomaterials. What modifications are made in the BET model of adsorption as compare to Langmuir model?
- (c) Write a short note on zeolitic metal-organic frameworks or ZMOFs.
- (d) Discuss the microwave process of synthesizing metal-organic frameworks. Write down its advantages.
- (e) What do you mean by preorganization and complementarity in supramolecular chemistry? Explain with examples.
- (f) What is hydrogen bonding? Name three parameters based on which hydrogen bonding can be classified as strong, moderate and weak.
- (g) What is a molecular wire? Discuss a strategy for protecting a molecular wire through chemical modification.

Question No. 2.

(2X7=14)

- (a) (i) Discuss in detail the top-down and bottom-up approach of synthesizing nanomaterials? Give examples of each type. (5 marks)
(ii) What are nanocomposites? Give some examples. (2 marks)
- (b) (i) Draw the schematic of experimental set-up for physical vapour synthesis of oxide nanomaterials. Label the components neatly and discuss the advantages of this process. (5 marks)
(ii) Match/relate the entries in the two columns: (2 marks)

(a) X-ray Diffraction (XRD) Pattern	(i) Electron wave
(b) Two dimensional material	(ii) Diffraction ring
(c) Electron Diffraction	(iii) MoS ₂
(d) Electron Microscopy	(iv) 2θ -intensity plot

- (c) (i) Discuss the importance of dangling bonds? Give two examples of nanomaterials (organic and inorganic) which can be prepared by taking advantage of dangling bonds with reasoning. (5 marks)
(ii) What is chromatic aberration in electron microscopy? How can it be corrected? (2 marks)

Question No. 3.**(2X7=14)**

- (a) (i) Discuss the terms coordination polymers (CPs) and metal-organic frameworks (MOFs). Give some common examples. (3 marks)
- (ii) Provide some examples of metal nodes and linkers that are used to construct MOFs. What are secondary building units? (2+2 marks)
- (b) (i) Write down the advantages of hydrothermal synthesis of CPs or MOFs. Make a drawing of the Teflon lined steel autoclaves used for hydrothermal synthesis with proper labeling. (4 marks)
- (ii) Discuss the synthesis of MIL-100 (MIL = Materials Institute Lavoisier) and HKUST-1 (HKUST = Hong Kong University of Science and Technology). (3 marks)
- (c) Discuss in detail the adsorption and catalytic application of metal-organic frameworks (MOFs). (7 marks)

Question No. 4.**(2X7=14)**

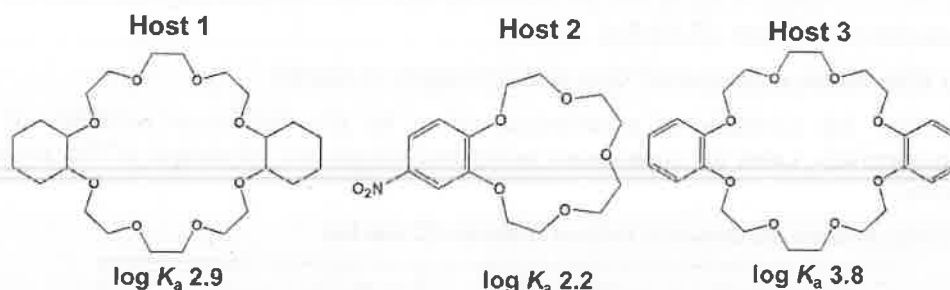
- (a) (i) What do you mean by “host-guest” chemistry in supramolecular chemistry? Explain with a suitable example. What kind of interaction is crucial in forming a supramolecular structure – covalent or non-covalent interaction? (3 + 1 marks)
- (ii) Discuss briefly the lock and key analogy. Where in nature the principle of lock and key analogy is present? (3 marks)
- (b) (i) Discuss solvation and hydrophobic effects in supramolecular chemistry. (4 marks)
- (ii) What do you mean by thermodynamic and kinetic selectivity? (3 marks)
- (c) (i) Discuss the importance of weak interactions in supramolecular chemistry. Write short notes on the following interactions:

Ion–ion, Ion–Dipole, Dipole–Dipole (2 + 3 marks)

- (ii) What is a supermolecule? Give a suitable example. (2 marks)

Question No. 5.**(2X7=14)**

- (a) (i) What properties of Rhodopsin make it a supramolecular photonic device? Discuss the working of Rhodopsin in biology (1 + 4 marks)
- (ii) Discuss the role of magnesium tetrapyrrole system in supramolecular chemistry. (2 marks)
- (b) (i) What are calixarenes? How are calixarenes generally synthesized? Draw the structure of p-t-butyl-calix[4]arene. (4 marks)
- (ii) The binding (specified with $\log K_a$) of the following hosts towards fullerene varies as given below. Explain the trend. (3 marks)



Condition: RT, CCl_4

- (c) (i) What is a molecular switch? Explain the process of photo- and electrochemical switching by taking an example of 1,2-dithienylethene switch unit. (4 marks)
- (ii) Explain Dexter and Förster mechanism of electron transfer in molecular devices. (3 marks)

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations, June 2022

Programme: M.Sc. Chemistry

Semester: IV

Course Title: Organic Chemistry-VI

Course Code: SBS CH 010413 SE 4004

Session: 2021-22

Max. Time: 3 Hours

Max. Marks: 70

Instructions:

1. Question no. 1 has seven sub parts and students need to answer any four. Each sub part carries three and half Marks.

2. Question no. 2 to 5 have three sub parts and students need to answer any two sub parts of each question. Each sub part carries seven marks.

Question No. 1.

(4X3.5=14)

- a) Describe a synthesis of cisplatin. How does it act on DNA?
- b) Discuss the laboratory synthesis of fluconazole.
- c) Describe the various types of neurotransmitters. Draw their structures and mention its function wherever necessary.
- d) Describe the various sources of a lead.
- e) What are "Me too" and "Me better" drugs? What precautions should be taken in its development? Explain with some examples.
- f) Describe the cytoplasmic and intracellular biosynthesis stages of bacterial cell wall.
- g) Define the term isosterism and bioisosterism by taking suitable examples.

Question No. 2.

(2X7=14)

- a) (i) Illustrate major drug targets. Describe the various intra molecular bonding forces involved in drug-target binding. **(3.5 marks)**
(ii) How do you establish structure-activity relationship for a series of newly developed lead compounds? **(3.5 marks)**
- b) (i) Briefly describe the secondary and tertiary structures of protein. **(3.5 marks)**
(ii) Describe the classification of receptors. What are their roles? **(3.5 marks)**
- c) (i) What are competitive and noncompetitive enzyme inhibitors. Explain with suitable diagrams. **(3.5 marks)**
(iii) Define the various mechanisms of desensitization of receptors. **(3.5 marks)**

Question No. 3.

(2X7=14)

- a) (i) Explain the terms partial agonist and inverse agonist. Give examples. **(3.5 marks)**
(ii) What are suicide substrates? Give an example and illustrate its mechanism of action? **(3.5 marks)**
- b) (i) How are DNA-active drugs classified? Give examples for each of them. **(3.5 marks)**
(ii) What is nitrogen mustard? How does it inhibit DNA replication? **(3.5 marks)**

- c) (i) What are the active and inactive conformations of receptors? (3.5 marks)
(ii) Briefly explain the terms pharmacokinetics and pharmacodynamics. (3.5 marks)

Question No. 4.

(2X7=14)

- a) (i) Describe the different stages of drug discovery and development process. What are the major challenges faced during this process? (3.5 marks)
(ii) Define the term serendipity. Give a short note on lead development based on it. (3.5 marks)
- b) (i) What are the various drug theories adopted. Discuss briefly any two. (3.5 marks)
(ii) Describe the term *in vitro*, *in vivo* and *in silico* testing methods. (3.5 marks)
- c) (i) Define QSAR. Explain how this method help towards designing new leads. (3.5 marks)
(ii) How to reduce toxicity of a drug by chemical modification? Explain with a suitable example. (3.5 marks)

Question No. 5.

(2X7=14)

- a) (i) What is 6-APA? Describe the semi synthesis of penicillin-G and amoxicillin. (3.5 marks)
(ii) What do you mean by local anesthetic drugs? Discuss its mechanism of action. (3.5 marks)
- b) (i) Illustrate the terms stimulants, depressants and hallucinogens using appropriate examples. (3.5 marks)
(ii) Describe the synthesis of 7-ACA and demonstrate one general method for the preparation cephalosporin. (3.5 marks)
- (c) (i) Write a brief note on the discovery and development of vaccines (3.5 marks)
(ii) What is the difference between sedative and hypnotic drugs? (3.5 marks)

CENTRAL UNIVERSITY OF HARYANA
End Semester Examinations June-July 2022

Programme: M.Sc. Chemistry

Semester: Fourth

Course Title: Applied Electrochemistry (Physical Chemistry-VI)

Course Code: SBS CH 010415 SE 4004

Session: 2021-22

Max. Time: 3 H

Max. Marks: 70

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

Q 1. (4 × 3.5 = 14)

- a) Differentiate between polarizable and non-polarizable interfaces with suitable examples.
- b) Write a short note on electronation and de-electronation current density.
- c) Write down different factors affecting the efficiency of the electrochemical energy convertor.
- d) Write down the advantages and disadvantages of the H₂-O₂ fuel cell.
- e) Write a short note on activation polarization. What are different factors on which activation polarization depend?
- f) Differentiate between cathodic and anodic protection of metal and their alloys.
- g) How does e-i interface different from the semiconductor p-n interface?

Q 2. (2 × 7 = 14)

- a) Derive the basic fundamental equation of electrodictics i.e., the Butler-Volmer equation.
- b) Discuss in detail the physical significance of the symmetry factor.
- c) Briefly explain two special cases i.e., High and Low field approximation of electrodictics.

Q 3. (2 × 7 = 14)

- a) Briefly explain the construction, working, principle, and reactions taking place at the electrode surface in the Silver-Zinc cell.
- b) Describe the construction, working, principle, and reactions of Natural gas, and CO-air fuel cells.
- c) Write short notes on the following: energy storage density, maximum efficiency of electrochemical energy convertor, Sodium-Sulphur cell, and electrolyte used in a dry cell.

Q 4. (2 × 7 = 14)

- a) Discuss in detail the Mixed potential theory of electrochemical corrosion.
- b) Write a short note on the following: i) Evans diagram, ii) Tafel slopes, iii) Mechanism of passivity, and iv) corrosion current density.

- c) Briefly describe the impedance spectroscopic method to find corrosion inhibition efficiency.

Q 5.

(2 × 7 = 14)

- a) Discuss in detail the mechanism of current across a biological membrane.
- b) Briefly describe the Hot emission of electrons into a vacuum.
- c) Derive the basic fundamental equation of the semiconductor n-p junction interface.

CENTRAL UNIVERSITY OF HARYANA

Even Semester Term End Examinations June 2022

Session: 2021-2022

Programme: M.Sc. Chemistry

Semester- IV

Course Title – Inorganic Chemistry-V (Organometallic Chemistry)

Course Code – SBS CH 010410 SE 4004

Time : 3 Hours

Maximum Marks : 70

Instructions

1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half marks.
2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries 7 marks.

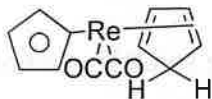
Q 1. (a) Draw and discuss structure of Ziese salt.

3.5x4 = 14

(b) Differentiate between Fischer type and Schrock type carbenes by taking suitable examples.

(c) Which of the following complexes obeys 18 electron rule? Calculate number of electrons in each case.

i)



ii) $V(CO)_6$

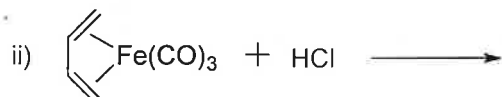
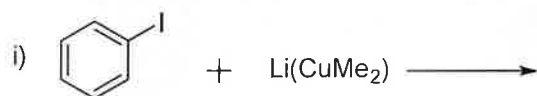
iii) $Fe_2(CO)_9$

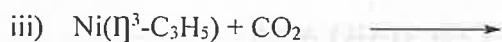
(d) What is Tebbe's reagent? What are its uses?

(e) What is water gas shift reaction? Why do we wish to increase the proportion of H_2 in water gas?

(f) Discuss Buchwald-Hartwig amination reaction.

(g) Complete the following reactions:





- Q 2. a) i) What are the various decomposition pathways of alkyl and aryl complexes of transition elements ? 4
- ii) Discuss role of organocuprate reagents in organic synthesis? 3
- b) Explain methods of preparation, structure and bonding of Fischer type carbene complexes. 7
- c) Explain reactivity, structure and bonding considerations of Schrock carbene complexes. 7
- Q 3. a) Discuss structure of Ferrocene with the help of Molecular Orbital Theory (MOT). 7
- b) Discuss the following reactions of Ferrocene:
- i) Nitration 2
- ii) Mannich reaction 2
- iii) Friedel Craft alkylation 3
- c) i) Give examples of half sandwich and bent sandwich compounds. 3
- ii) Discuss synthesis and structure of Chromocene and Nickelocene. 4
- Q 4. a) (i) What is stereochemical non-rigidity ? How can it be detected by NMR spectroscopy? 4
- (ii) Explain Berry Pseudorotation with suitable examples. 3
- b) Discuss mechanism of fluxionality in η^1 -cyclopentadienyls giving suitable examples. 7
- c) Discuss Tsuji-Trost and Miyaura-Suzuki coupling reactions. 7
- Q 5. a) Discuss mechanism of hydrogenation using the following catalysts: 7
- i) Wilkinson Catalyst
- ii) $\text{RhH}(\text{CO})(\text{PPh}_3)_3$
- b) What are Ziegler-Natta catalysts? Discuss mechanism of Ziegler-Natta polymerization of alkenes. 7
- c) Explain catalytic cycle for the synthesis of acetic acid by Monsanto process. Why $[\text{RhI}_2(\text{CO})_2]^-$ and CH_3I are most suitable for this reaction ? 7

CENTRAL UNIVERSITY OF HARYANA
End Semester Examinations June-July 2022

Programme: M.Sc. Chemistry
Semester: 4th
Course Title: Polymer & Surface Chemistry
Course Code: SBS CH 010414 SE 4004

Session: 2021-22
Max. Time: 3 H
Max. Marks: 70

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.
2. Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

Q 1. (4×3.5=14)

- a) Differentiate between inhibitor and retarder in the polymerization reaction. How do they affect the degree of polymerization?
- b) Differentiate between homogeneous and heterogeneous polymerization.
- c) Write a short note on the FTIR method for characterizing the polymer.
- d) How does the TGA/DTA technique help in the thermal analysis of polymers?
- e) Briefly explain the mechanism of adsorption of the L/S interface.
- f) Briefly explain Szyszkowski, Langmuir, and Frumkin adsorption equations.
- g) Briefly explain different factors affecting CMC.

Q 2. (2×7=14)

- a) Explain the mechanism and kinetics of radical chain polymerization.
- b) Difference between coordination and copolymerization reaction.
- c) Write down the importance of Polydispersity and molecular weight distribution in polymers.

Q3. (2×7=14)

- a) Discuss in detail the ultracentrifugation method of finding the average molecular weight of the polymer.
- b) Discuss in detail the osmotic pressure method. How does it help in determining the average molecular weight of the polymer?
- c) Briefly describe fatigue and hardness physical methods of testing polymers.

Q 4. (2×7=14)

- a) Discuss in detail the Gibbs equation for determining the surface area of solids.
- b) Discuss in detail the BET equation for determining the surface area of solids.
- c) Briefly describe the effects of adsorption from an aqueous solution on the surface properties of a solid adsorbent.

Q 5. (2×7=14)

- a) Describe different micellar structures and shapes in different aqueous and non-aqueous media?
- b) Derive different thermodynamics parameters of adsorption at the Liquid/Gas and Liquid/Liquid Interfaces.
- c) Explain different physical methods of determination of CMC of surfactant.

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CENTRAL UNIVERSITY OF HARYANA
End Semester Examinations June-July 2022

Programme: M.Sc. Chemistry

Session: 2021-22

Semester: 4th

Course Title: Polymer & Surface Chemistry

Course Code: SBS CH 010414 SE 4004

Max. Time: 3 H

Max. Marks: 70

Instructions:

1. Question no. 1 has seven parts and students need to answer any four. Each part carries three and half Marks.
2. Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

- Q 1. (4×3.5=14)
- a) Differentiate between inhibitor and retarder in the polymerization reaction. How do they affect the degree of polymerization?
 - b) Differentiate between homogeneous and heterogeneous polymerization.
 - c) Write a short note on the FTIR method of characterization of polymer.
 - d) How does the TGA/DTA technique help in the thermal analysis of polymers?
 - e) Briefly explain the mechanism of adsorption of the L/S interface.
 - f) Briefly explain Szyszkowski, Langmuir, and Frumkin's adsorption equations.
 - g) Briefly explain different factors affecting CMC.

- Q 2. (2×7=14)
- a) Explain the mechanism and kinetics of radical chain polymerization.
 - b) Difference between coordination and copolymerization reaction.
 - c) Write down the importance of Polydispersity and molecular weight distribution in polymers.

- Q3. (2×7=14)
- a) Discuss in detail the ultracentrifugation method of finding the average molecular weight of the polymer.
 - b) Discuss in detail the osmotic pressure method of finding the average molecular weight of the polymer.
 - c) Briefly describe fatigue and hardness physical methods of testing polymers.

- Q 4. (2×7=14)
- a) Discuss in detail the Gibbs equation for determining the surface area of solids.
 - b) Discuss in detail the BET equation for determining the surface area of solids.
 - c) Briefly describe the effects of adsorption from an aqueous solution on the surface properties of a solid adsorbent.

- Q 5. (2×7=14)
- a) What different micellar structures and shapes are possible in different aqueous and non-aqueous media?

- b) Derive different thermodynamics parameters of adsorption at the Liquid/Gas and Liquid/Liquid Interfaces.
- c) Explain different physical methods of determination of CMC of surfactant.

CENTRAL UNIVERSITY OF HARYANA
End Semester Examinations June-July 2022

Programme: M.Sc. Chemistry
Semester: 1st
Course Title: Electroanalytical Techniques for Chemists
Course Code: SBS CH 030106 E 5016

Session: 2022-23
Max. Time: 3 H
Max. Marks: 60

Instructions: Attempt any five questions out of the following. Each question carries equal marks.

- Q 1. (2×6=12)
- Discuss in detail the mixed potential theory to find corrosion rate.
 - Write down advantages of impedance spectroscopy technique over polarization technique to find corrosion rate.
- Q2. (2×6=12)
- Briefly describe the theory, principle, and procedure of impedance spectroscopy.
 - Briefly explain how the structure of an electrified interface can be identified from an equivalent circuit diagram.
- Q 3. (2×6=12)
- Differentiate between Potentiostatic and Galvanostatic chronoamperometry.
 - Discuss in detail the theory, principle, and basics of electrochemistry of Cyclic Voltammetry.
- Q 4. (2×6=12)
- Briefly explain the Hydrothermal and co-precipitation method of synthesis of nanoparticles.
 - Write a short note on TEM and DSC techniques for the characterization of nanomaterials.
- Q. 5. (2×6=12)
- Write a short note on the following: Stern-Gerry equation, Importance of OCP, and Tafel slopes.
 - Write down applications of impedance spectroscopy in finding corrosion inhibition efficiency.
- Q. 6. (2×6=12)
- Briefly explain how chronoamperometry techniques help in finding the charge-discharge cycle of a rechargeable battery.
 - Differentiate between 0D, 1D, and 2D nanomaterials with suitable examples.
- Q. 7. (2×6=12)
- Briefly discuss XRD and FTIR techniques for characterizing nanomaterials.
 - Write down applications of nanomaterials in the field of energy storage devices and sensor technology.
- Q. 8. (2×6=12)
- Briefly explain the activation polarization of metal electrodes. What are the factors on which activation polarization depends?

b) Discuss in detail the role of biosensors in environmental pollutant detection.

