

Total No. of Questions : 8]

SEAT No. :

PD3119

[Total No. of Pages : 5

[6476]-101

First Year M.Sc. (Organic/Inorganic/Analytical/Drug/Physical)

CHE-501 : PHYSICAL CHEMISTRY-I

(2023 Credit Pattern) (Semester-I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answer to the two sections should be written in separate answer books.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5.	1 eV		$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	$96487 \text{ C equiv}^{-1}$
8.	Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10.	1 amu		$= 1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

Q1) Answer the following. **[5]**

- a) Define Helmholtz free energy.
- b) What is de-Broglie's hypothesis?
- c) What do you mean by extensive property.
- d) What is meant by wavefunction?
- e) Define eigen function.

Q2) a) Solve any two. **[6]**

- i) Consider the following differential:

$dq = nc_v dT + \frac{nRT}{V} dv$, where n and R are constants. whether the thermodynamic quantity q a path function or state function?

- ii) Using the Maxwell relations, determine a relationship for $\left(\frac{\partial s}{\partial v}\right)_T$ and $\left(\frac{\partial s}{\partial p}\right)_v$ for a gas whose equation of state is given by $P = \frac{RT}{v - b}$.

- iii) What is significance of the change in Gibbs free energy?

b) Solve any two: **[4]**

- i) Calculate the entropy of mixing of one mole of oxygen gas and two mole of hydrogen gas assuming that no chemical reaction occurs and the gas mixture behave ideally.
- ii) Six moles of an ideal gas expand isothermally and reversibly from a volume of 1 dm³ to volume of 10 dm³ at 27°C. What is the work done (Joules)?
- iii) Calculate the entropy change accompanying the freezing of one mole of water at 25°C to ice at -10°C.

(Given: Heat of fusion of ice at 0°C = 6.00 kJ mole⁻¹,

Heat capacity of ice = 36.82 J K⁻¹ mol⁻¹,

Heat capacity of liquid water = 75.31 J K⁻¹ mol⁻¹)

- Q3) a)** Solve any two. [6]
- Derive the equation for energy of a particle in 1D box.
 - Which of the following functions is /are eigenfunctions of the operator $\frac{\partial^2}{\partial x^2}$? Find its eigen value.
 - $6 \cos(4x)$
 - $5x^2$
 - What are the postulates of quantum mechanics?
- b)** Solve any two. [4]
- A photon of wavelength 4000 Å strikes a metal surface with work function 2.13 eV. Calculate the velocity of the photoelectron.
 - An electron has kinetic energy 2.8×10^{-25} J. Calculate its de-Bröglie wavelength.
 - Calculate the expectation value of $\langle \hat{P}_x \rangle$ for a particle in one dimensional box in the $n=1$ state
- Q4) a)** Solve any two. [6]
- Show that reversible work is always greater than irreversible work.
 - What is the probability of find a particle within half of the one dimensional box?
(Length of the box a to $\frac{a}{2}$)
 - Describe the variation of chemical potential with pressure.
- b)** Solve any one. [4]
- Which of the following operators commute with each other
 - $\left[\frac{\partial}{\partial x}, x^n \right]$
 - $\left[\sin x, \frac{\partial}{\partial x} \right]$
 - $\left[x, \frac{\partial^2}{\partial x^2} \right]$
 - What is degeneracy? Illustrate with cubic box of length l . How many eigen states are there with energy equal to $\frac{101h^2}{8ml^2}$?

SECTION - II

Q5) Answer the following. **[5]**

- a) Define Grand Canonical Ensemble.
- b) Give the graphical representation of plot $\frac{1}{[A]}$ Vs t for a second order reaction.
- c) Define rate constant (k).
- d) What is stirling approximation?
- e) What is rate determining step?

Q6) a) Answer any two. **[6]**

- i) Derive the equation for rate constant for a parallel reaction.
- ii) Derive the equation for rate constant for a second order reaction with initial unequal concentration.
- iii) Discuss how the values of k_m and V_{max} are obtained from analysis of the Lineweaver-Burk plot.

b) Answer any two. **[4]**

- i) Rate constant of a first order reaction is $5.70 \times 10^{-5} \text{ s}^{-1}$ at 25°C and $1.64 \times 10^{-4} \text{ s}^{-1}$ at 40°C . Calculate the activation energy.
- ii) Estimate the diffusion controlled rate constant for the recombination of iodine in n-hexane at 25°C
[Given: η for n-hexane = 0.325 cp. (centipoise)]
- iii) Half life of a first order reaction is 8 minutes. Calculate the amount of product formed after 500 seconds.

Q7) a) Answer any two of the following. **[6]**

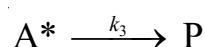
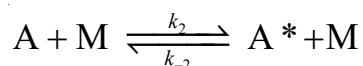
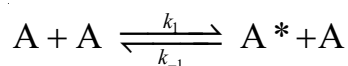
- i) Deduce the formula for specific heat at constant volume (C_v) from partition function.
- ii) Derive the formula for vibrational partition function.
- iii) Give the difference between Fermi-Dirac and Bose-Einstein statistics.

b) Solve any two of the following: [4]

- i) Calculate the translational partition function of H_2 (g) at 1000 K and 1 atm pressure.
- ii) A certain system of N particles possesses among other two non degenerate energy levels with energy difference of 1.661×10^{-20} cal/molecule. Calculate the ratio of the total number of particles in the two states at $800^\circ C$.
- iii) Calculate the characteristic rotational temperature for N_2 molecule. The internuclear distance of N_2 is 109.76 picometer.

Q8) a) Answer any two of the following: [6]

- i) For the reaction mechanism of decomposition of A in the presence of an inert gas M:



Applying SSA, derive the rate law for the formation of product.

- ii) Derive the rate equation for competitive inhibition of enzymes.
- iii) Explain Collision theory of reaction rates of bimolecular gases.

b) Solve any one of the following. [4]

- i) A bimolecular gaseous reaction between like molecules with collision diameter 200 pm and molar mass 100 g mol^{-1} and steric factor 1. Calculate Arrhenius pre-exponential factor at $100^\circ C$.
- ii) For an enzyme-substrate system obeying the simple Michaelis-Menten mechanism, the rate of product formation when the substrate concentration is very large, has the limiting value 0.02 mol dm^{-3} . At a substrate concentration of 250 mg dm^{-3} the rate is half this value. Calculate k_1/k_{-1} assuming that $k_2 \gg k_{-1}$.



Total No. of Questions : 6]

SEAT No. :

PD3120

[Total No. of Pages : 3

[6476]-102

First Year M.Sc. (Physical /Inorganic/Analytical Chemistry)

CHE-502 : INORGANIC CHEMISTRY - I

(2023 Credit Pattern) (4 Credits) (Semester-I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use separate answer sheet for two different sections.

SECTION - I

Q1) a) Attempt any four of the following. **[8]**

- i) Define plane of symmetry with suitable example.
- ii) What do you mean by classes of group? Give classes for C_3V point group.
- iii) How do you differentiate cis and trans platin on the basis of symmetry.
- iv) Give the symmetry criterion for molecule to be optically active.
- v) Define point group. Identify the point group for a molecule containing following symmetry element.

$$E, C_2^{(2)}, \sigma_V^{(x2)}, \sigma_V^{(y2)}$$

b) Find out the associative symmetry operation fo S_3 . **[3]**

Q2) a) Answer the following (any one). **[6]**

- i) Define improper axis of rotation. Prove that $S_n^{2n} = E$ using suitable example.

P.T.O.

- ii) Find out the product of symmetry operation and identify whether they are commutative or Non commutative.

1) $C_2^{(2)} \times \sigma h^{(xy)}$

2) $C_2^2 \times i$

3) $C_2 \times C_2^{-1}$

- b) Attempt any two of the following. [6]

- i) Prepare group multiplication table for C_{2h} point group.
 ii) What do you mean by normal modes of vibration? Find out normal modes of vibrations in C_2H_2 and H_2S molecule.
 iii) Identify and show the axis of rotation in $[Ni(CN)_4]^{2-}$ ion.

- Q3)** a) Answer the following (any one) [6]

- i) Explain all symmetry operations of $C_5H_5^-$ ion. Hence prepare a list of symmetry element and classify into appropriate point group.
 ii) Using great orthogonality theorem derive character table for C_{2h} point group.

- b) Attempt any two of the following. [6]

- i) Using similarity transformation show that in C_{2v} point group all symmetry element forms separate classes.
 ii) Predict the product using matrix multiplication method.

1) $C_2^{(2)} \times i$

2) $C_2^{(2)} \times \sigma h^{(xy)}$

- iii) Find out the resultant SALC of B_{1g} irreducible representation which operates on σ_1 orbital of $[PtCl_4]^{2-}$

Given:

D_{4h}	E	$2C_4$	C_2	$2C_2'$	$2C_2''$	i	$2S_4$	σh	$2\sigma v$	$2\sigma d$
B_{1g}	1	-1	1	1	-1	1	-1	1	1	-1

SECTION - II

- Q4) a)** Answer any four of the following. [8]
- The alkali metal solutions in ammonia are good reducing agents. Why?
 - What are arachnaboranes? Explain with example.
 - What are different allotropes of carbon?
 - What are interhalogen compounds? Explain with examples.
 - What are Grignard Reagents? Give its synthesis.
- b)** Give an account of oxyacids of sulphur. [3]
- Q5) a)** Answer any one of the following. [6]
- Write a note on carbon nanotubes with respect to classification, synthesis, properties and applications.
 - Explain the structure and bonding in:
 - B_rF_5
 - Graphite
- b)** Answer any two of the following: [6]
- Give an account of phosphonitrilic compounds.
 - Write a note on activation of nitrogen.
 - Give an account of saline hydrides.
- Q6) a)** Answer any one of the following. [6]
- Write a note on oxoacids and oxoanions of nitrogen.
 - Draw the structures of following:
 - ClF_3
 - XeF_4
 - $\text{B}_3\text{N}_3\text{H}_6$
 - B_4H_{10}
 - IF_7
 - $\text{S}_4\text{N}_4\text{F}_4$
- b)** Answer any two of the following: [6]
- What are zeolites? Give their examples and applications.
 - Write a note electron precise hydrides.
 - Determine the STYX code for following boranes.
 - B_2H_6
 - B_6H_{10}



Total No. of Questions : 3]

SEAT No. :

PD3121

[Total No. of Pages : 2

[6476]-103

M.Sc. - I (Organic / Drug Chemistry)

CHEMISTRY

CHEOD - 502 - MJ : Inorganic Chemistry - I
(2023 Credit Pattern) (Semester - I) (2 Credits)

Time : 2 Hours]

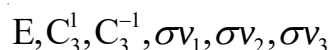
[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.

Q1) a) Attempt any four of the following. [8]

- i) Define center of inversion with suitable examples.
- ii) What do you mean by abelian group? Explain with suitable example.
- iii) How do you differentiate cis and trans isomer of 1, 2 - dichloroethylene using plane of symmetry.
- iv) Give the symmetry criterion for a molecule to be optically active.
- v) Define point group? Identify the point group for a molecule containing following symmetry elements.



- b) Define plane of symmetry. Explain different types of planes of symmetry with the help of suitable example. [3]

Q2) a) Answer the following (any one) [6]

- i) Define improper axis of rotation. Prove that $S_n^n = E$ using suitable example.
- ii) Find the product of symmetry operation and identify whether they are commutative or non commutative.

- 1) $C_3 \times \sigma v_1$
- 2) $\sigma v_1 \times \sigma v_3$
- 3) $C_3 \times C_3^{-1}$

P.T.O.

- b) Attempt any two of the following. [6]
- Prepare Group Multiplication Table (GMT) for C_{2v} point group.
 - What do you mean by normal modes of vibration? Find out normal modes of vibration in H_2O and CO_2 molecule.
 - Identify and show the axis of rotation in PCl_5 molecule.

Q3) a) Answer the following (any one) [6]

- Explain all symmetry operations in benzene molecule and hence prepare a list of symmetry element and classify into appropriate point group.
- Using orthogonality theorem derive the character table for C_{2v} point group.

b) Attempt any two of the following. [6]

- Show that in C_{2h} point group all symmetry elements forms separate classes (Using similarity transformations).
- Give the matrix representation for $C_2^{(z)}, C_2^{(x)}, C_2^{(y)}$
- Find out the resultant SALC of B_{19} irreducible representation which operates on σ , orbital of $[AuCl_4]^{3-}$

Given

D_{4h}	E	$2C_4$	C_2	$2C_2^1$	$2C_2^{11}$	i	$2S_4$	σ_h	$2\sigma_v$	$2\sigma_d$
B_{19}	1	-1	1	1	-1	1	-1	1	1	-1



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M.Sc. - I (Physical Chemistry/Inorganic Chemistry/
Analytical Chemistry)

CHE PIA - 503 MJ : ORGANIC CHEMISTRY - I
(Aromaticity, Stereochemistry and Reagents)
(2023 Credit Pattern) (Semester - I) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

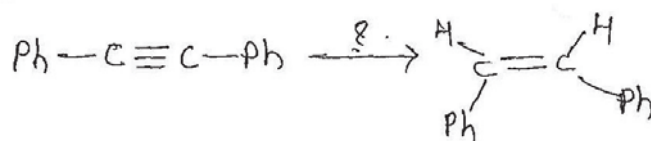
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) Attempt the following.

[5]

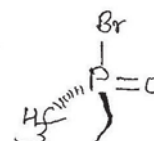
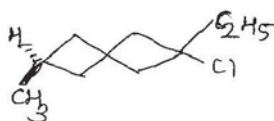
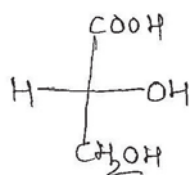
- a) Define homoaromaticity.
- b) Define stereoselective reactions.
- c) Explain the term % ee.
- d) Draw the structures of IBX.
- e) Suggest the reagent for following conversion.



Q2) a) Attempt any two of the following.

[6]

- i) Assign R/S configuration to the following compounds.

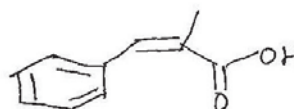
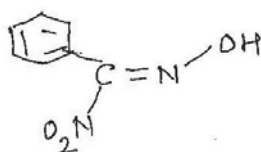


- ii) Cyclooctatetraene is neither aromatic nor antiaromatic. Explain.
- iii) The reaction of esters with LiAlH_4 gives primary alcohol whereas reaction with DIBAL forms aldehyde. Explain.

b) Attempt any two of the following.

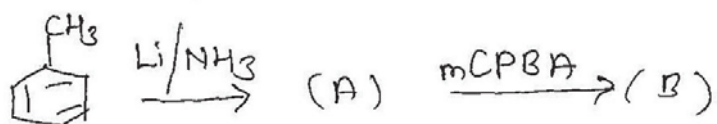
[4]

- i) Assign E/Z designation to the following.

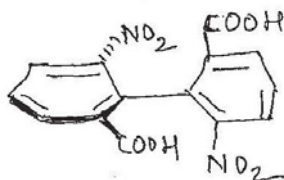


P.T.O.

ii) Predict the product A & B in the following.



iii) Comment on optical activity of following compound.

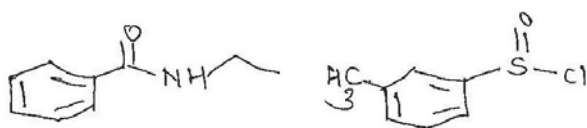


Q3) Attempt any five of the following.

[10]

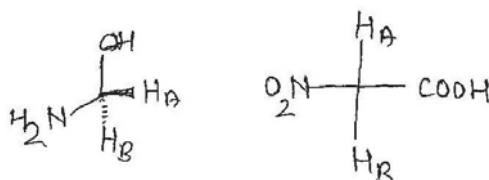
a) Heptalene is unstable compound. Explain.

b) Assign Re/Si labels to the following.

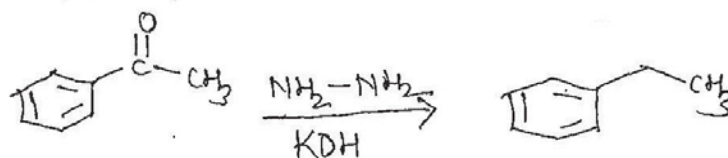


c) Explain stereochemical aspect involved in E2 reaction.

d) Assign Pro-R and Pro-S labels to H_A and H_B



e) Write the mechanism for the following reaction.



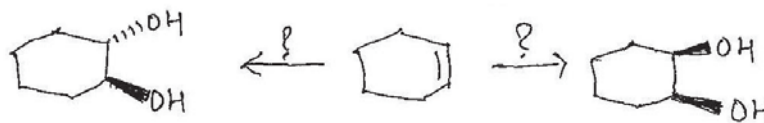
f) Explain swern oxidation.

g) Which of the following compound shows dipole moment. Justify.



Q4) a) Attempt any two of the following. **[6]**

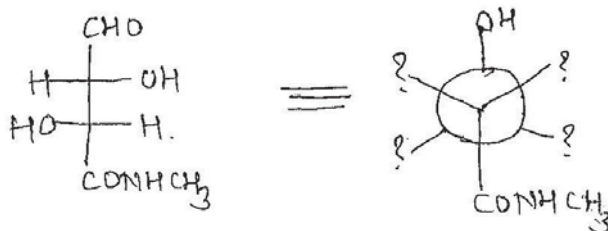
- i) Explain the concept of optical activity in ansa compounds.
- ii) Suggest the reagent for following transformations.



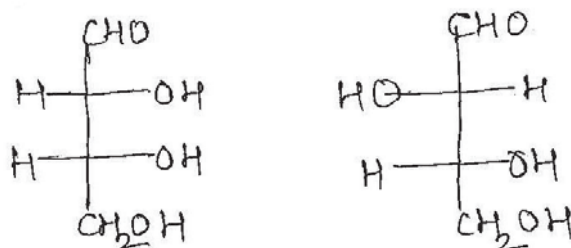
- iii) Write any three applications of NaBH_3CN

b) Attempt any two of the following. **[4]**

- i) Convert Fischer projection formula to Newman projection as shown below.



- ii) What is stereochemical relationship between the following compounds.



- iii) Write only one application of PDC and HIO_4 .



Total No. of Questions : 4]

SEAT No. :

PD3124

[Total No. of Pages : 3

[6476]-106

F.Y. M.Sc. (Organic/Drug/Physical/Analytical/Inorganic Chemistry)

CHE-507A-MJ : CHEMICAL MATHEMATICS

(2023 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table, calculator is allowed.

Q1) Solve the following :

[5]

- a) What is order of the matrix?

$$A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & 1 \\ 4 & 5 & 0 \\ 1 & 2 & 3 \end{bmatrix}$$

- b) Write any two rules of derivative.

c) If $A = \begin{bmatrix} 1 & 3 \\ 0 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 2 & -1 \\ 4 & 1 \end{bmatrix}$ what is $A \times B = ?$

d) Evaluate the following $y = 2x^2 + 4$, $\frac{dy}{dx} = ?$

e) What is order of the following equation $\left(\frac{d^3 y}{dx^2} \right) + x \left(\frac{dy}{dx} \right)^3 = 0$

Q2) a) Solve any two :

[6]

i) Find maxima and minima of $x^3 - 3y + 4$.

ii) Show that the following equation exact or inexact

$$2(y + x) e^x dx + 2 [e^x - 2y] dy = 0$$

iii) Solve $\int x \sin x dx$

P.T.O.

b) Solve any two

[4]

i) $y = \frac{3-x}{x-1} \quad \frac{dy}{dx} = ?$

ii) $\int_0^{100} nRT \frac{dv}{v} = ?$

iii) Partial derivative of f w.r.t. x , $f(x, y) = x^3y + y^2x^2$.

Q3) a) Solve any two :

i) Find the inverse of the following matrix using minor, cofactor and Adjoint. [6]

$$A = \begin{bmatrix} 1 & 2 & -1 \\ 0 & -3 & 4 \\ 1 & 3 & 5 \end{bmatrix}$$

ii) Find A^{-1} $A = \begin{bmatrix} 1 & -3 & 4 \\ 7 & 3 & -1 \\ -2 & 0 & -1 \end{bmatrix}$.

iii) If $A = \begin{bmatrix} 3 & 2 & 0 \\ 1 & 2 & 1 \\ 1 & 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 2 & -1 \\ -1 & 0 & 2 \\ 1 & 2 & -1 \end{bmatrix}$ Find $(A \times B)^T = ?$

b) Solve any two :

[4]

i) Find angle between u and v .

$$u = [1, -1, -3], v = [2, 1, -1]$$

ii) Solve the determinant $A = \begin{bmatrix} 3 & 1 & 5 \\ 3 & 2 & -1 \\ -1 & 1 & 3 \end{bmatrix}$

iii) If $A = \begin{bmatrix} 3 & 0 & 1 \\ -1 & 1 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 2 & -1 & 0 \\ 1 & 3 & 2 \end{bmatrix}$ Find $3A + 2B = ?$

Q4) a) Solve any two :

[6]

i) Determine the order and degree for

$$\left(\frac{dy}{dx}\right) + 6y = 0 \text{ and } \left(\frac{d^3y}{dx^3}\right) + 2\left(\frac{d^2y}{dx^2}\right) + \left(\frac{dy}{dx}\right) = 0$$

ii) Verify that the $y = \cos x + c$ is a solution.

$$\left(\frac{dy}{dx}\right) + \sin x = 0$$

iii) Find the general solution of a differential equation

$$\frac{dy}{dx} = y/x$$

b) Solve any one :

[4]

i) Explain the following terms

- 1) Square matrix
- 2) Digonal matrix
- 3) Null matrix
- 4) Column matrix

ii) Solve the following

- 1) $\int \log x \, dx$
- 2) $\int e^{-ax} \, dx$



Total No. of Questions : 3]

SEAT No. :

PD3125

[Total No. of Pages : 2

[6476]-107

M.Sc. (Part - I) (Organic/Drug/Physical/ Inorganic/Analytical Chemistry)

CHEMISTRY

**CHE-507(B)MJ : Chemistry of Nanomaterials
(2023 Credit Pattern) (Semester - I) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right indicate full marks.*
- 3) Neat diagrams must be drawn wherever necessary.*

Q1) a) Answer any four of the following : [8]

- i) Define Aggregation of nanomaterials.
- ii) What is top-down approach of nanomaterial synthesis?
- iii) What is mean by antiphase domains?
- iv) Draw the band energy diagram of insulator.
- v) What is point defect? Explain in brief.

b) Explain magnetic properties of nanomaterials. [3]

Q2) a) Answer any one of the following : [6]

- i) Why fullerene and graphite are used as conductors? Discuss applications of fullerene & graphites.
- ii) Explain hydrothermal synthesis method with suitable diagram.

b) Answer any two of the following : [6]

- i) Write a note on : Nanomaterial as catalyst.
- ii) What is Non-stoichiometry? Explain Frenkel defect with suitable example.
- iii) Draw the band structure of elemental magnesium (Mg) and account for it's metallic conductivity.

P.T.O.

- Q3) a)** Answer any one of the following : **[6]**
- i) Give examples of 1D, 2D, 3D nanomaterials and describe their unique structural properties.
 - ii) What are gas sensors? Explain working principle and applications of Gas Sensor.
- b)** Answer any two of the following : **[6]**
- i) What are the diverse applications of nanomaterials in textile industries?
 - ii) Explain synthesis of MgAl_2O_4 material by sol-gel method.
 - iii) Write a short note on Giant magnetoresistance (GMR).



Total No. of Questions : 4]

SEAT No. :

PD3126

[Total No. of Pages : 2

[6476]-108

M.Sc. (Part - I) (Physical/Inorganic/Analytical/Organic/Drug Chemistry)

CHE-507(C)-MJ : ANALYTICAL CHEMISTRY

(2023 Credit Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right indicate full marks.*
- 3) Draw diagrams wherever necessary.*

Q1) Answer the following :

[5]

- a) Give the principle of mass spectrometry.
- b) Give any two applications of mass spectrometry.
- c) What is electronic record with respect to lab safety?
- d) What is MSDS?
- e) What is CFR?

Q2) a) Attempt any two of the following :

[6]

- i) Explain chemical ionization in mass spectrometry.
- ii) Explain validation of analytical methods.
- iii) How accidental release of hazardous materials is handled?

b) Attempt any two of the following :

[4]

- i) Draw a neat labelled diagram of secondary ion mass analyzer.
- ii) Give any two control measures for chemical hazards.
- iii) Explain the term TLV.

P.T.O.

Q3) Attempt any five of the following :

[10]

- a) Write the principle of TOF analyzer.
- b) How GLP certification is obtained?
- c) What are the functions of quality assurance.
- d) Give any two example of combustible gases.
- e) Draw safety symbol for explosives.
- f) Give any two guidelines of handling the labelling of chemicals.
- g) Explain how fragmentation patterns are useful in interpretation of mass spectrum.

Q4) a) Attempt any two of the following :

[6]

- i) Explain the working of a mass spectrometer with the help of a block diagram.
- ii) Explain the working of a Fire Extinguisher
- iii) Explain the hazards of organic synthesis.

b) Attempt any one of the following :

[4]

- i) Give the principles of Good laboratory practices.
- ii) Explain principle working and construction of ICPMS.



Total No. of Questions : 4]

SEAT No. :

PD3127

[Total No. of Pages : 2

[6476]-109

M.Sc. - I (Physical/Inorganic/Analytical Chemistry)

CHEMISTRY

CHEPIA-507(D)MJ : Basic Organic Chemistry

(2023 Credit Pattern) (Semester - I) (NEP 2020) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) Attempt the following :

[5]

- a) Comment on the stability of 1° , 2° , & 3° carbocation.
- b) Write short note on carbene
- c) Explain Non-classical carbocation
- d) Discuss the aromatic nucleophilic substitution reaction.
- e) What are the characteristics of hard acid?

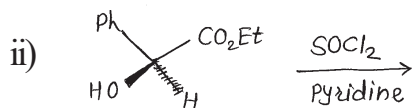
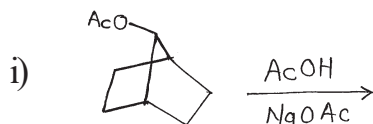
Q2) a) Write a short note on any two of the following :

[6]

- i) S_N1 reaction
- ii) Nucleophilicity & Basicity
- iii) Reimer-Tieman reaction

b) Predict the product with mechanism for any two of the following :

[4]



P.T.O.

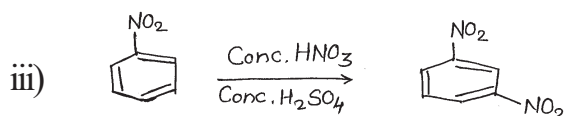
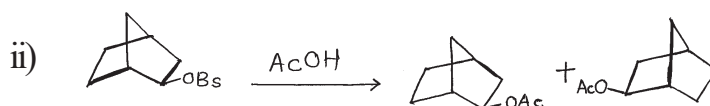
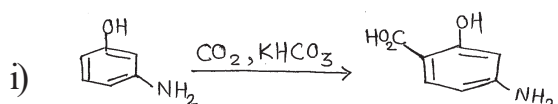
Q3) Answer any five of the following :

[10]

- a) Write a short note on nitrene.
- b) Chlorobenzene cannot be hydrolyzed using S_N1 & S_N2 conditions. Explain.
- c) Acetamide is neutral but phthalamide is acidic. Explain.
- d) Write a short note on Sandmeyer reaction.
- e) What is IPSO substitution?
- f) Factors affecting the stability.
- g) Comments on benzenonium ion

Q4) a) Suggest the mechanism of any two of the following :

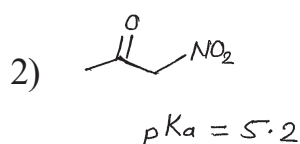
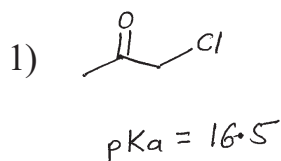
[6]



b) Answer any one of the following :

[4]

- i) Chloromethyl methyl ether is solvolyzed by RCOOH at 10^4 times faster than methyl chloride. Explain.
- ii) Explain pK_a values of the following compounds.



[6476]-110

M.Sc. - I (Organic Chemistry and Drug Chemistry)
CHEOD-507(D)-MJ : ORGANIC REACTIONS AND REAGENTS
(2023 Credit Pattern) (Semester - I) (2 Credits)

Time : 2 Hours]

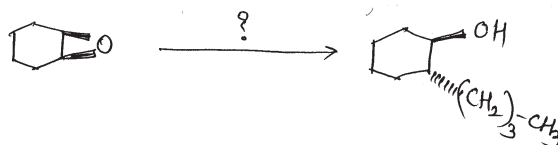
[Max. Marks : 35

Instructions to the candidates:

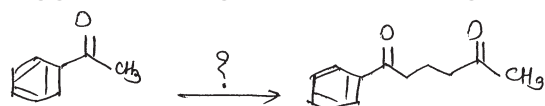
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) Answer the following :**[5]**

- a) What are the conditions for Nazarov cyclization?
- b) Draw cononical structure of Phosphoranes in ylide.
- c) Give any two reactions involving organozinc reagents.
- d) Suggest the reagent for following reactions.



- e) Suggest the reagent for following reaction.

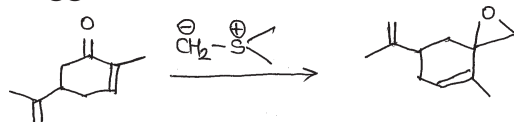
**Q2)** a) Write a short note on any two of the following :**[6]**

- i) Mitsunobu reaction
- ii) Robinson annulation reaction
- iii) McMurry coupling reaction

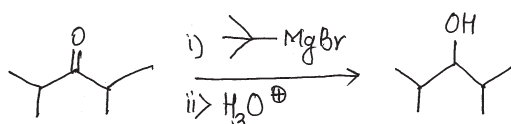
b) Attempt any two :

[4]

- i) Organolithium and organomagnesium reagent reactions carried out in dry solvents. Explain.
- ii) Suggest the mechanism



- iii) Suggest the mechanism

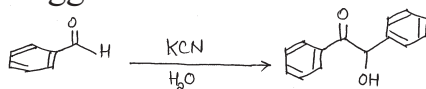


Q3) a) Attempt any two of the following : [6]

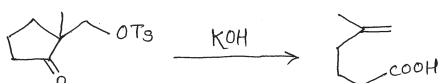
- i) Discuss the wittig reaction
- ii) Explain Gilman reagents with its synthesis and applications in organic synthesis.
- iii) In sommelet rearrangements, the product is formed from the less stable ylide. Explain.

b) Attempt any two of the following : [4]

- i) Explain, Why pyridine on reaction with sodium amide (NaNH_2) gives 2-amino pyridine only and not 4-amino pyridine.
- ii) Suggest the Mechanism

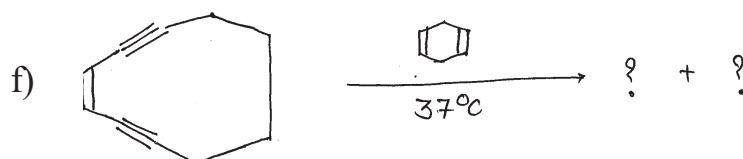
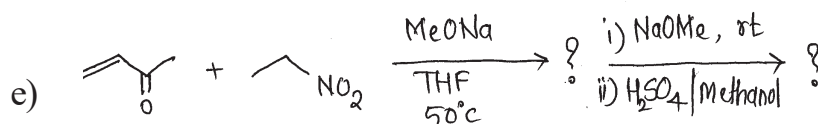
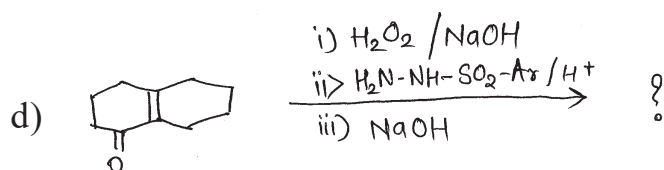
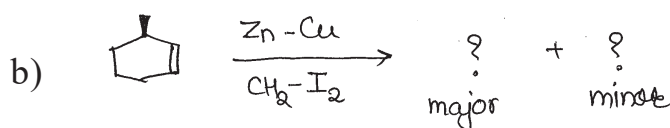
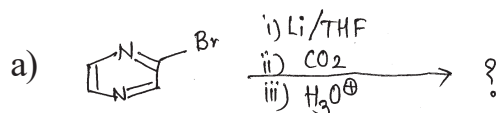


iii) Suggest the Mechanism



Q4) Predict the products (Any five)

[10]



Total No. of Questions : 8]

SEAT No. :

PD3129

[Total No. of Pages : 3

[6476]-111

M.Sc. - I (Organic/Drug/Physical/Inorganic/Analytical Chemistry)
CHE-508-MJ : RESEARCH METHODOLOGY
(2023 Credit Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Answers to the two sections should be written in separate answer books.*
- 3) Figures to the right indicate full marks.*

SECTION - I

Q1) Attempt the following : **[5]**

- a) What is Plagarism?
- b) Define research ethics.
- c) What is intelectual property right?
- d) What is literature survey?
- e) Give the name of any one software used to draw the chemical structure.

Q2) a) Attempt any two of the following : **[6]**

- i) Explain material safety data sheet.
- ii) Discuss the steps involved in electronic submission of manuscript to the journals.
- iii) Discuss fundamental and applied research.

b) Attempt any two of the following : **[4]**

- i) Explain the application of scifinder.
- ii) What is UGC care list? When it was introduced?
- iii) What is impact factor? How it is calculated?

P.T.O.

Q3) Attempt any five of the following : **[10]**

- a) Explain the methods of disposal of chemical waste.
- b) Discuss the use of power point to prepare the research presentation.
- c) Explain the co-relation and regration in research.
- d) What is result and discussion in research?
- e) Write the name of any two plagarism checking software.
- f) Give any two names of automatic reference managing software.
- g) Write a short note on author metrics.

Q4) a) Write any two of the following : **[6]**

- i) Discuss sources of literature survey.
- ii) Explain the use of scopous data base.
- iii) Discuss recovery, recycling and reuse of Laboratory chemicals.

b) Write any two of the following : **[4]**

- i) What are the different component of research paper?
- ii) Explain the term SNIP and SJR.
- iii) What are four tranformations of exponential functions?

SECTION - II

Q5) Attempt all of the following : **[5]**

- a) What is the use of fumehood?
- b) Draw the symbol use to indicate harmful chemicals.
- c) Give any two methods of presentation of research.
- d) What is the exponetial fitting?
- e) What is the use of grammerly tools?

Q6) a) Attempt any two of the following : **[6]**

- i) Discuss patents and copy right.
- ii) Explain scirus and chem industry.
- iii) Explain chemometrics.

b) Attempt any two of the following : **[4]**

- i) What is the research gate network?
- ii) Discuss chemical abstract.
- iii) What is research gap?

Q7) Attempt any five of the following :

[10]

- a) What are research gate and google scholar?
- b) What are different types of polynomial regression?
- c) What are three types of multiple regression analysis?
- d) Define and explain research objectives.
- e) What are the characteristics of the research?
- f) Explain the meaning of research hypothesis in context of research design.
- g) What are copyright and trademarks?

Q8) a) Attempt any two of the following :

[6]

- i) What do you mean by research problem?
- ii) Write a note on descriptive statistic.
- iii) Discuss Q ranking of journals.

b) Attempt any two of the following :

[4]

- i) Discuss any two referencing styles with suitable examples.
- ii) Write a note on science direct.
- iii) Compare full length research paper & communications.



Total No. of Questions : 6]

SEAT No. :

PD3130

[6476]-201

[Total No. of Pages : 5

First Year M.Sc. (Physical/Inorganic/Analytical Chemistry)

CHE-551 MJ : PHYSICAL CHEMISTRY - II

(2023 Credit Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer of two sections should be written in Separate answer books.
- 2) All questions are compulsory.
- 3) Figure to the right indicate full marks.
- 4) Use of logarithmic table, and non-programmable calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico-Chemical Constants

- | | |
|-------------------------|---|
| 1) Avogadro Number | $N = 6.023 \times 10^{23} \text{ mol}^{-1}$ |
| 2) Boltzmann Constant | $k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$ |
| 3) Planck Constant | $h = 6.626 \times 10^{-16} \text{ erg s}$
$= 6.626 \times 10^{-34} \text{ J s}$ |
| 4) Electronic Charge | $e = 4.803 \times 10^{-10} \text{ esu}$
$= 1.602 \times 10^{-19} \text{ C}$ |
| 5) 1 eV | $= 23.06 \text{ k cal mol}^{-1}$
$= 1.602 \times 10^{-12} \text{ erg}$
$= 1.602 \times 10^{-19} \text{ J}$
$= 8065.5 \text{ cm}^{-1}$ |
| 6) Gas Constant | $R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7) Faraday Constant | $F = 96487 \text{ C equivalent}^{-1}$ |
| 8) Speed of light | $c = 2.997 \times 10^{10} \text{ cm s}^{-1}$
$= 2.997 \times 10^8 \text{ m s}^{-1}$ |
| 9) 1 cal | $= 4.187 \times 10^7 \text{ erg}$
$= 4.187 \text{ J}$ |
| 10) 1 amu | $= 1.673 \times 10^{-27} \text{ kg}$ |
| 11) Bohr Magnetron | $\beta_e = 9.274 \times 10^{-24} \text{ J T}^{-1}$ |
| 12) Nuclear Magnetron | $\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$ |
| 13) Mass of an electron | $m_e = 9.11 \times 10^{-31} \text{ Kg}$ |

P.T.O.

SECTION - I

Q1) a) Answer the following (Any four) **[8]**

- i) Classify the molecules on the basis of moments of inertia.
 $\text{CH}_2 = \text{CHCl}$, OCS and SO_3
 - ii) Explain the term Hooke's law.
 - iii) What do you mean by molecular polarizability.
 - iv) Write down Born-oppenheimer approximation.
 - v) Give the applications of Mossbauer spectroscopy.
- b) The spacing between the lines in the microwave spectrum of H^{35}Cl is 6.350×10^{11} Hz. Calculate the bond length of H^{35}Cl . **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Sketch and explain the different stretching vibrational frequencies for CO_2 molecule.
 - ii) Write a note on Birge-sponer extrapolation plot.
 - iii) Discuss the classical method for Raman effect.
 - iv) Explain the principle of the Mossbauer spectroscopy.
- b) In the pure rotational spectrum of xy molecule, the adjacent lines are separated by 8 cm^{-1} . If the molecule is irradiated by radiation of $20,000 \text{ cm}^{-1}$. What is the wave number of first stokes lines? **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) What is the significance of zero point energy? Obtain an expression for zero point energy of harmonic & anharmonic oscillator.
- ii) Discuss the Franck-Condon principle in electronic spectroscopy.
- iii) Discuss the rotational fine structure of electronic vibration transitions.

b) Attempt any two of the following. **[4]**

- i) Calculate $J_{\max}$ for a rigid diatomic molecule for which at 300 K, the rotational constant is 1.56 cm^{-1} .
- ii) The IR spectrum of a diatomic molecule exhibits transitions at 2143.0 cm^{-1} & 4260 cm^{-1} corresponding to excitations from ground state to first and second vibrational levels respectively. What is the value of fundamental frequency?
- iii) If the vibrational frequency of H_2 molecule is 4400 cm^{-1} . What will be the frequency of HD?

SECTION - II

Q4) a) Answer the following (Any four) **[8]**

- i) What are the general characteristics of radioactive decay?
- ii) What do you mean by neutron evaporation & spallation?
- iii) Define tracks and spurs.
- iv) Write the equation for the preparation of ^{32}P & ^{22}Na .
- v) Define decay constant and half life.

b) For the radioactive isotope ^{131}I , the time required for 50% disintegration is 8 days. What is the time required for the 99.9% disintegration of 5.5 g of ^{131}I in days? **[3]**

Q5) a) Attempt any three of the following. **[9]**

- i) Express the equation of the decay constant in radioactivity.
- ii) Explain the term neutron energy distribution.
- iii) Write a note on Fricke Dosimeter.
- iv) Explain the concept of radiolysis of water.

b) Find the thickness of pb required to reduce the level of radiation due to ^{60}Co source at a point **[3]**

- i) from 0.1 Gy/min to 3.1 mGy/h
- ii) from 100 Gy/min to 0.1 mGy/h
- iii) What is the half thickness of pb for this radiation?

Q6) a) Attempt any two of the following. **[8]**

- i) Explain the application of radioisotope to physicochemical problems as the determination of
 - 1) The solubility of a sparingly soluble substance
 - 2) The surface area of a powder or precipitate
- ii) Discuss any one analytical application in radioactivity.
- iii) Explain the energy spectrum of fragments of fission at ^{235}U by thermal neutrons.

b) Attempt any one of the following.

[4]

- i) A ruby weighing 0.5 was irradiated in a neutron flux of $10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$ for exactly 24 h and ^{51}Cr activity (half life is 27.7d) counted immediately there after. It was found to give 35,000 c/s. Given that the σ for ^{50}Cr to be 15.9 b, the counting efficiency 10% & the ^{50}Cr content of natural Cr to be 4.35% find the Cr content of the ruby.
- ii) A 20 ml sample of a saturated solution containing 4 mg/l of labelled pbSO_4 has an activity of 1600 c/min. The solution was shaken with 1 g of precipitated pbSO_4 and filtered. The filtrate was found to give 900 c/min. All activities are net and free from background. Given the surface area of one formula entity of pbSO_4 to be $18.4 \times 10^{-16} \text{ cm}^2$, find the surface area of 1 g of the precipitate sample.



Total No. of Questions : 3]

SEAT No. :

PD3131

[6476]-202

[Total No. of Pages : 3

First Year M.Sc. (Organic Chemistry/Drug Chemistry)

CHEOD-551 MJ : PHYSICAL CHEMISTRY-II

(2023 Credit Pattern) (Semester - II)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figure to the right indicate full marks.
- 3) Use of logarithmic table, and non programmable calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico-Chemical Constants

1) Avogadro Number	$N = 6.023 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	$k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	$h = 6.626 \times 10^{-16} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	$e = 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV	$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	$R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	$F = 96487 \text{ C equivalent}^{-1}$
8) Speed of light	$c = 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal	$= 4.187 \times 10^7 \text{ erg}$ $= 4.187 \text{ J}$
10) 1 amu	$= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr Magneton	$\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear Magneton	$\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ Kg}$

P.T.O.

Q1) a) Attempt any Four of the following. **[8]**

i) Classify the following molecules on the basis of moment of inertia.

OCS, BF₃, CH₄ and H₂O

ii) State the selection rules for harmonic and anharmonic oscillators.

iii) What is the criterion for the molecule to be Raman active?

iv) What is predissociation?

v) What is the principle of Mössbauer spectroscopy?

b) The rotational constant for ¹²CO and ¹³CO is 1.92118 cm⁻¹ and 1.83669 cm⁻¹ respectively. Calculate the mass of carbon which is substituted in place of ¹²C. **[3]**

Q2) a) Attempt any three of the following. **[9]**

i) Sketch and explain different stretching vibration frequencies for H₂O and CO₂ molecules.

ii) Explain the spectrum of rigid diatomic rotator.

iii) How the Fortrat diagram is utilized in electronic spectroscopy.

iv) Discuss any two applications of Mössbauer spectroscopy.

b) A sample was excited by the 4358 Å line of mercury. A Raman line was observed at 4447 Å Calculate the Raman shift in cm⁻¹. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) Explain the classical theory of Raman effect.
- ii) Discuss the rotational vibrational spectrum of a diatomic molecule.
- iii) What is the principle of molecular photoelectron spectroscopy? Explain Ultra violet photoelectron spectroscopy.

b) Solve any two of the following. **[4]**

- i) The fundamental frequency of O_2 is 1554.7cm^{-1} . Calculate the wavelength of 1st stokes and antistokes lines in the vibrational Raman spectrum. When the 253.6 nm line is used as the exciting one.
- ii) Fundamental and first overtone transition of $^{14}\text{N } ^{16}\text{O}$ are concentrated at 1876.04cm^{-1} and 3724.2cm^{-1} respectively. Calculate equilibrium vibrational frequency and the anharmonicity constant for the molecule.
- iii) The first line in the rotational spectrum of molecule is observed at 3.84235 cm^{-1} . Calculate the moment of inertia of the molecule if the reduced mass of the molecule is $11.3836 \times 10^{-27}\text{ kg}$.



Total No. of Questions : 6]

SEAT No. :

PD3132

[Total No. of Pages : 5

[6476]-203

M.Sc. - I (Physical Chemistry/Inorganic Chemistry/Analytical Chemistry/Organic Chemistry/Drug Chemistry)

INORGANIC CHEMISTRY-II

CHE-552-MJ : Coordination and Bioinorganic Chemistry
(2023 Credit Pattern) (Semester-II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right indicate full marks.
- 4) Use of calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

SECTION-I

Q1) a) Answer the following. [8]

i) Calculate the total degeneracy for following term and configuration:

1) 6_G

2) $(t_{2g})^3 (e_g)^2$

ii) Arrange the following terms in increasing order of energy.

$^1P, ^2D, ^3F, ^4G, ^3I$.

iii) What is the Laporte selection rule for electronic transition?

iv) Give the statement of first order and second order Zeeman effect.

b) Write a note on: Nephelauxetic effect and series. [3]

Q2) a) Answer any one of the following. [6]

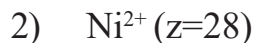
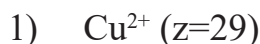
i) Prepare a microstate table for S^1P^1 configuration and hence assign the allowed R.S term symbols for the same.

ii) Give the splitting of 2I R.S term in weak cubic field using character table for pure rotational point group (o) and reduction formula.

P.T.O.

b) Answer any two of the following. [6]

i) Determine the ground state term symbol for the following metal ions:



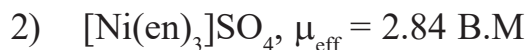
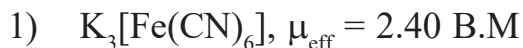
ii) Calculate the effective magnetic moment for $[\text{Cr}(\text{Ox})_3]^{3-}$ using following data. [Given: $\lambda=+92 \text{ cm}^{-1}$, $10 \text{ Dq}=17200 \text{ cm}^{-1}$]

iii) Write a note on: Orgel diagram for $n\text{P}$ and $n\text{F}$ R.S terms.

Q3) a) Answer any one of the following. [6]

i) For hexa-aquo Co(II) complex ion, three absorption bands are observed at 8200 cm^{-1} , 16000 cm^{-1} and 19500 cm^{-1} . Calculate crystal field splitting parameter (10Dq), Racah parameter, nephelauxetic ratio and also comment on nature of M-L bond. (Given: $B_0=971 \text{ cm}^{-1}$).

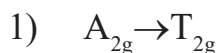
ii) How would you account for the magnetic moment listed against each of the following complexes?



b) Answer any two of the following. [6]

i) Determine the spin multiplicities to the states arising from $(t_{2g})^2$ configuration using Bethe's method of descending symmetry, correlation table and direct product table.

ii) Classify the following transitions in the octahedral complex as orbitally allowed, vibronically allowed and forbidden transitions. Justify your answer.



iii) Define and explain: Ferromagnetism and antiferromagnetism.

SECTION-II

Q4) a) Answer any four of the following. **[8]**

- i) What are the oxidation states of copper in oxyhemocyanin and deoxyhemocyanin?
- ii) Why nature does not chosen element from second and third series of transition element in biological system?
- iii) What are the bridging groups are present in hemerythrin?
- iv) What are the functions of Cobalt and Nickel in biological system?
- v) Explain the pathways for absorption of metal ions by cells.

b) Explain the uptake of iron by E.Coli. **[3]**

Q5) a) Answer any one of the following. **[6]**

- i) What are the types of model complexes? Explain the concept of spontaneous self-assembly.
- ii) Explain the administration and in-vivo chemistry of the cis-platin.

b) Answer any two of the following. **[6]**

- i) What is Chelate effect? Explain Irving-Williams series.
- ii) Discuss the role of Mg in chlorophyll.
- iii) Explain the use of metal complexes in medicine.

Q6) a) Answer any one of the following. **[6]**

- i) What are metalloenzymes? Explain how chemical transformation occurs in the substrate upon action of metalloenzyme.
- ii) Explain the importance of Ligand exchange rate in biological system.

b) Write note on any two of the following. **[6]**

- i) Transferrin
- ii) Calmodulin
- iii) Vitamin B₁₂

Direct Product

1. Group of the form $G \times i$ or $G \times \sigma_h$

The g, u, or '," additions to the IR symbol in this group satisfy

$$g \times g = u \times u = g, g \times u = u, 'x' = 'x' =$$

2. Product of the form $A \times A$, $B \times B$, $A \times B$

For all groups:

$$\text{Letter Symbol: } A \times A = A, B \times B = A, A \times B = B$$

$$\text{Subscript: } 1 \times 1 = 1, 2 \times 2 = 1, 1 \times 2 = 2$$

Except for the B representations of D_2 and D_2 where

$$B \times B = B, \text{ and } 1 \times 2 = 3, 2 \times 3 = 1, 3 \times 1 = 2$$

3. Products of the forms: $A \times E$, $B \times E$:

(a) For all groups $A \times E_k = E_k$ irrespective of the suffix on A.

(b) For all groups except D_{4h} , D_{4d} , S_8 :

$$B \times E_1 = E_2, B \times E_2 = E_1$$

irrespective of the suffix on B (If the group has only one B representative put $E_1 = E_2 = E$)

(c) For D_{4h} :

$$B \times E_1 = E_3, E \times E_2 = E_3, B \times E_3 = E_3, B \times E_2 = E_2, B \times E_3 = E_1$$

Irrespective of the suffix on B:

(d) For D_{4d} , S_8 :

$$B \times E_1 = E_3, B \times E_2 = E_2, B \times E_3 = E_1$$

Irrespective of the suffix on B:

4. Products of the form $E \times E$:

(For groups which have A, B, or E symbols without suffixes put $A_1 = A_2 = A$, etc in the equation below)

(a) For O_h , O , T_3 , D_{6h} , D_2 , C_{6v} , C_{6h} , C_6 , S_6 , D_{2d} , D_{2h} , D_3 , C_2 , C_{3h} , C_3 :

$$E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + B_2; E_1 \times E_2 = B_1 + B_2 + E_1$$

(b) For D_{4h} , D_4 , C_{4v} , C_{4h} , C_4 , S_4 , D_{2d} :

$$E \times E = A_1 + A_2 + B_1 + B_2.$$

(c) For D_{6d} :

$$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_g$$

$$E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + E_g$$

$$E_3 \times E_3 = A_1 + A_2 + B_1 + B_2$$

$$E_1 + E_2 = E_4 + E_3 = E_1 + E_3, E_1 \times E_3 = E_3 \times E_1 = E_2 + E_1.$$

$$E_1 + E_4 = E_2 + E_3 = E_3 + E_3, E_2 \times E_3 = E_3 \times E_4 = E_1 + E_3.$$

$$E_1 + E_3 = B_4 + B_2 + E_4, E_2 \times E_4 = B_1 + B_2 + E_2.$$

(d) D_{5d} , D_{2h} , D_3 , C_{3v} , C_{3h} , C_3 :

$$E_1 \times E_1 = A_1 + A_2 + E_2, E_2 \times E_2 = A_1 + A_2 + E_1$$

$$E_1 \times E_2 = E_1 + E_2$$

(e) For D_{4d} , S_8

$$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2$$

$$E_2 \times E_2 = A_1 + A_2 + B_1 + B_2$$

$$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3, E_1 \times E_3 = B_1 + B_2 + E_2$$

5. Product involving the T (or F) representation of O_h , O , T_d :

$$A_1 \times T_1 = T_1, A_1 \times T_2 = T_2, A_2 \times T_1 = T_2, A_2 \times T_2 = T_1,$$

$$E \times T_1 = E \times T_2 = T_1 + T_2.$$

$$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2$$

$$T_1 \times T_2 = A_2 + E + T_1 + T_2.$$

6. To Complete result for O are

O	A ₁	A ₂	E	T ₁	T ₂
A ₁	A ₁	A ₂	E	T ₁	T ₂
A ₂	A ₂	A ₁	E	T ₂	T ₁
E	E	E	A ₁ + A ₂ + E	T ₁ + T ₂	T ₁ + T ₂
T ₁	T ₁	T ₂	T ₁ + T ₂	A ₁ + E + T ₁ + T ₂	A ₂ + E + T ₁ + T ₂
T ₂	T ₂	T ₁	T ₁ + T ₂	A ₂ + E + T ₁ + T ₂	A ₁ + E + T ₁ + T ₂

Character Table for O rotational group

O	E	6C ₄	3C ₂ (=C ₄ ²)	8C ₃	6C ₂		
A ₁	1	1	1	1	1		$x^2 + y^2 + z^2$
A ₂	1	-1	1	1	-1		$(2z^2 - x^2 - y^2)$
E	2	0	2	-1	0	(R _x , R _y , R _z); (x, y, z)	$x^2 - y^2$
T ₁	3	1	-1	0	-1		(xy, xz, yz)
T ₂	3	-1	-1	0	1		

Correlation table for group Oh

Oh	O	Td	D _{4h}	D _{2d}	C _{4v}	C _{2v}	D _{3d}	D ₃	C _{2h}
A _{1g}	A ₁	A ₁	A _{1g}	A ₁	A ₁	A ₁	A _{1g}	A ₁	A _g
A _{2g}	A ₂	A ₂	B _{1g}	B ₁	B ₁	A ₂	A _{2g}	A ₂	B _g
E _g	E	E	A _{1g} + B _{1g}	A ₁ + B ₁	A ₁ + B ₁	A ₁ + A ₂	E _g	E	A _g + B _g
T _{1g}	T ₁	T ₁	A _{2g} + E _g	A ₂ + E	A ₂ + E	A ₂ + B ₁ + B ₂	A _{2g} + E _g	A ₂ + E	A _g + 2B _g
T _{2g}	T ₂	T ₂	B _{2g} + E _g	B ₂ + E	B ₂ + E	A ₁ + B ₁ + B ₂	A _{1g} + E _g	A ₁ + E	2A _g + B _g
A _{1u}	A ₁	A ₁	A _{1u}	B ₁	A ₂	A ₂	A _{1u}	A ₁	A _u
A _{2u}	A ₂	A ₁	B _{1u}	A ₁	B ₂	A ₁	A _{2u}	A ₂	B _u
Eu	E	E	A _{1u} + B _{1u}	A ₁ + B ₁	A ₂ + B ₂	A ₁ + A ₂	Eu	E	A _u + B _u
T _{1u}	T ₁	T ₂	A _{2u} + Eu	B ₂ + E	A ₁ + E	A ₁ + B ₁ + B ₂	A _{2u} + Eu	A ₁ + E	A _u + 2B _u
T _{2u}	T ₂	T ₁	B _{2u} + Eu	A ₂ + E	B ₁ + E	A ₂ + B ₁ + B ₂	A _{1u} + Eu	A ₁ + E	2A _u + B _u



Total No. of Questions : 6]

SEAT No. :

PD3133

[Total No. of Pages : 6

[6476]-204

M.Sc.-I (Organic/Drug Chemistry)

ORGANIC CHEMISTRY-II

CHE-553-MJ: Pericyclic Reactions, Molecular Rearrangements,
Photochemistry & Organic Spectroscopy
(Credit 2023 Pattern) (Semester -II) (4 Credits) (NEP)

Time : 3 Hours]

[Max. Marks : 70

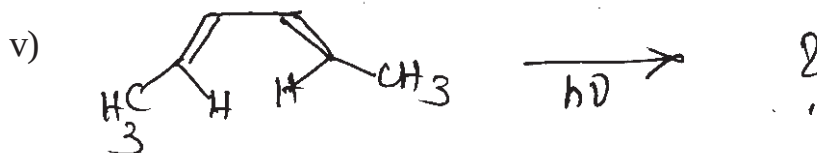
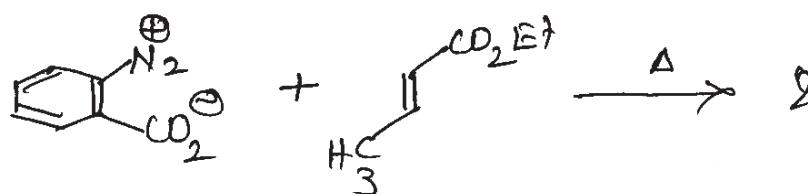
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Answer to the two sections should be written on separate answer book.

SECTION-I

Q1) a) Answer any four of the following. [8]

- i) In Baeyer-viliger oxidation, t-butyl group migrates in preference to methyl group.
- ii) Oxime of ethyl methyl ketone gives two products on treatment with H_2SO_4 while oxime of acetone gives only one product
- iii) Explain 1, 3 dipolar addition reaction with suitable example
- iv) Predict the product in the following reaction

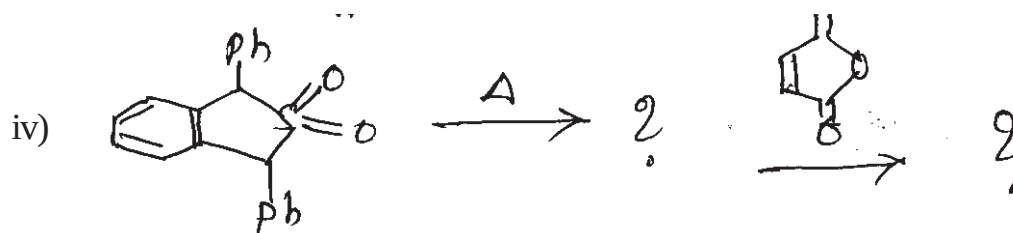
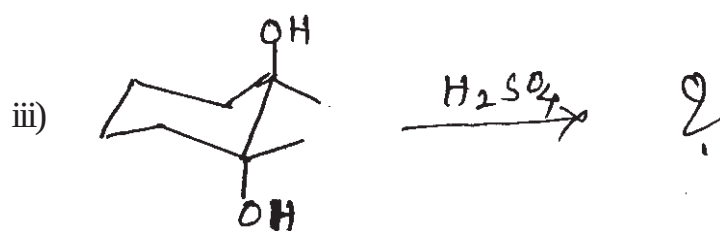
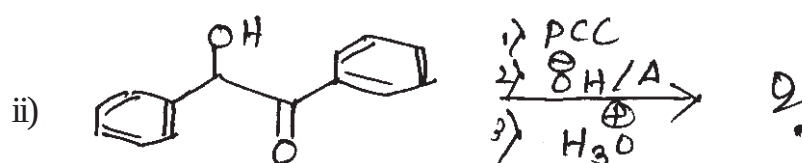
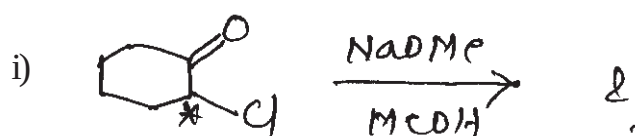


b) Explain sigmatropic reactions with suitable examples [3]

P.T.O.

Q2) a) Answer any three of the following with mechanisms.

[9]



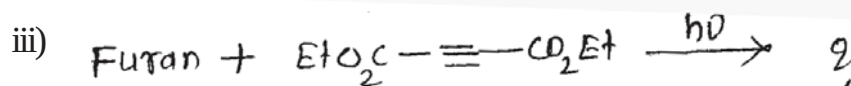
b) Draw correlation diagram for 1, 3- butadiene for electrocyclic ring formation. [3]

Q3) a) Answer any four of the following

[8]

i) What are pericyclic reactions? Explain with suitable examples.

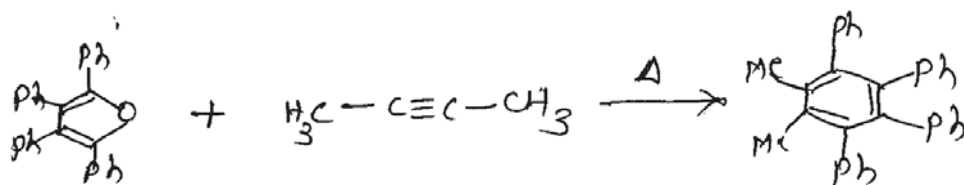
ii) Explain schmidt rearrangement.



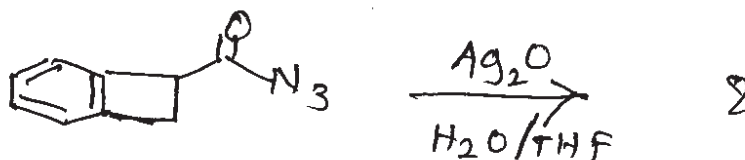
iv) Explain Wolff rearrangement can be used to prepare propanoic acid from acetic acid

v) Explain mechanism of Hofmann rearrangement with suitable example.

- b) Answer any two of the following [4]
 i) Suggest the suitable mechanism for the following reaction



- ii) Explain stereochemical principles involved in Diels-Alder reaction
 iii) Predict the product & name the reaction involved.

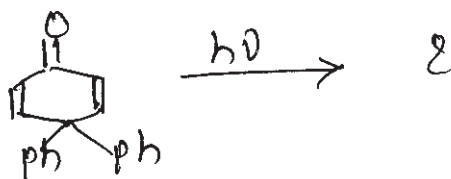


SECTION-II

- Q4) a) Answer the following questions. (Any four) [8]

- Sensitivity of ^{13}C signal is about 6000 times less than ^1H signal in NMR
- How will you distinguish the type of hydrogen bonding by IR spectroscopy?
- Cis-stilbene shows absorption at 283nm however trans-stilbene shows at 295 nm. Explain.
- Discuss the photochemical rearrangement of 1,4-pentadiene
- How will you distinguish maleic acid & Fumaric acid by ^1H NMR

b) Predict the Product/s indicating mechanism [3]



Q5) a) Write note on any three of the following [9]

- i) Photo fries rearrangement
- ii) Paterno-Buchi reaction
- iii) Fluorescence & phosphorescence
- iv) Photoenolization

b) A organic compound having MF $C_6H_{10}O_4$ shows the following spectral data [3]

UV : - No significant peak above 210cm

IR: 1760 & 2950 cm^{-1}

PMR: 1.5 (3H) d, J = 6.5 Hz

2.2 (6 H) S

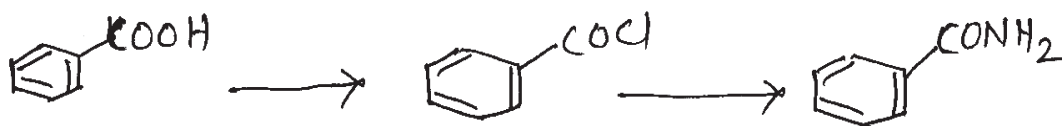
6.8 (1 H) q J = 6.5 Hz

CMR (off resonance Decoupled)

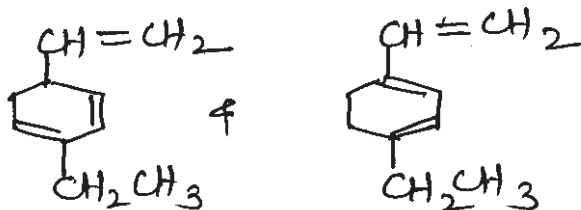
one singlet at 165 ppm, one doublet & two quartets.

Q6) a) Attempt any two of the following [8]

i) 1) How will you monitor the following reaction by IR spectroscopy



2) How will you distinguish following pair by UV spectroscopy



ii) Deduce the structure from the following spectral data

MF : $C_9H_{10}O_2$

IR : 1680 cm^{-1}

PMR: 2.5δ (s) 3H

3.8δ (s) 3H

6.9δ (d, $J = 8\text{ Hz}$) 2H

7.9δ (d, $J = 8\text{ Hz}$) 2H

CMR– off resonance spectrum of the compound shows-singlet above 180 ppm, 2– quartets, 2 doublets & 2 singlets for aromatic region.

iii) Deduce the structure From the following spectral data.

MF $C_{15}H_{14}O$

IR - 1650 cm^{-1}

PMR $\delta = 2.4\delta$, s (6H)

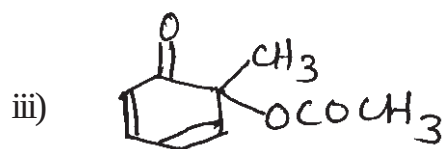
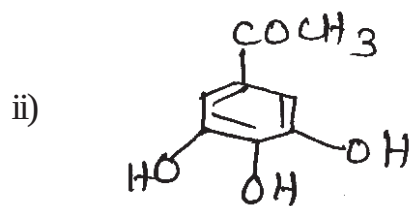
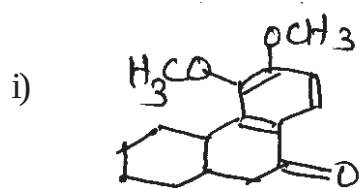
7.2δ , d (4H), $J = 8\text{ Hz}$

7.7δ d (4H), $J = 8\text{ Hz}$

CMR = 21, 129, 133, 136, 141, 190 δ

b) Calculate $\lambda_{\max}$ of any two of the following

[4]



Total No. of Questions : 3]

SEAT No. :

PD3134

[Total No. of Pages : 3

[6476]-205

M.Sc. -I (Physical Chemistry/Inorganic Chemistry/Analytical Chemistry)

ORGANIC CHEMISTRY-II

**CHEPIA-553-MJ: Molecular Rearrangement and Organic Spectroscopy
(2023 Credit Pattern) (Semester -II) (2 Credit)**

Time : 2 Hours]

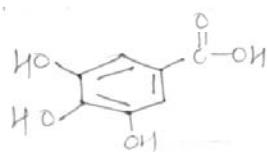
[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) a) Answer the following (Any 4) **[8]**

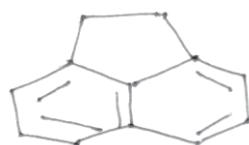
- i) What is Pinacol-Pinacolone rearrangement? Give one example
- ii) Explain why anti-groups migrate in Beckmann rearrangement?
- iii) Calculate the $\lambda_{\max}$ for the following compound



- iv) Distinguish following pair by IR spectroscopy

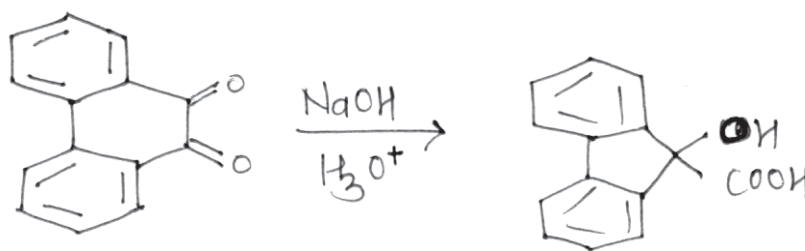


- v) How many ^{13}C NMR signals are present in proton decoupled spectrum of following compound.



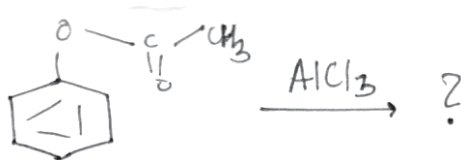
P.T.O.

b) Suggest the reaction mechanism for following transformation [3]



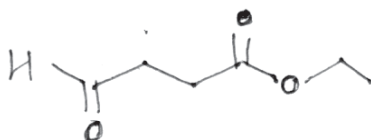
Q2) a) Attempt any three of the following. [9]

- Write a note on Bayer-villiger rearrangement.
- Predict the product of following rearrangement reaction and give suitable reaction mechanism.

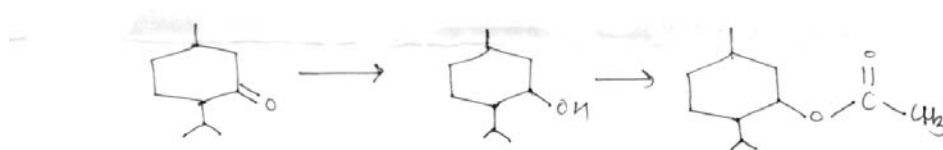


- Explain the concept of diamagnetic anisotropic effect in NMR spectroscopy.
- Assign the given ^{13}C NMR chemical shifts to the structure of the compound shown below. Justify your assignments.

Chemical Shifts in ppm: 202, 173, 62, 39, 27, 14



b) How will you monitor the following reaction sequence by IR spectroscopy? [3]



Q3) a) Attempt any two of the following. **[8]**

i) Predict the structure using following spectral data

M.F. : $C_9H_4O_3NCl$

U.V. : 255nm $\epsilon=12,000$

I.R. : 850, 1530, 1350, 1770 cm^{-1}

PMR: $\delta = 8.03$ (d, J=8Hz, 2H)

8.13 (d, J=8Hz, 2H)

ii) Predict the structure using following spectral data

M.F. : $C_9H_{11}NO$

U.V. : 235, 336nm $\epsilon = 8650, 28300$

I.R. : 820, 1567, 1695, 2740, 2960, 3020 cm^{-1}

PMR: $\delta = 2.98$ (s, 6H)

6.65 (d, 2H)

7.7 (d, 2H)

9.72 (s, 1H)

iii) Explain Hoffmann rearrangement with suitable examples.

b) Attempt any two of the following **[4]**

i) Give examples of rearrangement reactions involving ketene and carbocation intermediates

ii) On dilution with CCl_4 , the IR frequency of hydroxyl group in o-hydroxyacetophenone remains unchanged. Explain

iii) Explain how inductive and resonance effect affects the chemical shift in 1H NMR spectroscopy



Total No. of Questions : 3]

SEAT No. :

PD3135

[Total No. of Pages : 2

[6476]-206

M.Sc. - I (Physical Chemistry/Inorganic Chemistry/Analytical Chemistry)

CHEMISTRY

**CHE-561-(A) MJ : Organometallic Compounds and Inorganic
Reaction Mechanism
(2023 Credit Pattern) (Semester-II)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of log table & calculator is allowed.*
- 4) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Answer the following : **[8]**

- i) Give the rate law for dissociative reaction.
- ii) What is hydride elimination reaction?
- iii) Between two compounds which do not obey $18e^-$ rule.
 - 1) $[V(CO)_6]$
 - 2) $Fe(CO)_5$
- iv) What is insertion reactions? Explain with suitable example.

b) Write a short note on carbenes. **[3]**

Q2) a) Answer any one of the following. **[6]**

- i) Discuss the metallocene complexes with suitable example.
- ii) Explain the conjugate base mechanism with suitable examples.

b) Answer any two of the following. **[6]**

- i) Explain characterization of carbonyl compounds by IR spectroscopy.
- ii) Write note on trans effect.
- iii) Draw the structure of the following complexes.
 - 1) $Co_2(CO)_8$
 - 2) $Fe_3(CO)_{12}$
 - 3) $Mo(CO)_6$

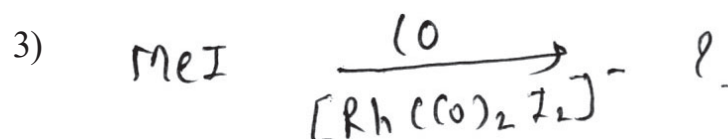
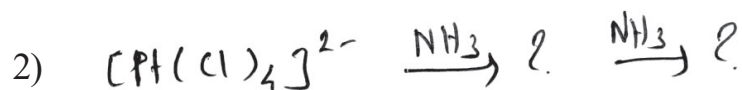
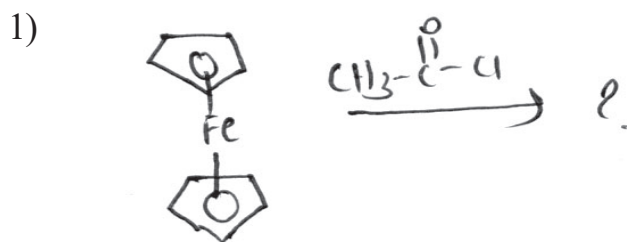
P.T.O.

Q3) a) Answer any one of the following. [6]

- i) Explain Wilkinson's catalytic cycle for hydrogenation of alkenes.
- ii) Explain outer and Inner sphere mechanism.

b) Answer any two of the following. [6]

- i) Discuss the methods for synthesis of binary carbonyl complexes.
- ii) Complete the following reactions.



- iii) Explain with the help of suitable example the role of organometallic compound as a protecting agent.



Total No. of Questions : 4]

SEAT No. :

PD3136

[Total No. of Pages : 2

[6476]-207

M.Sc. - I (Physical Chemistry/Inorganic Chemistry/Analytical Chemistry/Organic Chemistry/Drug Chemistry)

CHEMISTRY

**CHE - 561(B) - MJ : Material Characterization Techniques
(2023 Credit Pattern) (Semester - II) (Major Elective) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) Answer the following. [5]

- a) What are the factors affecting distortion of diffraction of diffraction spectra in XRD?
- b) Enlist the operational variables in SEM.
- c) What is ultramicrotomy in TEM?
- d) Explain in brief working atmosphere in XRF.
- e) Give uses of High Resolution X-Ray Diffractometer (HRXRD).

Q2) a) Answer any two of the following. [6]

- i) Give construction and working of x-ray tube.
- ii) Discuss analyzing crystal in wavelength dispersive spectroscopy. (WDS).
- iii) What are the applications of x-ray diffractometer? Explain one application in detail.

b) Answer any two of the following. [4]

- i) Describe electrolytic thinning in TEM.
- ii) What are the applications of XRF?
- iii) What is topographic contrast in SEM?

P.T.O.

Q3) Answer any five of the following.

[10]

- a) Explain absorption filter in XRD.
- b) Draw a labelled diagram of Everhart - Thornley detector in SEM.
- c) What is energy dispersive spectroscopy?
- d) What is compositional contrast in SEM?
- e) Which electron guns are used in TEM? Explain one electron gun in brief.
- f) What are the selection rules for electron transitions between two shells in an atom?
- g) The diffraction of crystal of sample with x-rays ($\lambda = 1.54\text{\AA}$) gives first order reflection at 25° . Calculate the interplanar distance in crystal.

Q4) a) Answer any two of the following.

[6]

- i) Describe Si(Li) detector in energy dispersive spectroscopy.
- ii) Justify; $n\lambda = 2d \sin \theta$
- iii) Explain electron-specimen interaction in SEM.

b) Answer any one of the following.

[4]

- i) Explain X-Ray Fluorescence spectroscopy. (XRF)
- ii) Explain various image modes in TEM.



Total No. of Questions : 3]

SEAT No. :

PD3137

[Total No. of Pages : 2

[6476]-208

M.Sc. - I (Physical Chemistry/ Inorganic Chemistry/Analytical Chemistry/Organic Chemistry/Drug Chemistry)

**CHE-561(C) MJ : Green Chemistry
(2023 Credit Pattern) (Semester-II)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of logarithmic table, calculator is allowed.*
- 4) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Answer the any four of the following : **[8]**

- i) Give the applications of CO₂ surfactants.
 - ii) What are the effects of VOCs on environment?
 - iii) What do you mean by sustainable development?
 - iv) Explain need of green chemistry.
 - v) Enlist the enzymes used for synthesis of vitamin C.
- b) Write comparison of Ziegler Natta catalyst and metallocene catalyst used for polymerisation. **[3]**

Q2) a) Answer the following. (any 3) **[9]**

- i) What is supercritical carbon dioxide? Give the applications of supercritical CO₂.
 - ii) Give the advantages and example of microwave assisted reactions for green chemistry.
 - iii) Explain Ionic liquid and benign catalyst in green chemistry.
 - iv) Explain solvent free synthesis and their advantages.
- b) Explain zeolites in catalysis for sustainable synthesis in green chemistry. **[3]**

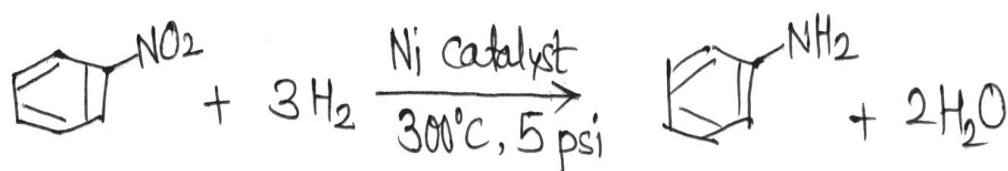
P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) Write a note on principles of green chemistry.
- ii) What is green synthesis? Explain the green synthesis of Ibuprofen.
- iii) Define the ultrasound assisted reactions? Give the principle and applications of ultrasound assisted reactions in green chemistry.

b) Attempt any two of the following. **[4]**

- i) Explain click chemistry is useful for green chemistry with example.
- ii) What is solid phase synthesis? Write microwave assisted solid phase reactions.
- iii) Calculate the atom economy for following reactions:



Total No. of Questions : 3]

SEAT No. :

PD3138

[Total No. of Pages : 2

[6476]-209

First Year M.Sc. (Organic/Drug Chemistry)
CHEOD-561(D)MJ: NUCLEAR AND RADIATION CHEMISTRY
(2023 Credit Pattern) (Semester - II)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table and non-programmable calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	= $6.022 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	= $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ = $1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	= $6.626 \times 10^{-27} \text{ erg s}$ = $6.626 \times 10^{-34} \text{ J s}$
4.	Electronic Charge	e	= $4.803 \times 10^{-10} \text{ esu}$ = $1.602 \times 10^{-19} \text{ C}$
5.	1 eV		= $23.06 \text{ kcal mol}^{-1}$ = $1.602 \times 10^{-12} \text{ erg}$ = $1.602 \times 10^{-19} \text{ J}$ = 8065.5 cm^{-1}
6.	Gas Constant	R	= $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ = $1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	= $96487 \text{ C equiv}^{-1}$
8.	Speed of light	c	= $2.997 \times 10^{10} \text{ cm s}^{-1}$ = $2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		= $4.184 \times 10^7 \text{ erg}$ = 4.184 J
10.	1 amu		= $1.673 \times 10^{-24} \text{ kg}$
11.	Bohr magneton	β_e	= $9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	= $5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	= $9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Attempt the following. (Any four) **[8]**
- i) Write the equation for the preparation of ^3H & ^{14}C .
 - ii) How does Geiger-Nuttall's Law explain the relationship between half life of a radioactive substance & the energy of the emitted particles.
 - iii) Define the terms dose and dose rate.
 - iv) What do you mean by Compton scattering?
 - v) Explain the application of radioisotope in reaction mechanism with one example.
- b) An isotope loses $\frac{1}{10}$ th of its activity in 23 hrs. What is its half life? **[3]**
- Q2) a)** Attempt any three of the following. **[9]**
- i) What is Auger's effect? Explain in details.
 - ii) Discuss the term fission energy & what is the process of nuclear fission?
 - iii) Explain the concept of radiolysis of water.
 - iv) Discuss the Szilard-Chalmer's reaction.
- b) Calculate the mass absorption coefficient for 1 MeV μ radiation for NaI & NaIO₃ (Given: O = 1.69, Na = 2.32, I = 12.03 b/atom) **[3]**
- Q3) a)** Attempt any two of the following. **[8]**
- i) Explain the following medical applications in radioactivity
 - 1) Thyroiditis
 - 2) Assessing the volume of Blood in a patient
 - ii) Explain the determination of mechanism of Friedel-Craft reaction using radioactive tracers.
 - iii) What is spallation in nuclear fission & how does it differ from neutron evaporation.
- b) Attempt any one of the following. **[4]**
- i) A sample containing of unknown amount of germanium metal is irradiated in neutrons flux of $10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$ for 1 hr when $^{76}\text{Ge} \rightarrow ^{77}\text{Ge}$ for half life 1 min after the 1 hr irradiated is 2500 dps. Find the amount of Ge in the same, given the cross section for the reaction is 3.28 mb, and isotopic abundance of ^{76}Ge to be 7.8%.
 - ii) A ruby weighing 0.5g was irradiated in a neutron flux of $10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$ for exactly 24 h and ^{51}Cr activity (half life is 27.7d) counted immediately thereafter. It was found to give 35,000 c/s. Given that the σ for ^{50}Cr to be 15.9 b, the counting efficiency 10% and the ^{50}Cr content of natural Cr to be 4.35% Find the Cr content of the ruby.

[6476]-210

M.Sc. - I (Physical/Inorganic/Analytical Chemistry)
CHEPIA-561(D)MJ: PERICYCLIC REACTIONS AND
PHOTOCHEMISTRY
(2023 Credit Pattern) (Semester - II) (2 Credit)

Time : 2 Hours]

[Max. Marks : 35

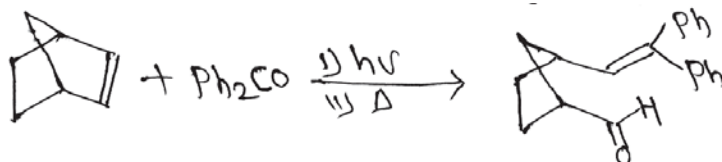
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) a) Answer the following. (Any 4) **[8]**

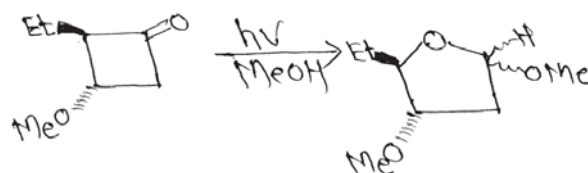
- i) What is a [1, 5] sigmatropic shift? Give one example.
- ii) What is meant by phosphorescence and fluorescence in photochemistry?
- iii) Draw the π molecular orbitals of 1,3-butadiene.
- iv) What is singlet and triplet state in photochemistry?
- v) What is Ene reaction? Give one example.

b) Explain the mechanism for following reaction. **[3]**



Q2) a) Attempt any three of the following. **[9]**

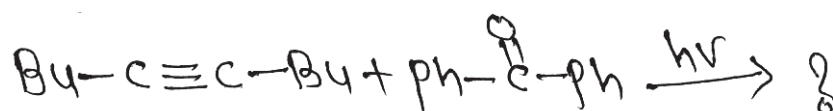
- i) Suggest the suitable mechanism for following reaction.



- ii) Write short note on cheletropic reaction.
- iii) What are pericyclic reactions? Predict the products with exact stereochemistry for following reaction.

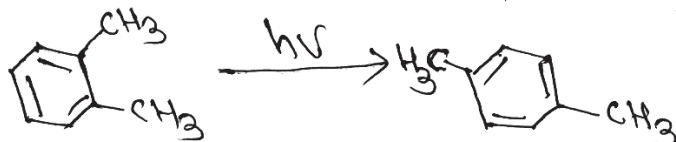


- iv) Predict the product with suitable mechanism for following reaction.



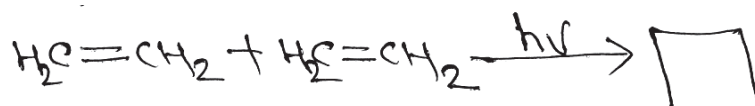
P.T.O.

- b) Explain the mechanism for following reaction. [3]

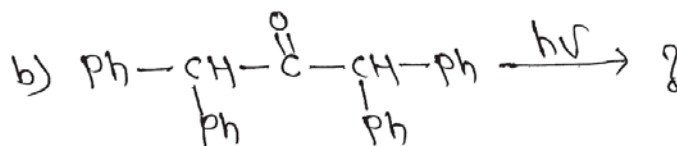
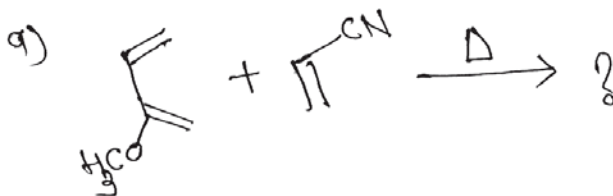


- Q3) a) Attempt any two of the following. [8]

- i) What is cycloaddition reaction? Draw the correlation diagram for following reaction.

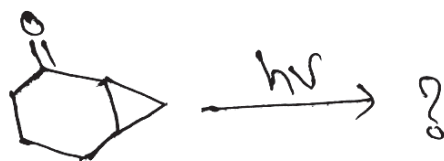


- ii) What is photorearrangements? Explain the Lumiketone rearrangement in details.
 iii) Predict the product with justification in following reactions.

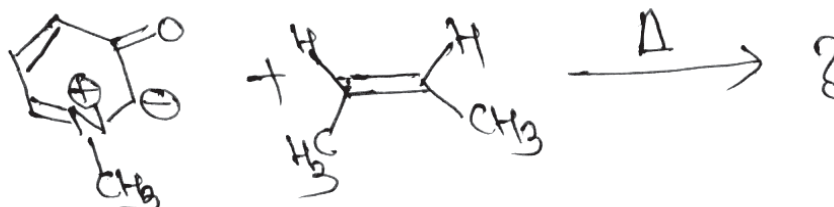


- b) Attempt any two of the following. [4]

- i) Predict the product with suitable mechanism for the following reaction.



- ii) Predict the product with justification in following reaction.



- iii) What is photoreduction? Give one example.



Total No. of Questions : 6]

SEAT No. :

PD3140

[Total No. of Pages : 3

[6476]-301

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-601-MJ : Quantum and Solid State Chemistry
(2023 Credit Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer book.
- 2) All questions are compulsory.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1) Avogadro Number	N	$= 6.022 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ JK}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV		$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	R	$= 8.314 \times 10^7 \text{ ergK}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
8) Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10) 1 amu		$= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

Q1) a) Attempt any four of the following. [8]

- i) Explain the properties of quantum mechanical operators.
- ii) What are the conditions for the wave function to be acceptable?
- iii) State Pauli's exclusion principle.
- iv) Give the importance of Ladder operator.
- v) Define 'eigen function' and 'eigen value'.

b) What is regular and inverted multiplet? Give their significance. [3]

Q2) a) Attempt any three of the following. [9]

- i) Formulate the Hamiltonian operator H_2^- ion and state the terms involved in it.
- ii) Compare perturbation method with the variation method.
- iii) Define linear operator. Explain it with suitable example.
- iv) State Russel-Saunders's rules to determine ground state of an atom.

b) If $\hat{A} = 3x^2$ and $\hat{B} = \frac{d}{dx}$ then show that $\hat{A}\hat{B} \neq \hat{B}\hat{A}$. [3]

Q3) a) Attempt any two of the following. [8]

- i) Show that Hermitian operators yield real eigen values.
- ii) Write a note on Slater determinant.
- iii) Discuss Hartree-Fock SCF method.

b) Attempt any one of the following. [4]

- i) Derive the expression for first order correction to the energy of the non-degenerate unperturbed level.
- ii) If $g = \hat{A}F$, find g for each of the following choices of $\hat{A}$ and F .

1) $\hat{A} = \frac{d}{dx}$ and $F = \cos(x^2 + 1)$

2) $\hat{A} = 5$ and $F = \sin x$

3) $\hat{A} = \frac{d^2}{dx^2}$ and $F = \ln 3x$

4) $\hat{A} = \exp$ and $F = \ln x$

SECTION - II

- Q4) a)** Attempt any four of the following. [8]
- i) Write the equation for Frankel defects and explain the terms involved in it.
 - ii) State the Bravais law in relation to the crystal growth.
 - iii) Give steps in the photographic process.
 - iv) What is Piezoelectricity?
 - v) What is Antiferromagnetism?
- b) Discuss the mechanism of diffusion in solids. [3]
-
- Q5) a)** Attempt any three of the following. [9]
- i) Discuss the growth of crystal from vapour phase.
 - ii) Explain the parabolic rate law used to explain the mechanism of gas-solid reactions.
 - iii) Explain the origin of colour centres in halide crystals.
 - iv) Explain intrinsic and extrinsic semiconductors.
- b) Explain Hydrothermal method to grow crystal from solution. [3]
-
- Q6) a)** Attempt any two of the following. [8]
- i) Discuss Hall effect in semiconductor.
 - ii) Sketch and explain the hysteresis loop observed for magnetization of an insulator crystal.
 - iii) Explain with a suitable example an addition reaction in solid.
- b) Attempt any one of the following. [4]
- i) Calculate the number of Schottky defects in 1 cm^3 NaCl single crystal if energy required to remove a pair of oppositely charged ions is 2 eV. [Given : $\rho = 2.165\text{ g cm}^{-3}$, $M = 58.5$]
 - ii) Calculate the Fermi energy in eV for a solid having 10^{25} electrons per m^3 at 25°C .



Total No. of Questions : 6]

SEAT No. :

PD3141

[Total No. of Pages : 3

[6476]-302

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-602-MJ : Polymer Chemistry

(2023 Credit Pattern) (Semester-III) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1) Avogadro Number	N	$= 6.022 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV		$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	F	$= 96487 \text{ C equiv}^{-1}$
8) Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10) 1 amu		$= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

Q1) a) Answer the following (any 4) [8]

- i) State the principle of viscosity method.
 - ii) Define the term homochain and heterochain polymer.
 - iii) Explain degree of polymerization.
 - iv) Explain colligative properties.
 - v) Define the term copolymerization.
- b) If the degree of polymerization of polystyrene is 1000. Find out molecular weight of polystyrene. [3]

Q2) a) Attempt any three of the following. [9]

- i) Explain sedimentation velocity method.
 - ii) Write any three types of molecular forces present in polymer.
 - iii) Discuss characterization of polymers.
 - iv) Explain thermoplastic and thermosetting polymer.
- b) Explain vapour phase osmometry technique for determination of polymer molecular weight. [3]

Q3) a) Attempt any two of the following. [8]

- i) Describe in detail classification of polymers.
 - ii) Write a note on entropy and heat of mixing of polymer solutions.
 - iii) Why do polymers have average molecular weight? What is polydispersity index?
- b) Attempt any two of the following. [4]
- i) Describe principle of membrane osmometry.
 - ii) What is $\overline{M}_n$, $\overline{M}_w$ & $\overline{M}_v$?
 - iii) Explain copolymer equation

SECTION - II

- Q4)** a) Answer the following (any 4) [8]
- i) Define the term film extrusion.
 - ii) Give the advantages of compression molding.
 - iii) Explain term glass state.
 - iv) What is vulcanization?
 - v) What are mechanical properties of crystalline polymer?
- b) What are the different types of spinning techniques. [3]
-
- Q5)** a) Attempt any three of the following. [9]
- i) Describe cross linking of polymer.
 - ii) What is Rheology and discuss viscous flow phenomenon.
 - iii) Explain the effect of Radiation on polymer.
 - iv) Explain the relationship between T_g and T_m .
- b) Compare textile properties and fabric properties of polymers. [3]
-
- Q6)** a) Attempt any two of the following. [8]
- i) Describe phenomenon of polymer utilization.
 - ii) Explain conduction mechanism in conducting polymers.
 - iii) Describe injection molding with neat diagram.
- b) Attempt any two of the following. [4]
- i) What is crystalline melting point.
 - ii) Give applications of conducting polymers.
 - iii) Explain the term Random degradation.



Total No. of Questions : 3]

SEAT No. :

PD3142

[Total No. of Pages : 2

[6476]-303

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-603-MJ : Nuclear and Radiation Chemistry
(2023 Credit Pattern) (Semester-III) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right side indicate full marks.
- 3) Use of logarithmic table, calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1. Avogadro Number	N	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	$= 6.626 \times 10^{-16} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J/s}$
4. Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	$= 96487 \text{ C equivalent}^{-1}$
8. Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		$= 4.187 \times 10^3 \text{ erg}$ $= 4.187 \text{ J}$
10. 1 amu		$= 1.673 \times 10^{-22} \text{ kg}$
11. Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Answer the following (any 4) [8]
- i) What is elastic scattering in nuclear reactions?
 - ii) Explain the function of reactor moderator & reflectors.
 - iii) State limitations of liquid drop model.
 - iv) Draw the schematic diagram of PIXE analysis.
 - v) What is scintillation detectors?
- b) Discuss photonuclear reactions with examples. [3]
- Q2) a)** Attempt any three of the following. [9]
- i) Describe thermal, fast and intermediate reactors.
 - ii) Discuss ionization and X-ray emission of PIXE.
 - iii) Discuss the discontinuities in nuclear properties with reference to magic number.
 - iv) Write the construction and working of Li-drifted detector.
- b) Calculate energies of two peaks in the RBS spectrum correspond to ^{197}Au and ^{65}Cu , assuming an incident $^4\text{He}^+$ ions of 2 meV energy and scattering angle of 170° . [3]
- Q3) a)** Attempt any two of the following. [8]
- i) Describe different types of research reactors.
 - ii) Explain depth profiling using RBS spectrometry.
 - iii) Discuss the working of surface barrier semi conductor detector.
- b) Attempt any two of the following. [4]
- i) Describe conservation in nuclear reactions.
 - ii) Describe the role of T_1 in NaI (T_1) scintillator.
 - iii) What is semi empirical mass equation.



Total No. of Questions : 3]

SEAT No. :

PD3143

[Total No. of Pages : 2

[6476]-304

M.Sc. - II

PHYSICAL CHEMISTRY

CHP - 610 (A) MJ : Photochemistry

(2023 Credit Pattern) (Semester - III) (2 Credits) (Elective Option - A)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table, calculators is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1) Avogadro Number	$N = 6.022 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	$k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	$h = 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	$e = 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$ $= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	$R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	$F = 96487 \text{ C equiv}^{-1}$
8) Speed of light	$c = 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$ $= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$ $= 1.673 \times 10^{-27} \text{ kg}$
9) 1 cal	
10) 1 amu	$\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$
11) Bohr magneton	$\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
12) Nuclear magneton	$m_e = 9.11 \times 10^{-31} \text{ kg}$
13) Mass of an electron	

P.T.O.

- Q1) a)** Answer the following (Any 4) **[8]**
- i) State Grothus Draper law.
 - ii) State the selection rule.
 - iii) Give two important characteristics of phosphorescence.
 - iv) How many types of electronic transitions possible in organic molecule. Arrange them in decending order of the energy.
 - v) Define the following
 - 1) Self phase modulation
 - 2) Single photon counting
- b)** Explain the light phase reaction in photosynthesis. **[3]**
-
- Q2) a)** Attempt any three of following. **[9]**
- i) Discuss the solvent perturbation technique for distinguish between electronic transition in organic molecule.
 - ii) Explain p-type delayed fluorescence
 - iii) Describe the pico second flash photolysis.
 - iv) Explain the Jablonski diagram depicting photophysical proless.
- b)** Discuss the Einstein treatment of absorption and emission phenomenon. **[3]**
-
- Q3) a)** Attempt any two the the following. **[8]**
- i) Derive Stern-Volmer equation for kinetics of collision quenching.
 - ii) Describe in detail the Ruby laser.
 - iii) Explain the process of photosynthesis with mechanism
- b)** Attempt any two of the following. **[4]**
- i) Enlist the various processess that are involved in photophysical kinetics of unimolecular process.
 - ii) What is population inversion
 - iii) Discuss the charge transfer mechanism quenching by added substance.

Total No. of Questions : 3]

SEAT No. :

PD3144

[Total No. of Pages : 2

[6476]-305

M.Sc. - II

PHYSICAL CHEMISTRY

**CHP-610 (B)-MJ : Physicochemical Methods of Analysis
(2023 Credit Pattern) (Semester - III) (Elective) (Option-B) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of logarithmic table, calculator is allowed.*
- 4) *Neat diagrams must be drawn wherever necessary.*

Physico-Chemical Constants

1) Avogadro Number	$N = 6.023 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	$k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	$h = 6.626 \times 10^{-16} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	$e = 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV	$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	$R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	$F = 96487 \text{ C equivalent}^{-1}$
8) Speed of light	$c = 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal	$= 4.187 \times 10^7 \text{ erg}$ $= 4.187 \text{ J}$
10) 1 amu	$= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr Magneton	$\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear Magneton	$\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ Kg}$

P.T.O.

- Q1) a)** Answer the following. (any 4) [8]
- i) Define the terms binding energy and work function used in ESCA.
 - ii) Give two application of X-ray absorption.
 - iii) Draw a neat labelled block diagram of Thermobalance.
 - iv) What is meant by short wavelength cutoff.
 - v) Why does weight of empty crucible change when it is heated upto 1000°C in TGA technique.
- b) Discuss the application of DSC techniques. [3]
- Q2) a)** Answer the following. (any 3) [9]
- i) What are advantages of X-ray radioactive source?
 - ii) Explain the factor affecting DTA technique.
 - iii) Explain any one analyser used in ESCA with neat labelled diagram.
 - iv) What is X-ray fluorescence? Draw a neat labelled diagram of energy dispersive instrument.
- b) The work function of spectrometer is 35eV. The binding energy of the emitted electron is 1.050eV. If the kinetic energy of the electron is 1.75eV. Find the wavelength of X-ray. [3]
- Q3) a)** Answer the following. (any 2) [8]
- i) Write a note of ESCA satellite peak.
 - ii) Explain X-ray fluorescence and draw a neat labelled diagram of wavelength dispersive and energy dispersive instrument used in Fluorescence technique.
 - iii) Explain the various factor which affect thermogravimetric analysis.
- b) Answer the following. (any 2) [4]
- i) Write the application of DTA technique.
 - ii) Discuss the application of ESCA technique.
 - iii) What is absorptive edge and state its uses.



[6476]-306

M. Sc. - II

PHYSICAL CHEMISTRY

CHP-610 (C) MJ : Special Topics in Physical Chemistry
(2023 Credit Pattern) (Semester - III) (Elective) (Option-C)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table, calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1) Avogadro Number	$N = 6.022 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant	$k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant	$h = 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge	$e = 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV	$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant	$R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant	$F = 96487 \text{ C equiv}^{-1}$
8) Speed of light	$c = 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal	$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10) 1 amu	$= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr magneton	$\beta_e = 9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear magneton	$\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Attempt the following. (Any 4) [8]
- i) What are smart polymers?
 - ii) Discuss any two properties of nanoparticles.
 - iii) What are factors affecting on physisorption?
 - iv) What are shape memory alloys?
 - v) Define piezoelectric materials.
- b) What is chemisorption in hydrogen storage? [3]
- Q2) a)** Attempt the following (Any 3) [9]
- i) Explain electric double layer in metal nanoparticles.
 - ii) What are the different methods for preparation of nanoparticles?
 - iii) Explain sol-gel method for preparation of nanoparticles.
 - iv) Discuss actively smart and passively smart materials.
- b) Explain electrochemical storage of hydrogen in carbon materials. [3]
- Q3) a)** Attempt the following. (Any 2) [8]
- i) Give electrical properties of metal nanoparticles.
 - ii) Explain chemical of catalytic aspect of nano crystals.
 - iii) Discuss the role of physisorption in the storage of hydrogen
- b) Attempt the following (Any 2) [4]
- i) Explain semiconductor nanoparticles.
 - ii) What is adsorption energy?
 - iii) Explain electro rheological fluids.



Total No. of Questions : 6]

SEAT No. :

PD3146

[Total No. of Pages : 3

[6476]-307

M.Sc.-II

INORGANIC CHEMISTRY

CHI - 601 - MJ : Organometallic and Homogeneous Catalysis
(2023 Credit Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Answers to the two sections should be written in separate answer books.
- 3) Figures to the right indicate full marks.
- 4) Neat diagram must be drawn wherever necessary.

SECTION - I

Q1) a) Answer the following. **[8]**

- i) What is mean by Homoleptic sigma complexes?
- ii) What is hapticity? Explain with suitable example.
- iii) Give the properties of cyclopentadienyl complexes.
- iv) Explain EAN rule with suitable example.

b) Give an account of transition metal carbene complexes. **[3]**

Q2) a) Answer any one of the following. **[6]**

- i) Explain synthesis, bonding and applications of metal - arene complexes.
- ii) Explain the Dewar - Chatt-Duncanson model for bonding in metal olefin complexes.

b) Answer any two of the following. **[6]**

- i) What is the significance of 18-electron rule in organometallic compounds?
- ii) Write short note on detection of stereochemical non-rigidity.
- iii) Write note on Fischer and Schrock carbene.

P.T.O.

- Q3) a)** Answer any one of the following. [6]
- i) Explain synthesis, bonding and applications of allyl complexes.
 - ii) Give the systematic classification of 6 - bonded transition metal hydrocarbonyls.
- b)** Answer any two of the following. [6]
- i) Explain the term π -acid ligands with suitable example.
 - ii) Give the classification of sigma complexes.
 - iii) What is Trienyl complexes? Explain.

SECTION - II

(Homogeneous Catalysis)

- Q4) a)** Answer the following. [8]
- i) Give the general features of homogeneous catalysis.
 - ii) Which properties of phosphines makes them good ligand in homogeneous catalysis.
 - iii) List out the important reactions of organometallics.
 - iv) Give the typical reaction conditions for suzuki coupling reactions.
- b)** Discuss oxidative addition and reductive elimination reactions with suitable examples. [3]
- Q5) a)** Answer any one of the following. [6]
- i) Give an account of catalyst protect seperation strategies used in homogeneous catalysis.
 - ii) Discuss various types of metathesis reactions with suitable example alongwith catalyst used in them.
- b)** Answer any two of the following. [6]
- i) Differentiate between homogeneous and heterogeneous catalysis.
 - ii) Discuss sharpless epoxidation reaction.
 - iii) How metallocene based catalysts are superior for polymerisation of olefins.

Q6) a) Answer any one of the following. **[6]**

- i) Discuss the cativa process for methanol carboxylation with the help of catalytic cycle.
- ii) Discuss the mechanism of Heck reaction with the help of catalytic cycle.

b) Answer any two of the following. **[6]**

- i) Discuss different types of polypropylene.
- ii) Write a note on types of selectivities.
- iii) Write a note on Aqueous biphasic catalysis.



Total No. of Questions : 6]

SEAT No. :

PD3147

[Total No. of Pages : 3

[6476]-308

M.Sc. - II (Chemistry)

INORGANIC CHEMISTRY

CHI-602-MJ : Inorganic Reaction Mechanism, Photochemistry and
Reaction of Co-ordinated Ligand
(2023 Credit Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

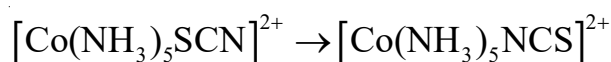
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Answer of the two sections should be written in separate answer books.

SECTION - I

Q1) a) Attempt the following : [8]

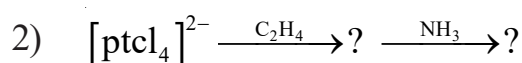
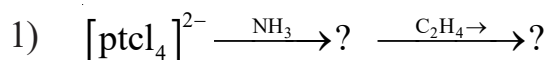
- i) What is Chelate effect?
- ii) Suggest the mechanism for following reaction.



- iii) How does following modification effect the rate of substitution reaction in square planar complex.

- 1) Adding Bulky substituent to the Cis-Ligand.
- 2) Increasing positive charge on metal.

- iv) Complete the following reaction sequence.



- b) What is inner sphere and outer sphere explain with suitable mechanism.[3]

P.T.O.

- Q2) a)** Attempt any one of the following. [6]
- Discuss in brief ligand substitution reaction in four coordinated complexes.
 - Explain in detail SN^1 , SN^2 & SN^1 CB mechanism with suitable example.
- b)** Attempt any two of the following. [6]
- Explain Marcus equation.
 - Discuss trans effect in detail.
 - Differentiate betⁿ phosphorescence & fluroscence.
- Q3) a)** Attempt any one of the following. [6]
- Explain the factor affecting on substitution and stereochemistry.
 - What are the types of electron transfer reaction and types of electron transfer reaction?
- b)** Write a note on (any two) [6]
- How isotope labelling technique is used in studying the kinetics and mechanism of the reaction?
 - Explain two electron transfer reaction.
 - Racemization in trichelate metal complexes.
- SECTION - II**
- Q4) a)** Answer the following : [8]
- What is the role of d-d transition in photochemical reaction?
 - What is inseration reaction?
 - What is photochemical reaction? Give example.
 - What do you mean by quantum yeild in photochemical reaction?
- b)** Describe in detail the mechanism of about solvolysis of co-ordinated phosphorous atoms. [3]

Q5) a) Attempt any one of the following. [6]

- i) Give an account of methyl migration reaction.
- ii) Discuss the light induced substitution reactions and redox reactions of Co (III) amine complexes.

b) Answer any two of the following. [6]

- i) Comment on substitution by reversible oxidative addition.
- ii) What is chelate ring modifying reactions?
- iii) Comment ligand substitution reaction in detail.

Q6) a) Answer any one of the following. [6]

- i) Discuss in brief kinetic template effect involving reaction between one donor atom and one non donor atom.
- ii) Draw and discuss the experimental set up for study of photochemical reaction.

b) Write a note on (any two). [6]

- i) Halogenation of coordinated nitrogen atom.
- ii) Prompt and delayed reactions.
- iii) CT band transition in metal-metal bonded systems.



Total No. of Questions : 3]

SEAT No. :

PD3148

[Total No. of Pages : 2

[6476]-309

M.Sc. - II

INORGANIC CHEMISTRY

CHI-603-MJ : Bioinorganic Chemistry
(2023 Credit Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Draw neat and labelled diagrams wherever necessary.

Q1) a) Attempt the following : [8]

- i) Name any four biological processes in which Fe-5 proteins are involved.
- ii) Name the naturally occurring organometallic enzyme? Which element is present at active site.
- iii) What are structurally important components of Mo containing enzymes?
- iv) What is the rate determining step in hydrolysis of CO_2 by carbonicanhydrase.

b) Explain in detail the model complexes of vit B_{12} ? [3]

Q2) a) Attempt any one of the following : [6]

- i) Explain the structure & function of Fe-Mo cofactor in detail.
- ii) Explain in detail Type-I, Type-II & Type-III copper protein.

b) Attempt any two of the following : [6]

- i) Explain in detail role of Apoenzyme.
- ii) Explain adenosyl coenzyme as a cofactor.
- iii) Match the following :

A

B

1) Carboxypeptidase

A) $\text{O}_2 \xrightleftharpoons[+1e^-]{-1e^-} \text{O}_2$

2) SOD

B) Electron transfer

3) Cytochrome

C) Digestion of proteins

P.T.O.

Q3) a) Attempt any one of the following : **[6]**

- i) How does nitrogen fixation take place by molybdenum.
- ii) Explain antagonism with suitable example.

b) Write note on any two. **[6]**

- i) Enzyme xanthine oxidase
- ii) Non-Heme iron
- iii) Hydroxylase



Total No. of Questions : 6]

SEAT No. :

PD3149

[Total No. of Pages : 3

[6476]-310

M.Sc. - II

INORGANIC CHEMISTRY - IV

**CHI-610(A)MJ: Physical Methods in Inorganic Chemistry
(2023 Credit Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answer to the two sections should be written in separate answer books.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic table and calculators are allowed.*

SECTION - I

(Thermal and Spectroscopic Techniques)

Q1) a) Answer the following. [8]

- i) What is the principle of TGA? How does it measures thermal stability?
 - ii) Give any two applications of DTA technique.
 - iii) What is the expected splitting pattern in the ^{19}F -NMR spectrum of ClF_3 ?
 - iv) What is the role of fluorophore in fluorescence spectroscopy?
- b) An organic radical has an unpaired electron interacting with two equivalent hydrogen nuclei ($I=\frac{1}{2}$). If the g-factor is 2.0023 and the magnetic field strength is 3400 G, calculate ESR transition frequency. Also, predict the ESR spectrum's splitting pattern. [3]

Q2) a) Attempt any one of the following. [6]

- i) Derive Bragg's equation in XRD. Discuss any three applications of XRD.
 - ii) State the principle of DSC. Discuss the working of DSC technique. Give any two applications of DSC technique.
- b) Attempt any two of the following. [6]
- i) Discuss the working of TPD technique.
 - ii) What is the principle of FT-IR spectroscopy? How does FT-IR differ from conventional I.R spectroscopy.
 - iii) Distinguish between DSC and DTA techniques.

P.T.O.

- Q3) a)** Attempt any one of the following. [6]
- Describe the instrumentation used in TGA technique. Discuss any three applications of TGA technique.
 - What is the selection rule in NMR spectroscopy? Discuss the expected ^{31}P NMR spectrum of $\text{H}_3\text{P} \cdot ^{11}\text{BCl}_3$ [for $^{11}\text{B}, I = \frac{3}{2}$] by assuming $^1J_{\text{PH}} \gg ^1J_{\text{PB}}$
- b)** Attempt any two of the following. [6]
- What are Miller indices? Draw the following planes in cubic cell
 - [111]
 - [122]
 - Discuss the ESR spectrum of $^{13}\text{CF}_3$ radical.
 - A 10.00 Mg sample contains a mixture of MgCO_3 and MgO . Upon heating all MgCO_3 decomposes to MgO and CO_2 . The residual mass after decomposition is 7.00mg. Determine the mass percentage of MgCO_3 in the original mixture.

SECTION - II

(Material characterization techniques and analytical techniques)

- Q4) a)** Answer the following. [8]
- How EDX provides elemental composition data in combination with SEM?
 - How is the band gap of a material determined using UV-DRS?
 - Explain the importance of the reference electrode in a cyclic voltammetry setup.
 - Explain the basic working principle of Flame Photometer.
- b)** What is the working principle of SEM? How does it differ from TEM? [3]
- Q5) a)** Answer any One of the following. [6]
- What is the principle of TEM? Describe it's working and mention the significance of TEM.
 - What is cyclic voltammetry? Explain construction working and applications of cyclic voltammetry.
- b)** Answer any Two of the following. [6]
- What is the principle of the BET Method? How does it determine the surface area of materials.
 - List the types of elements commonly analyzed using flame photometry. Explain it's clinical application.
 - Mention the advantages of UV DRS over traditional UV-Visible spectroscopy.

Q6) a) Answer any One of the following. **[6]**

- i) Explain the principle of XPS. Describe how the kinetic energy of photoelectron is related to the binding energy of electrons in a material.
- ii) Discuss the principle and working of UV DRS. What type of materials are typically analysed by UV DRS?

b) Answer any Two of the following. **[6]**

- i) A material is analyzed using nitrogen adsorption, the monolayer volume is determined to be 50 cm^3 (STP). The molar cross sectional area of nitrogen is 0.162 nm^2 , The molar volume of a gas at STP is $22,400 \text{ cm}^3$. Calculate the specific surface area of the material in m^2/g . (Given: Avogadro's number = 6.022×10^{23} molecules/mol)
- ii) In a cyclic voltammetry experiment, the peak current is measured at two different scan rates: When the scan rate is 0.02 v/s , the peak current is $50 \mu\text{A}$. Calculate the peak current at scan rate of 0.1 v/s .
- iii) What are secondary electrons in SEM? Discuss the role of secondary electrons in material characterization.



Total No. of Questions : 6]

SEAT No. :

PD3150

[Total No. of Pages : 3

[6476]-311

M.Sc. - II

INORGANIC CHEMISTRY-IV

CHI-610 (B) MJ : Magneto-Chemistry & Inorganic Polymers
(2023 Credit Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn whenever necessary.
- 3) Use of calculator is allowed.

SECTION - I

(Magneto Chemistry)

Q1) a) Attempt the following: [8]

- i) What are the applications of magnetic materials?
- ii) Define ferromagnetism & give two exam examples.
- iii) What is Neel Temperature? Give it's one example.
- iv) Define paramagnetic & diamagnetic substances with suitable example.

b) Explain experimental magnetic moment of the followings. [3]

- i) $\text{Co}^{2+} \mu_{\text{expt.}} = \sim 5.2 \text{ BM}$ At.No. 27
- ii) $\text{Fe}^{2+} \mu_{\text{expt.}} = \sim 5.5 \text{ BM}$ At.No. 26

Q2) a) Attempt any one of the following. [6]

- i) Discuss the structure & magnetic interaction in spinels.
- ii) Write a note on anti-ferromagnetic materials.

b) Answer any two of the following. [6]

- i) Describe potential energy for high spin cross-over complex.
- ii) Explain temperature independent paramagnetism.
- iii) Explain magnetic exchange interaction.

P.T.O.

- Q3) a)** Attempt any one of the following. [6]
- i) Write Van-Vleck equation. Give the application of it.
 - ii) Give in brief an account of Gouy method.
- b)** Attempt any two of the following. [6]
- i) Define photoinduced magnetism with suitable mechanism.
 - ii) Distinguish soft & Hard ferrites.
 - iii) Write a note on spin canting.

SECTION - II

(Inorganic Polymer)

- Q4) a)** Answer the following. [8]
- i) What is homopolar inorganic polymer? Give its example.
 - ii) What are polysilanes? Give their general formula.
 - iii) Draw the structure of Borazole. Give any one reaction of it.
 - iv) Define coordination polymer with suitable example.
- b)** Give detail classification of polymers. [3]
- Q5) a)** Attempt any one of the following. [6]
- i) What is degree of polymerisation? Discuss relationship between average degree of polymerisation & average molecular weight of polymer.
 - ii) Give the brief an account of synthetic, natural & blended polymers.
- b)** Attempt any two of the following. [6]
- i) Write a note on polythiazole.
 - ii) Explain luminescent inorganic polymers.
 - iii) Discuss the method for preparation of silicon carbide.

Q6) a) Attempt any one of the following. [6]

i) Explain the applications of inorganic polymers with respect to its catalytic and medicinal properties.

ii) Explain steps involved in polymerization process.

b) Attempt any two of the following. [6]

i) Draw structure of hexachlorophosphazenes. Give its chemical reaction with benzene in presence of AlCl_3 .

ii) Write a note on polysiloxanes.

iii) Give the comparison of Inorganic & organic polymers.



Total No. of Questions : 6]

SEAT No. :

[Total No. of Pages : 4

PD3151

[6476]-312

M.Sc. - II

ORGANIC CHEMISTRY

**CHO-601 MJ : Organic Reaction Mechanism and Stereochemistry
(2023 Credit Pattern) (Semester-III) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

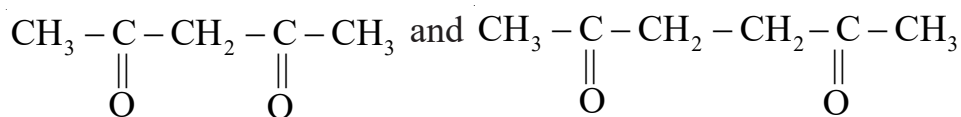
Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Answers to the two sections should be written in separate answer books.*

SECTION - I

Q1) a) Answer the following (any four): **[8]**

- i) Explain crossover experiment with suitable example.
- ii) Which of the following is more acidic? Justify.



- iii) Explain alkylation of enolates with suitable example.
 - iv) Give the significance of Hammett equation.
 - v) Define enamines with suitable example.
- b) Write a short note on Baylis-Hilman reaction. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Predict the sign of Hammett sigma (σ) constant for following substituents.
 - 1) p-NH₂
 - 2) m-CN
 - 3) p-COOH

P.T.O.

- ii) Explain secondary isotope effect with suitable example.
 - iii) Explain the acid catalyzed mechanism of halogenation of acetone.
 - iv) Give the application of enamines in organic synthesis.
- b) Saponification of ethyl m-nitrobenzoate is 63.5 times faster than the unsubstituted ester under the same conditions. What will be the comparable rate of hydrolysis of ethyl-p-methoxy benzoate? [3]

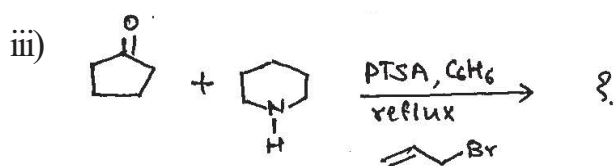
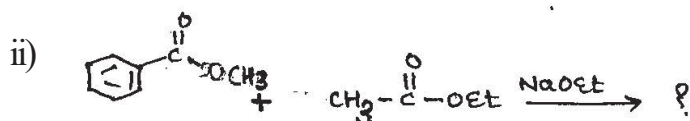
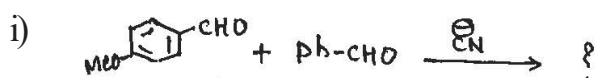
Given: $\sigma_m - \text{NO}_2 = 0.71$

$\sigma_p - \text{OCH}_3 = -0.27$

Q3) a) Answer any two of the following. [8]

- i) Write short note on - Taft equation.
- ii) Explain testing and trapping of intermediate to determine the mechanism of organic reaction.
- iii) Explain the Darzens reaction with mechanism.

b) Predict the product of the following reaction. (any two) [4]



SECTION - II

Q4) a) Answer the following : (Any four) [8]

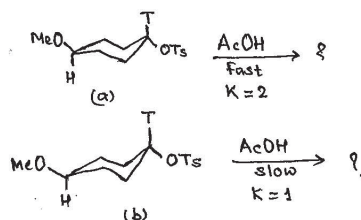
- i) What is Bredt's rule? Explain with suitable example.
- ii) Explain resolution by equilibrium asymmetric transformation.
- iii) Draw the various conformations of cycloheptane.

- iv) CIS-4-hydroxy cyclohexane carboxylic acid undergoes lactonization faster than its trans isomer. Explain.
- v) Explain Von Auwer Skita rule with example.
- b) Draw conformational structures of compound ① and ②. Discuss their stability. [3]

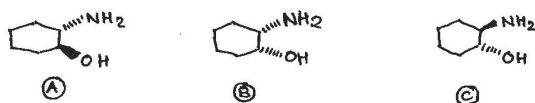


Q5) a) Attempt any Three of the following. [9]

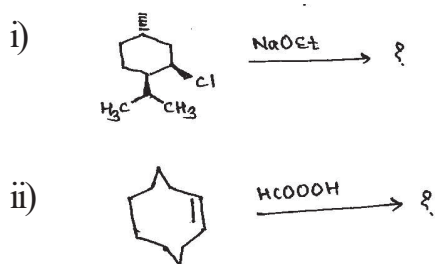
- i) Explain I strain with suitable examples.
- ii) Describe the stability of hydrindanes as a function of temperature. Justify.
- iii) Compare the rate and justify the answer.

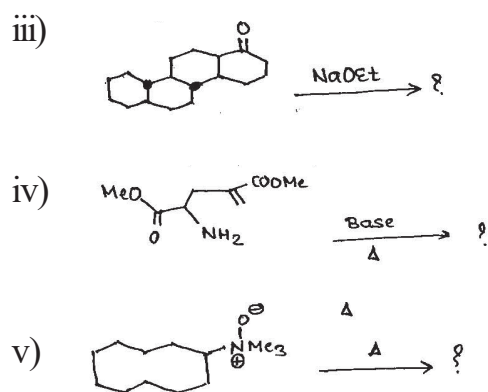


- iv) Describe the method of resolution via molecular complexes.
- b) Write the respective products formed giving mechanism for the reaction of nitrous acid with compounds ④, ⑤ and ⑥. [3]

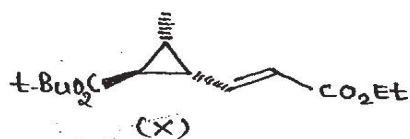


Q6) a) Predict the products in any four of following with stereochemistry. [8]





- b) Interpret the NMR signals on the basis of stereochemistry shown in the compound(X). [4]



NMR data:

δ_H 1.13(3H, d, $J = 8H_2$)
 1.32 (3H, t, $J = 7H_2$)
 1.47 (9H, s)
 1.71 (1H, t, $J = 3H_2$)
 2.2 (1H, ddq, $J = 5, 12, 7H_2$)
 4.3 (2H, q, $J = 8H_2$)
 6.05 (1H, d, $J = 17H_2$)
 6.75 (1H, dd, $J = 17, 12H_2$)



Total No. of Questions : 6]

SEAT No. :

PD3152

[Total No. of Pages : 6

[6476]-313

M.Sc. - II

ORGANIC CHEMISTRY

**CHO-602-MJ : Advanced Spectroscopic Methods in Structure Determination
(2023 Credit Pattern) (Semester - III) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Answers to the two sections should be written in separate answer book.

SECTION - I

Q1) a) Attempt any four of the following : **[8]**

- i) Distinguish following pairs by PMR spectroscopy.



- ii) Distinguish following pairs by CMR spectroscopy.



- iii) Distinguish following pairs by Mass spectrometry.



- iv) Explain the coupling constants observed in the following comps.



- v) ^{13}C - ^{13}C coupling is not observed in CMR. Explain.

- b) DMSO- d_6 shows septet (1:3:6:7:6:3:1) in ^{13}C NMR. Explain. **[3]**

P.T.O.

Q2) a) Deduce the structure using given spectral data (any 3) : **[9]**

- i) An organic compound containing C, H and O gave the following spectral data :

Molecular ion peak at m/z 158

IR : 1767, 1828 and 2857 – 3077 cm^{-1}

^1H NMR : δ 2.70 (septet, $J = 6.7\text{Hz}$, 2H)

1.20 (doublet, $J = 6.7\text{Hz}$ 12H)

- ii) MF : $\text{C}_4\text{H}_6\text{O}_2$

IR : 1770 cm^{-1}

^1H NMR : δ 1.2 (m, 2H), 2.5 (m, 2H), 4.0 (m, 2H)

Mass : 86, 42

- iii) MF : $\text{C}_9\text{H}_8\text{O}_3$

IR : 1661 cm^{-1}

^1H NMR : δ 2.5 (s, 3H)

6.1 (s, 2H)

6.85 (d, $J = 8\text{Hz}$, 1H)

7.44 (d, $J = 1.5\text{Hz}$, 1H)

7.56 (d, $J = 8$ and 1.5Hz , 1H)

^{13}C NMR : δ 26(q), 102(t), 107(d), 121(d), 132(s), 148(s), 151(s), 195(s)

- iv) MF : $\text{C}_7\text{H}_{12}\text{O}_3$

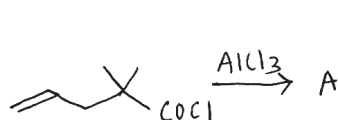
IR : 1720, 1740 cm^{-1}

^{13}C NMR : δ 14, 28, 30, 38, 61, 173, 207

DEPT 90 : No peak

DEPT 135 : 14, 30 up; 28, 38, 61 down; 173, 207 absent

- b) Predict the structure for the product of the following reaction and justify. **[3]**



$M^+ \cdot 110$
 $\nu_{\text{max}} (\text{cm}^{-1}) : 1720$
 $^1\text{H NMR} (\delta) : 1.1 (\text{s}, 6\text{H}), 2.2 (\text{dd}, 3 \& 2\text{Hz}, 2\text{H})$
 $6.2 (\text{dt}, 6 \& 2\text{Hz}, 1\text{H})$
 $7.7 (\text{dt}, 6 \& 3\text{Hz}, 1\text{H})$

Q3) a) Write short notes on (any two). [8]

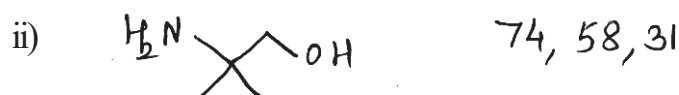
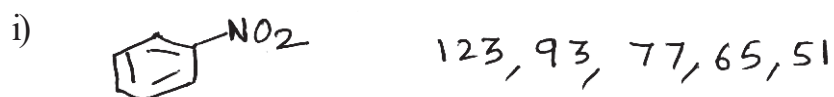
- i) Spin decoupling experiment
- ii) FAB and CI techniques.
- iii) ABX and AMX spin systems.

b) Attempt any two of the following : [4]

- i) Explain use of NOE technique in NMR spectroscopy.
- ii) Find out the intensity ratio of M, M+2, M+4 peaks for the compound containing three bromine atoms.
- iii) Discuss APT technique.

SECTION - II

Q4) a) Write the genesis of the ions. (Any 4) [8]

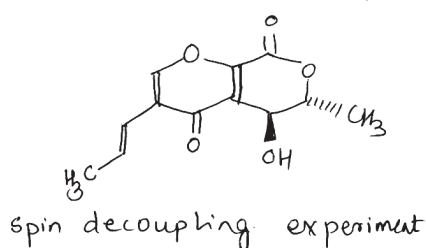


b) A compound with molecular formula $C_8H_{10}O$. Shows the following peaks in its mass. Deduce its structure. $\frac{m}{2} = 92, 91, 77, 65, 51$ [3]

Q5) a) Attempt any two of the following :

[8]

- i) The PMR of compound X. Shows following signals. Assign signals to different protons using decoupling experiment. Justify your answer.

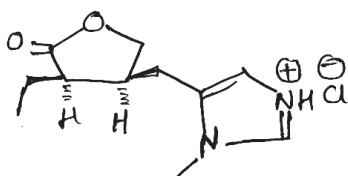


1.65 (3H, d, $J = 7 \text{ Hz}$)
 1.95 (3H, dd, $J = 1.5$ and 7 Hz)
 3.86 (1H, bs, exch)
 3.92 (1H, d, $J = 5 \text{ Hz}$)
 4.32 (1H, dq, $J = 5$ and 7 Hz)
 5.87 (1H, d, $J = 2 \text{ Hz}$)
 6.06 (1H, ddq, $J = 1.5, 2, 16 \text{ Hz}$)
 6.99 (1H, dq, $J = 6$ and 16 Hz)

Irradiation at Change at

- 1) 6.06 5.87(s)
 1.97(d, $J = 6 \text{ Hz}$)
 6.99(q, $J = 6 \text{ Hz}$)
 2) 3.92 4.32(q, $J = 7 \text{ Hz}$)

- ii) Assign the signal to different carbons of compound X and justify.



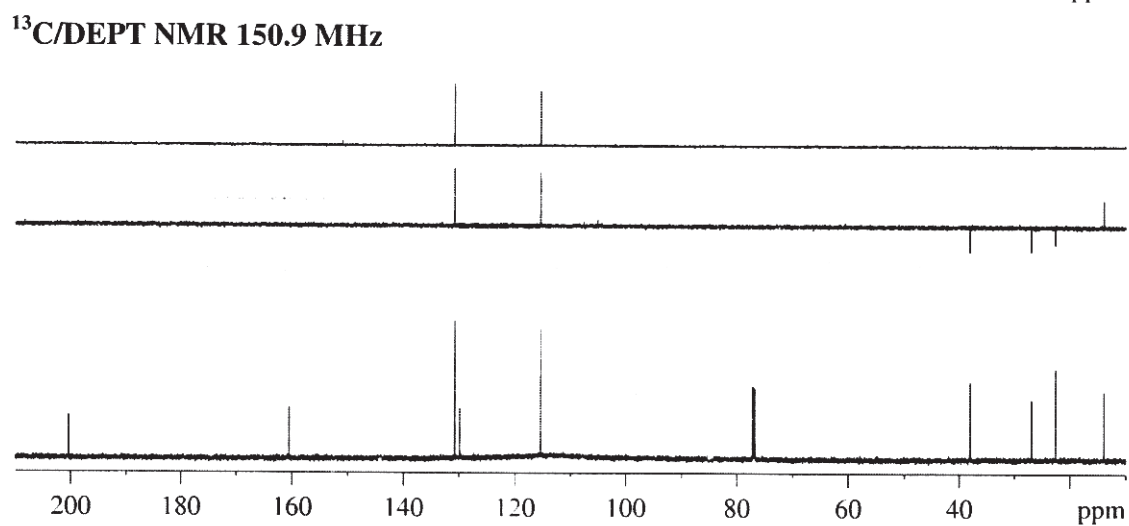
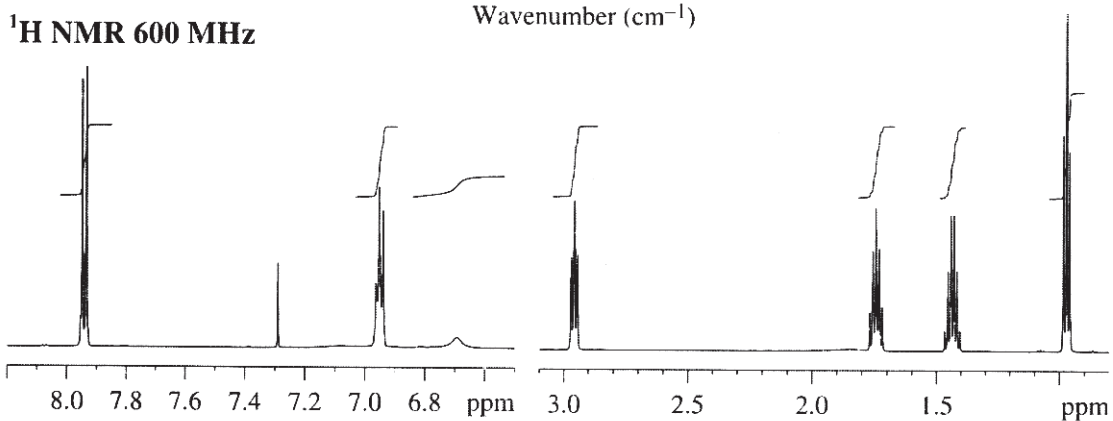
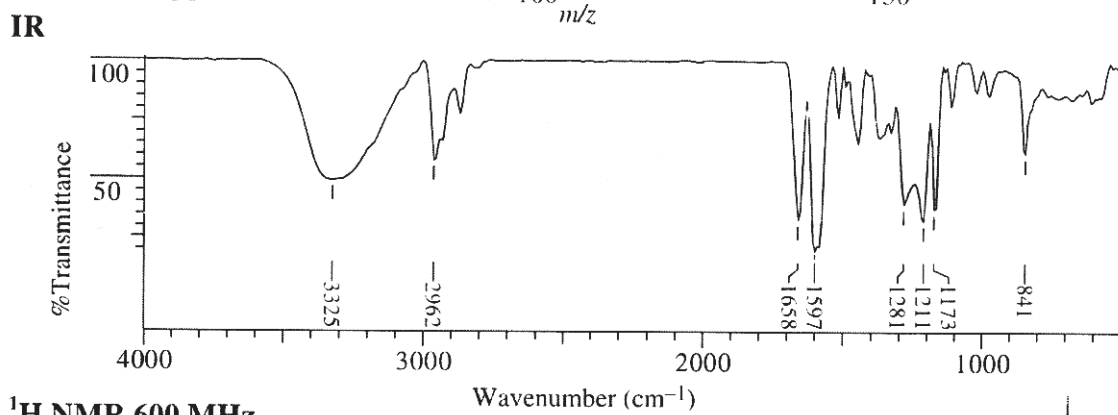
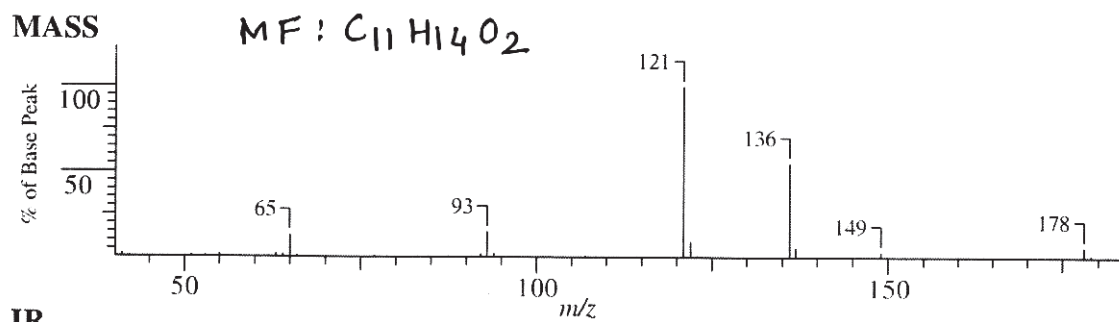
12.2 (q), 18.6 (t), 21.5 (t), 34.1 (q)
 36.8 (d), 45 (d), 71.8 (t), 117.6 (d)
 133.2 (s), 136.1 (d), 182.3 (s)

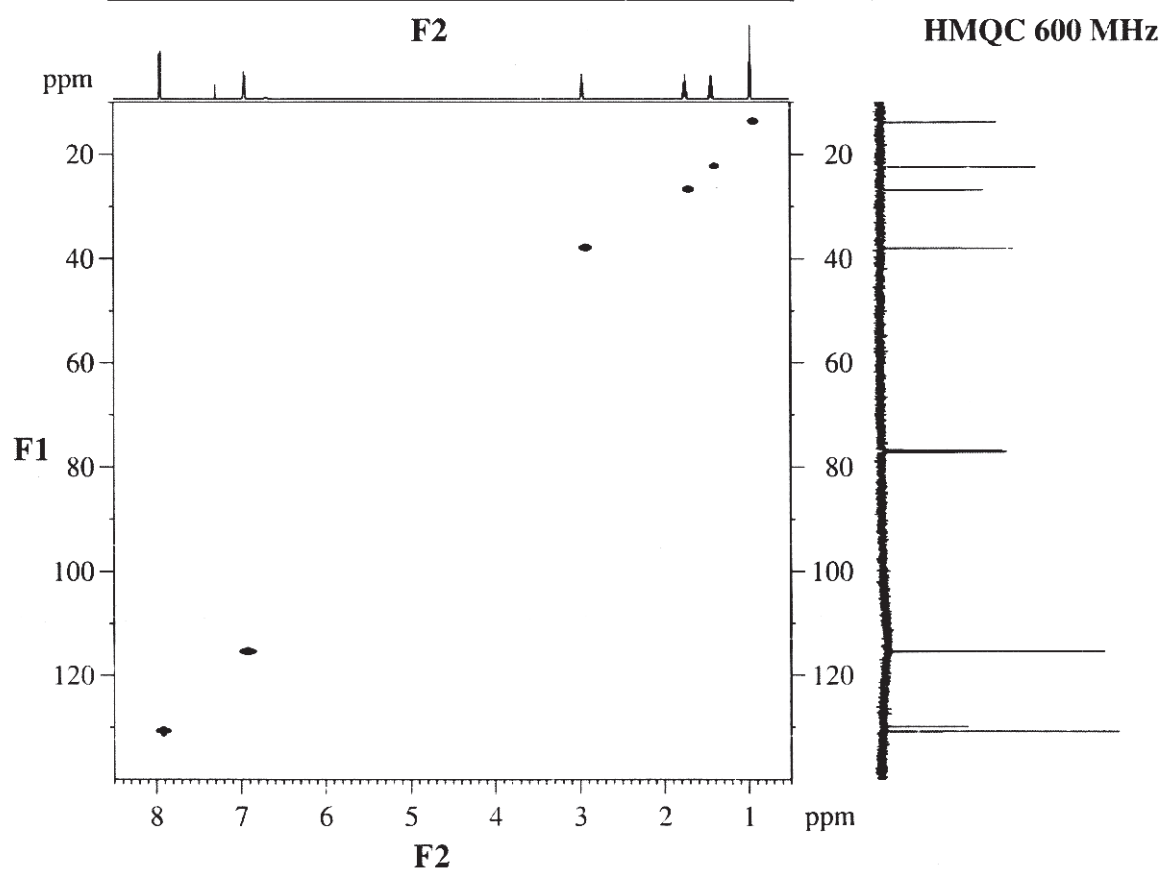
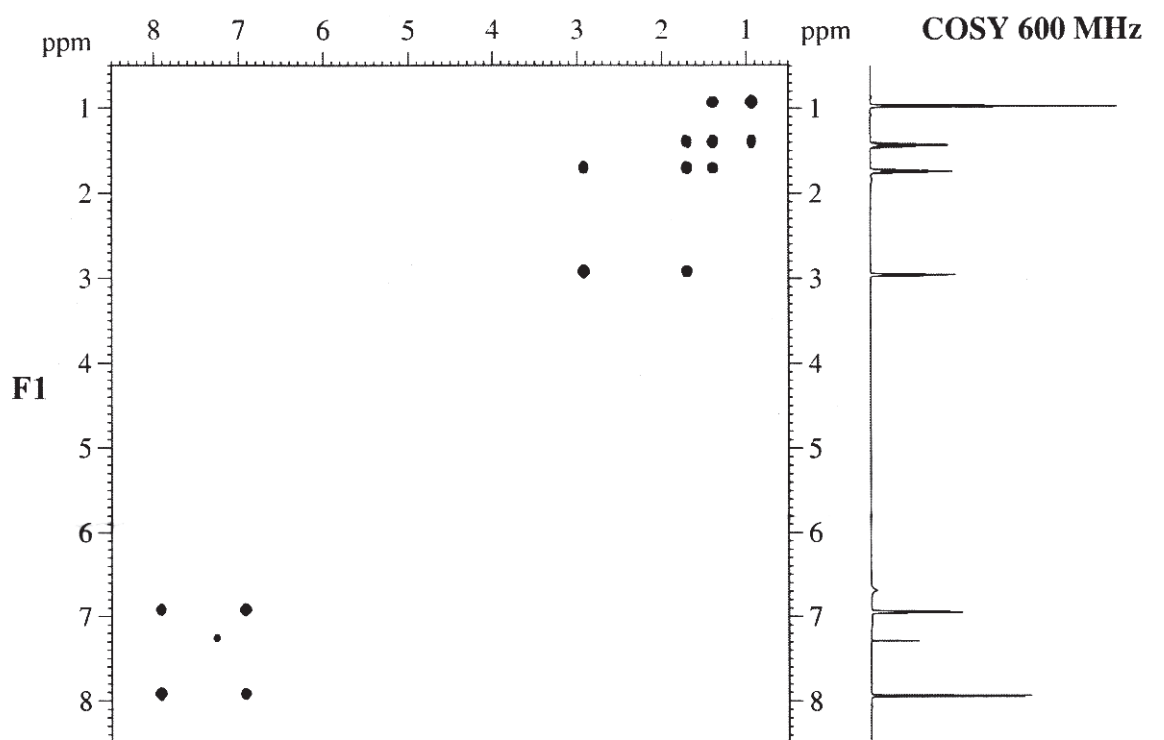
- iii) Write a note on rearrangement in MS.

- b) Explain the applications of any two 2D-NMR techniques. [4]

Q6) a) Bromotrifluorobenzene shows triplet of triplet and doublet of doublet in its ^{19}F NMR and only one peak in its ^1H NMR. Predict possible structures in consistent with this data. [3]

- b) You are provided the spectra of a compound on the adjacent page. Analyze the spectra and arrive at a correct structure. Justify your structure. [9]





Total No. of Questions : 3]

SEAT No. :

PD3153

[Total No. of Pages : 3

[6476]-314

M.Sc. - II

ORGANIC CHEMISTRY

CHO-603-MJ : Heterocyclic Chemistry

(NEP 2023 Credit Pattern) (Semester - III) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

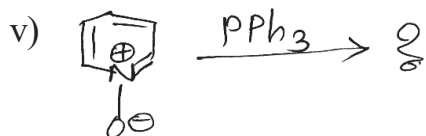
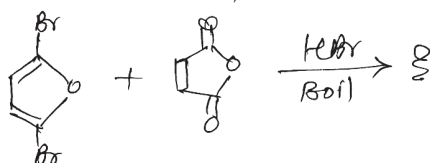
Q1) a) Answer the following (Any Four) :

[8]

- i) Name of the following heterocycles by systematic Hantzsch-Wildman nomenclature system.



- ii) Benzofuran is more stable than Furan towards acid, why?
- iii) Why thiophene is resistant to ring opening than pyrrole?
- iv) Predict the product for the following reaction.



Predict the product for the above reaction.

- b) Write a short note on Fischer-Indole synthesis.

[3]

P.T.O.

Q2) a) Attempt any three of the following : [9]

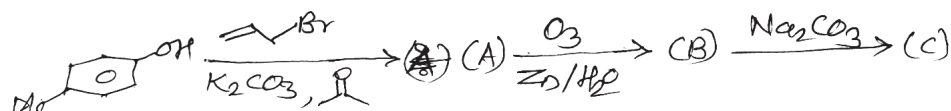
- i) Write the correct order of aromatic character with justification for the following heterocycles.



- ii) 5-methoxy quinoline can not be synthesized easily using Skraup synthesis, explain.
- iii) Predict the product with mechanism for the following.



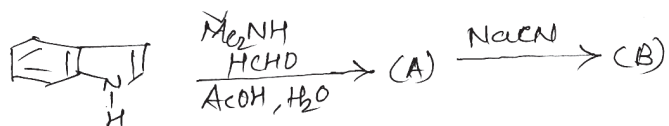
- iv) Predict the products for the following reaction sequence.



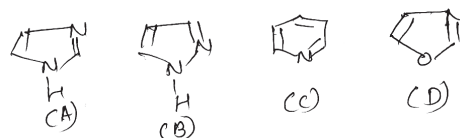
- b) Electrophilic substitution in 4-phenyl pyridine occurs in benzene ring, explain. [3]

Q3) a) Attempt any two of the following : [8]

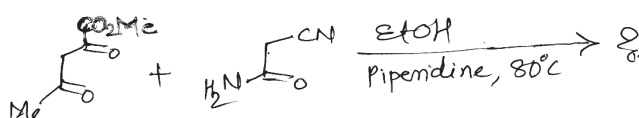
- i) Predict the products with suitable mechanism for the following reaction.



- ii) Arrange the following heterocycles as per their basicity & match the pKa values (Pka = 0.8, 2.5, 5.2 & 7.1) to the corresponding heterocycles. Justify your answer.



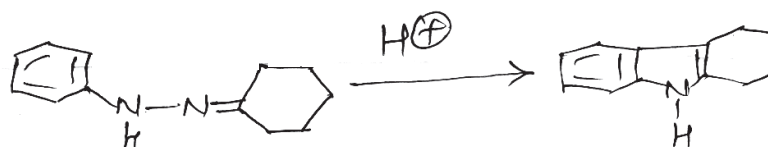
- iii) Predict the product with mechanism for the following reaction.



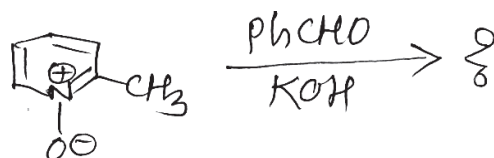
b) Attempt any two of the following :

[4]

- i) Write a short note on Bischler-Napieralski synthesis.
- ii) Write the correct mechanism for the following reaction.



- iii) Predict the product with mechanism for the following reaction.



[6476]-315

M.Sc. - II

ORGANIC CHEMISTRY

CHO-610(A)MJ: Synthetic Methods in Organic Chemistry
(2023 Credit Pattern) (Semester - III)

Time : 2 Hours]

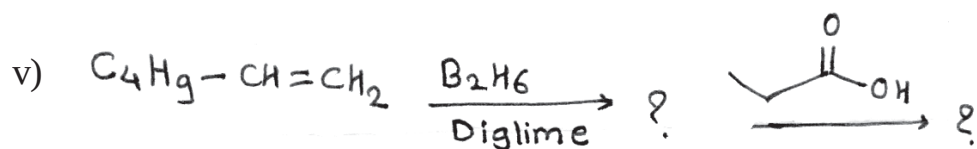
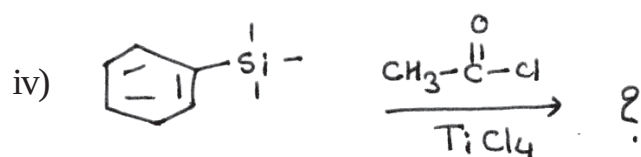
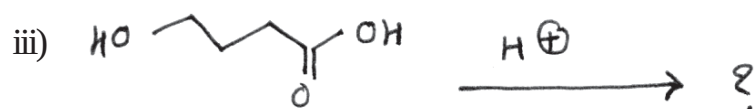
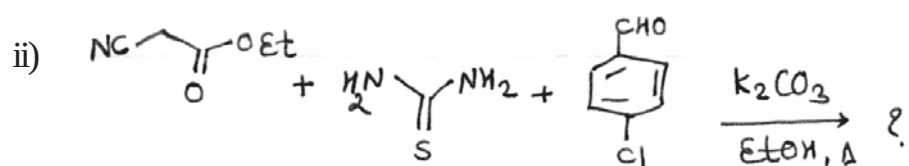
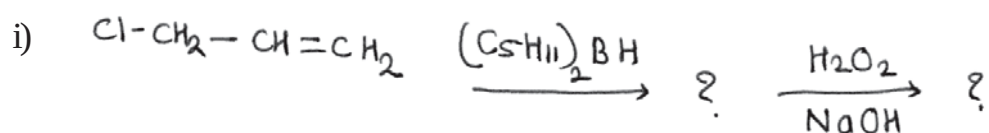
[Max. Marks : 35]

Instructions to the candidates:

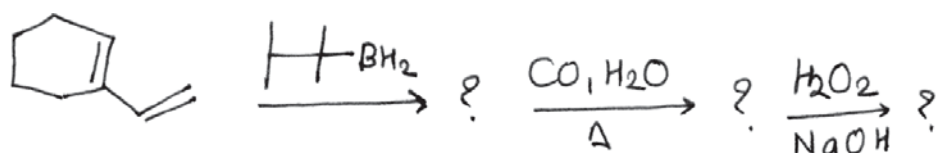
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) a) Predict the Product of the following. (any four)

[8]



b) Complete the following reaction sequence with suitable mechanism. [3]



P.T.O.

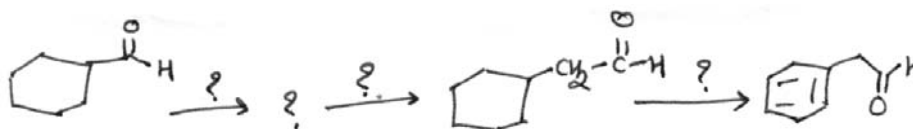
Q2) a) Answer the following. (any 3) **[9]**

- i) Use of g-BBN.
- ii) Horner - Wordworth - Emmons reaction Useful for organic synthesis.
- iii) Acyl anion equivalent can be prepared from enol ether such as methyl-1-propenyl ether.
- iv) Comment on the use of BT- Sulphones in Julia - Lythoge olefination.

b) Explain the pausan - khand reaction with suitable example. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) Write note on Bergman and Nazarov cyclization with suitable example.
- ii) Complete the following reaction sequence with correct explanation.

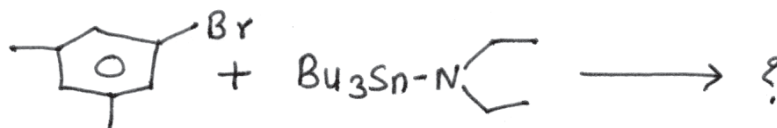


- iii) How will you convert the following conversion with suitable mechanism by organoboron approach.



b) Attempt any two of the following. **[4]**

- i) Synthesis of 1, 2 dicarbonyl compounds by using umpolung activity.
- ii) Use of organo-silicon compound in organic synthesis.
- iii) What is the product of the following reaction.



❗❗❗❗

[6476]-316

M.Sc. - II

ORGANIC CHEMISTRY

CHO-610 (B) MJ : Carbohydrates and Chiron Approach
(2023 Credit Pattern) (Semester - III) (2 Credit)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

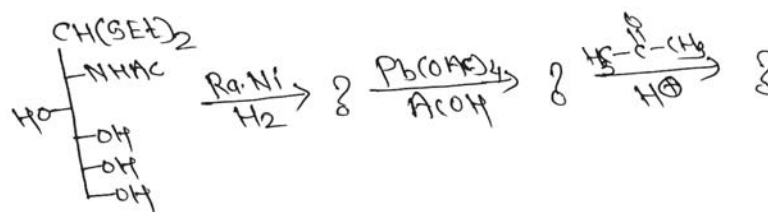
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

Q1) a) Answer the following (Any 4) [8]

- i) Why anomeric carbon is more reactive?
 - ii) Why carbohydrates are preferred as chiron for the synthesis of chiral molecules?
 - iii) Explain oxidative cleavage of benzylidene acetals.
 - iv) Write the retrosynthetic analysis of L(+) alanine.
 - v) Write the structure of C-2 epimer of the D-Glucose.
- b) Describe the role of oxidation studies using HIO_4 in Carbohydrate chemistry. [3]

Q2) a) Attempt any three of the following. [9]

- i) Write short note on trialkylsilyl protection.
- ii) Predict the products in following reaction.



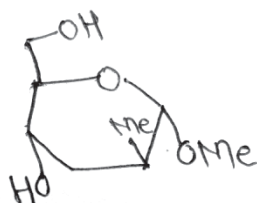
- iii) Explain the synthesis of (S) - epichlorohydrin from D-mannitol
 - iv) Show how D-Glucose is converted to α , β - D - Glucopyranose and α , β - D - Glucofuranose.
- b) Write the Killiani Fischer synthesis for the conversion of aldotetrose to aldopentose. [3]

P.T.O.

Q3) a) Attempt any two of the following.

[8]

i) Write the synthesis of (-) multistriatin from.



ii) What are glycosyl donors? Give any two examples of glycosyl donors.

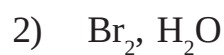
iii) Write the steps involved in following conversion.



b) Attempt any two of the following.

[4]

i) Give the reactions of D-Glucose with following reagents



ii) Write short note on mutarotation.

iii) What is glycosylation? Suggest any one promoter for glycosylation.

* * *

Total No. of Questions : 3]

SEAT No. :

PD3156

[Total No. of Pages : 2

[6476]-317

M.Sc. - II

ORGANIC CHEMISTRY

**CHO - 610 (C) MJ : Medicinal Chemistry
(2023 Credit Pattern) (Semester - III) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Figures to the right indicate full marks.*

Q1) a) Answer any four from following. [8]

- i) What is drug?
- ii) Give importance of proteins in drug design.
- iii) Give definition of partition coefficient.
- iv) What is mean by infectious diseases?
- v) Give definition of generic drugs?

b) What is mean by vaccines? [3]

Q2) a) Attempt any three of the following. [9]

- i) Explain pharmacokinetics of drug.
- ii) What is mean by target identification?
- iii) Write short note on biological assay's.
- iv) Discuss antiviral agents.

b) What is anti-cancer drug? Give the mode of action of it. [3]

P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) Draw the structure of oxamniquine and explain mechanism of action.
- ii) What is sulphonamides? Explain their mode of action.
- iii) What is SAR? Explain with suitable examples.

b) Attempt any two of the following. **[4]**

- i) What is Non-infectious diseases?
- ii) What is mean by regression study in drug design?
- iii) Give any two examples for antimalarial drug.

* * *

Total No. of Questions : 6]

SEAT No. :

PD3157

[Total No. of Pages : 3

[6476]-318

M.Sc.-II

ANALYTICAL CHEMISTRY

CHA - 601 - MJ : Thermal and Extraction Techniques in Analytical Chemistry

(2023 Credit Pattern) (Semester - III) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of log table and calculator is allowed.
- 4) Answers to two the sections should be written on separate answer sheets.

SECTION - I

Q1) a) Answer the following (any 4). **[8]**

- i) Explain thermomechanical analysis.
- ii) Define the term power compensated DSC and heat flux DSC.
- iii) What is crystalline phase transition?
- iv) Which different physical and chemical changes easily noted from DTA curve?
- v) What are components of thermobalance? Discuss important features of thermobalance.

b) Explain simultaneous TG-DSC and give its applications. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) What are advantages of DTA over TGA.
- ii) Explain detection and identification of evolved gases by EGA.
- iii) Write a note on TA - Infrared.
- iv) Give in detail any three factors affecting thermal analysis.

b) In thermometric analysis of 0.35g of Ca(OH)_2 the loss in weight at different temperature was **[3]**

- i) 0.018g at 100-150°C (loss of hygroscopic water)
- ii) 0.038g at 500-560°C (dehydration)
- iii) 0.022g at 900-950°C (dissociation)

Determine the composition of calcium hydroxide.

P.T.O.

- Q3) a)** Attempt any two of the following. **[8]**
- i) Explain instrumentation of TMA.
 - ii) Draw and explain TG curve of copper sulphate pentahydrate $[\text{CuSO}_4 \cdot 5\text{H}_2\text{O}]$.
 - iii) Write a note on 'TG - MS' analysis.
- b)** Attempt any two of the following. **[4]**
- i) Explain how change in atmosphere affect TGA analysis.
 - ii) Write a note on dielectric thermal analysis.
 - iii) Mention which types of thermal changes can be detected by DSC method.

SECTION - II

- Q4) a)** Answer the following (any 4): **[8]**
- i) What are the function of SPME holder?
 - ii) Write five stages of SPE.
 - iii) Enlist the post extraction technique.
 - iv) What is end - capping?
 - v) Define distribution ratio and distribution coefficient.
- b)** A metal chelate was extracted to the extent of 80% when equal volumes of aqueous and organic phases were shaken together? What will be the % extraction if the valume of the organic phase is tripled? **[3]**
- Q5) a)** Attempt any three of the following. **[9]**
- i) Discuss the process of pressurized microwave assisted extraction with a schematic diagram.
 - ii) Explain in detail determination of lead by solvent extraction.
 - iii) Explain in detail SPE formats & apparatus.
 - iv) Give theoretical considerations of SPME.
- b)** Calculate the milligrams of iron (III) left unextracted from 100 ml of a solution having 200 milligrams of Fe (III) and in 6m HCl after three extractions with 25ml of ethyl ether. The value of D for this extraction is 150. **[3]**

Q6) a) Attempt any two of the following. **[8]**

- i) Discuss principle of operation of soxhlet extraction with a schematic diagram.
- ii) Explain in detail purge & trap technique.
- iii) Discuss types of SPE media.

b) Attempt any two of the following. **[4]**

- i) Draw a schematic of the layout of a typical pressurized fluid extraction system.
- ii) Write note on Stir - Bar Sorptive Extraction (SBSE).
- iii) Explain microextraction in a packed syringe (MEPS).



Total No. of Questions : 6]

SEAT No. :

PD3158

[Total No. of Pages : 3

[6476]-319

M.Sc. - II

ANALYTICAL CHEMISTRY

**CHA-602-MJ: Advanced Chromatographic Methods
of Chemical Analysis
(2023 Credit Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answer of two sections must be written on two separate answer books.*
- 3) *Figures to right indicate full marks.*
- 4) *Use of logarithmic tables and calculator is allowed.*

SECTION - I

Q1) a) Answer any four of the following. **[8]**

- i) What is the principle of liquid-gas chromatography?
 - ii) Retention of for substance A and B is observed at time 12.6 and 14.5 min. Base width of peak for both peak same and its 2.2 min. Calculate resolution (R_s).
 - iii) What is head-space injection in gas chromatography?
 - iv) What is supercritical fluid chromatography?
 - v) What is the function of interface in ac-ms?
- b) Gas chromatographic analysis of pesticide residue was done after extraction of pesticide in organic solvent. 109 sample was extracted 25 ml solvent and, analysed. It showed peak of pesticide at 12.58 min of area 122 mV min. The standard containing 0.001 mg in 25 ml solvent showed peak of area 150 mV min. Calculate PPM of pesticide in sample. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Write note on supercritical fluid extraction.
 - ii) Explain identification of compounds using reference spectra matching in GC - MS.
 - iii) Write note on quantitative analysis by gas chromatography.
 - iv) Explain construction and working of electron capture detector.
- b) Formaldehyde from aqueous sample was analysed by GC. A standard sample containing 50 PPM formaldehyde showed peak at 3.92 min having peak height 12.2 mV. A sample of water showed peak at 1.25, 2.98, 3.92, 5.26 and 12.81 min of height 17.2, 6.5, 8.93, 1.33 and 5.75 mV. Calculate mg of formaldehyde in 100 ml water. **[3]**

P.T.O.

- Q3) a)** Answer any two of the following. **[8]**
- i) Draw block diagram of instrument for SFC and explain function of each component.
 - ii) Draw schematic diagram of a gas chromatograph and explain function of each component.
 - iii) Explain classical theory of chromatography in detail.
- b)** Answer any two of the following. **[4]**
- i) Write equation for retention factor (k) and selectivity (α) and meaning of terms in both equations.
 - ii) Write any four applications of GC-MS.
 - iii) What is the difference between packed and capillary column in GC?

SECTION - II

- Q4) a)** Answer any four of the following. **[8]**
- i) Why HPLC is considered as powerful technique.
 - ii) Describe functions of pumps in HPLC.
 - iii) What is the effect of particle size of stationary phase on HPLC resolution?
 - iv) What is indirect detection in HPLC?
 - v) Explain Hydrophilic interaction chromatography.
- b)** A sample what is ion exchange chromatography? Explain different types of ion exchangers. **[3]**
- Q5) a)** Answer any three of the following. **[9]**
- i) Describe how mobile phase is selected and prepared for HPLC.
 - ii) Write a note on fluorescence detector.
 - iii) Give applications of LCMS.
 - iv) What is precolumn derivatisation? Give its advantages.
- b)** The sample was analysed by HPLC by Calibration curve method. Calibration curve was set by 0.01 to 0.05 mg/ml standard. The slope of line peak area against concentration of standard is 10×10^3 . If 0.1g sample dissolved in 500 ml sample showed peak area 720 then calculate mg of sample in 0.1g quantity. **[3]**

Q6) a) Attempt any two of the following. **[8]**

- i) What are mass sensitive detector? Describe working of refractive index detector with suitable diagram.
- ii) Describe thermospray interface in LCMS. Give its advantages and disadvantages.
- iii) Explain principle of size exclusion chromatography. Give applications of size exclusion chromatography.

b) Attempt any two of the following. **[4]**

- i) Give functions of precolumn in HPLC.
- ii) What is indirect detection in HPLC.
- iii) What is drift in baseline? How it can be eliminated?



Total No. of Questions : 3]

SEAT No. :

PD3159

[Total No. of Pages : 2

[6476]-320

M.Sc. - II

ANALYTICAL CHEMISTRY

CHA-603-MJ : Applied Electro-analytical Techniques
(2023 Credit Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logtable and calculator is allowed.

Q1) a) Attempt any four of the following : **[8]**

- i) Distinguish between polarography and hydrodynamic voltammetry.
- ii) What is indicator electrode? Give the application of antimony-antimony oxide electrode.
- iii) Why stripping voltammetry is more sensitive than the other voltammetric techniques?
- iv) What is the interference of dissolved oxygen in polarographic analysis?
- v) What type of excitation signal is applied in cyclic voltammetry?

b) Solve the following : **[3]**

Calculate the electrode potential of a half cell consisting of cadmium electrode immersed in a solution that is 0.0150M in Cd^{2+} ?

(Given $E^\circ \text{Cd}^{2+}/\text{Cd} = -0.403\text{V}$)

Q2) a) Attempt any three of the following : **[9]**

- i) How the course of reversible, quasi reversible and irreversible redox reactions are studied by cyclic voltammetry?
- ii) What is membrane electrode? Show the construction of ion exchange electrode.
- iii) What is hydrodynamic voltammetry? Explain its application as a detector in liquid chromatography.
- iv) What is pulse voltammetry? Distinguish between differential pulse voltammetry and square wave voltammetry.

P.T.O.

- b) A sample of $8.0 \times 10^{-4} \text{M}$ of metal ion in a 0.2M KCl solution gives diffusion current of $7.10 \mu\text{A}$, when mercury flow rate and mercury drop time were 3.0 mg/sec and 5.0 second respectively. If diffusion coefficient of metal ion is $7.0 \times 10^{-6} \text{ cm}^2/\text{sec}$. Determine the number of electrons involved in the reduction process. [3]

Q3) a) Attempt any two of the following : [8]

- i) What is membrane electrode? Draw the construction of pH-sensitive glass membrane electrode. Give the representation of the cell when glass electrode is used in combination with calomel electrode for pH-measurement.
- ii) Draw the ideal cyclic voltammogram for a suitable redox reaction. Explain the method of determination of half wave potential from this voltammogram.
- iii) Draw the schematic representation of dropping mercury electrode? Explain the term drop time & mercury flow rate with their units.

b) Attempt any two of the following : [4]

- i) Distinguish between anodic stripping voltammetry & cathodic stripping voltammetry with respect to their analytical working.
- ii) Explain the significance of working electrode and reference electrode involved in polarographic cell.
- iii) Why pulse polarography is more sensitive than classical polarography?



Total No. of Questions : 3]

SEAT No. :

PD3160

[Total No. of Pages : 2

[6476]-321

M.Sc. - II

ANALYTICAL CHEMISTRY

**CHA-610(A)MJ: Analytical Methods of Examining of Water and Soil
(2023 Credit Pattern) (Semester - III) (Credits -2)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of log table and calculator is allowed.*

Q1) a) Solve any four of the following. **[8]**

- i) What are the sources of cadmium in water? Mention two health effects of cadmium on humans.
 - ii) What are polychlorinated biphenyls? Give one example.
 - iii) Mention any four techniques used for the drying of agricultural samples.
 - iv) What is dispensing errors? Give one example of it.
 - v) What effective cation exchange capacity?
- b) K^+ from soil is analysed by flame photometry. Standard solution of K^+ of conc 2, 4, 6, 8 and 10 microgram per ml showed flame intensity 12, 23, 38, 51 and 71 units. 10g sample extracted in 100 ml water flame intensity 26 units. Calculate microgram of soil in 100 g soil. (use calibration curve method) **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Discuss nitric acid digestion method of water sample for analysis of metals.
 - ii) Explain analysis of Na^+ & K^+ from soil by flame photometric method.
 - iii) Discuss estimation of bromide by phenol red method.
 - iv) How lime requirement of soil is determined?
- b) 100 ml water sample required 10-2 ml 0.01 m Na_2 EDTA for complete complexation. Calculate hardness of water sample in PPM (mol.wt. of $Ca Co_3 = 100g$). **[3]**

P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) Discuss in detail AAS method for the determination of metals from water sample.
- ii) Explain micro-kjeldahl method for estimation of ammonia from water sample.
- iii) How extractable phosphorous from soil is determined by manual method? Discuss in detail.

b) Attempt any two of the following. **[4]**

- i) How soil moisture is determined?
- ii) How turbidity of water sample is determined? What is the importance of turbidance measurement of water?
- iii) What is COD?



Total No. of Questions : 3]

SEAT No. :

PD3161

[Total No. of Pages : 2

[6476]-322

M.Sc. - II

ANALYTICAL CHEMISTRY

CHA-610 (B) MJ : Clinical Analytical Chemistry

(2023 Credit Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Q.1 to Q.3 are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of log tables & calculators are allowed.

Q1) a) Answer the following (any 4) [8]

- i) Explain in short the method for collection of venous blood.
 - ii) Draw the structure of vitamin-C.
 - iii) Define the term Toxicology.
 - iv) What are the deficiency symptoms of vitamin B-2.
 - v) Write about changes in urine on storage.
- b) Give a detailed account of the determination of blood haemoglobin. [3]

Q2) a) Attempt any three of the following. [9]

- i) Explain in brief the procedure for determination of urea in urine by urease method.
 - ii) Discuss in detail the LC-MS/MS method for Quantification of Leflunomide metabolite in human serum.
 - iii) Estimation of vitamin - A by spectrometry.
 - iv) Explain method for estimation of Na, K and Ca by flame photometry.
- b) Unknown blood sample of patient were analysed for inorganic phosphate by TCA method. The absorbance of sample is 0.088 and absorbance of standard is 0.110. Calculate the concentration of inorganic phosphate in given sample. [3]

[Given:- Conc. of standard phosphate = 2 mmol/lit]

P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) Give the detailed procedure for fluorimetric determination of xanthurenic acid.
- ii) Explain in detail the principle and procedure of analysis of Benzodiazepines in urine for abuse settings.
- iii) Explain the procedure for determination of serum bilirubin.

b) Attempt any two of the following. **[4]**

- i) What is preservative? Enlist the blood preservatives.
- ii) Define vitamins. Enlist the water soluble vitamins.
- iii) Give the principle of simultaneous determination of Tacrolimus and cyclosporine A in whole blood.

* * *

[6476]-323

M.Sc. - II (Analytical Chemistry)

**CHA-610 (C) MJ : FORENSIC ANALYTICAL CHEMISTRY
(2023 Credit Pattern) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of scientific calculator is allowed.*

Q1) a) Attempt any four of the following **[8]**

- i) What is fire investigation?
- ii) What is heroin?
- iii) Give the hazards of drug abuse.
- iv) Write Weber test.
- v) Write the name and structure of most active psychoactive compound present in cannabis.

b) A drug sample of phenethylamines (P_1 , P_2 and P_3) was analysed by TLC and the solvent front was at 8cm. If the samples P_1 , P_2 and P_3 were spotted at 3cm, 4.5cm and 5.5cm respectively, calculate the R_f value of each sample. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Discuss any two aqueous test reagents.
- ii) What are schedule II drugs?
- iii) Write a note on vapour phase detection.
- iv) What are chemical colour tests? Give their limitations.

b) A diamorphine sample was analysed by LC method and gave following observations- $C_s = 2.5 \mu\text{g/ml}$, $P_s = 3.5 \text{ mAUmin}$, $P_x = 4.5 \text{ mAUmin}$, $A_s = 6.5 \text{ mAUmin}$, $A_x = 5.5 \text{ mAUmin}$.

Calculate the concentration of diamorphine in the sample. **[3]**

P.T.O.

Q3) a) Attempt any two of the following [8]

- i) Write the Widmark's equation and discuss the significance of each variable in it.
- ii) Explain the physical & physiological effects of mescaline and ephedrine.
- iii) Discuss the chemical identification of cannabis.

b) Attempt any two of the following. [4]

- i) What are the disadvantages of microcrystal techniques?
- ii) What different forms of cannabis are generally encountered in forensic laboratory?
- iii) Write the names & structures of two controlled substances present in Khat.

* * *

Total No. of Questions : 6]

SEAT No. :

PD3163

[6476]-401

[Total No. of Pages : 4

M.Sc. -II

PHYSICAL CHEMISTRY

CHP-651-MJ : Molecular Structure and Spectroscopy
(2023 Credit Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer of two section should be written in SEPARATE answer books.
- 2) All questions are COMPULSORY.
- 3) Figure to RIGHT SIDE indicates FULL marks.
- 4) Use of logarithmic table, calculator is ALLOWED.
- 5) Neat diagrams must be drawn WHEREVER necessary.

Physico - Chemical Constants

1. Avogadro Number	N	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ Js}$
4. Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	$= 96487 \text{ C equivalent}^{-1}$
8. Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		$= 1.673 \times 10^{-24} \text{ kg}$
11. Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

Q1) a) Attempt any Four of the following. **[8]**

- i) Define the term coupling constant in NMR.
- ii) State Larmor equation and the terms involved init.
- iii) Give the applications of NQR.
- iv) Define Kramer's degeneracy.
- v) Explain the factors affecting width of ESR spectra.

b) Predict the nature of ESR spectra of $^{14}\text{NH}_3$. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Discuss the factors affecting chemical shift.
- ii) Explain the concept of electric field gradient.
- iii) Give the advantages of FT - NMR.
- iv) Write a note on NOE.

b) Explain the term spin density with respect to ESR spectroscopy. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) Describe the instrumentation used in NQR spectroscopy with suitable diagram.
- ii) Discuss the application of NMR spectroscopy in medical diagnosis.
- iii) Explain the principle of ESR. Why is the source from microwave region?

b) Attempt any one of the following. **[4]**

- i) Calculate the frequency required to excite proton from $M_I = \frac{1}{2}$ to $M_I = -\frac{1}{2}$ at magnetic field applied of 1.5T (Given $g_N = 5.585$. $B_N = 9.273 \times 10^{-24} \text{J/T}$).
- ii) Calculate NMR frequency of ^{35}Cl in a magnetic field of intensity 1.8T (Given $I = \frac{3}{2}$).

SECTION - II

Q4) a) Attempt any Four of the following. **[8]**

- i) State and explain Bragg's diffraction law.
- ii) What are the two major limitations of electron diffraction technique?
- iii) Enlist the applications of neutron diffraction technique.
- iv) State and explain Langevin equation.
- v) Define unit cell.

b) Discuss any three applications of x-ray diffraction technique. **[3]**

Q5) a) Attempt any three of the following. **[9]**

- i) Draw a neat labelled diagram of experimental arrangement of electron diffraction technique and describe it.
- ii) What is scattering intensity and scattering angle?
- iii) What are the factors which contribute to a paramagnetism in a substance?
- iv) Write a note on Ferro and AntiFerro magnetism.

b) How electron diffraction method is used for elucidation of structure of simple gas phase molecule? **[3]**

Q6) a) Attempt any two of the following. **[8]**

- i) Write a note on indexing in x-ray diffraction.
- ii) Describe Gouy method for the measurement of magnetic susceptibility.
- iii) Enlist the measurement techniques used in neutron diffraction analysis. Explain any one in brief.

b) Attempt any one of the following. **[4]**

- i) Calculate the spin only moment for a metal complex with 3 unpaired electrons.
- ii) Calculate the molar magnetic susceptibility of acetate ($\text{C}_2\text{H}_3\text{O}_2^-$) ion.

$$\text{Given } \chi_c = -6.00 \times 10^{-6} \text{ cgs unit}$$

$$\chi_H = -2.93 \times 10^{-6} \text{ cgs unit}$$

$$\chi_{\text{O}_2} (\text{carboxylate}) = -75.9 \times 10^{-6} \text{ cgs unit.}$$



Total No. of Questions : 6]

SEAT No. :

PD3164

[Total No. of Pages : 3

[6476]-402

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-652-MJ : Surface Chemistry and Electrochemistry
(2023 Credit Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer of two sections should be written in separate answer books.
- 2) All questions are compulsory.
- 3) Figures to the right side indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico-Chemical Constants

- | | |
|-------------------------|---|
| 1) Avogadro Number | $N = 6.023 \times 10^{23} \text{ mol}^{-1}$ |
| 2) Boltzmann Constant | $k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$ |
| 3) Planck Constant | $h = 6.626 \times 10^{-16} \text{ erg s}$
$= 6.626 \times 10^{-34} \text{ J s}$ |
| 4) Electronic Charge | $e = 4.803 \times 10^{-10} \text{ esu}$
$= 1.602 \times 10^{-19} \text{ C}$ |
| 5) 1 eV | $= 23.06 \text{ k cal mol}^{-1}$
$= 1.602 \times 10^{-12} \text{ erg}$
$= 1.602 \times 10^{-19} \text{ J}$
$= 8065.5 \text{ cm}^{-1}$ |
| 6) Gas Constant | $R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7) Faraday Constant | $F = 96487 \text{ C equivalent}^{-1}$ |
| 8) Speed of light | $c = 2.997 \times 10^{10} \text{ cm s}^{-1}$
$= 2.997 \times 10^8 \text{ m s}^{-1}$ |
| 9) 1 cal | $= 4.187 \times 10^7 \text{ erg}$
$= 4.187 \text{ J}$ |
| 10) 1 amu | $= 1.673 \times 10^{-27} \text{ kg}$ |
| 11) Bohr Magneton | $\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$ |
| 12) Nuclear Magneton | $\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$ |
| 13) Mass of an electron | $m_e = 9.11 \times 10^{-31} \text{ Kg}$ |

P.T.O.

SECTION - I

Q1) a) Attempt any four of the following : **[8]**

- i) Define Porous solids and give their types.
- ii) What is capillary condensation?
- iii) What is wetting phenomenon?
- iv) Give the assumptions on which Langmuir adsorption isotherm is based on.
- v) Define the following:
 - 1) Adsorbent
 - 2) Adsorbate

b) Explain the gravimetric method for measurement of adsorption. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Explain the mechanism of chemisorption on transition metal.
- ii) Discuss the mechanism of Detergency.
- iii) Explain the mercury porosimeter method for determination of pore size.
- iv) Distinguish between physisorption and chemisorption.

b) Describe the microtome method for verification of Gibb's equation. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) Discuss the potential theory for multilayer adsorption.
- ii) Derive the expression for enthalpy of adsorption.
- iii) Discuss the froth flotation technique.

b) Attempt any two of the following. **[4]**

- i) Write Clausius Clapeyron equation and explain the terms.
- ii) Define the term surface tension and give its unit.
- iii) What is hysteresis of adsorption.

SECTION - II

- Q4) a)** Attempt any four of the following : **[8]**
- i) What is zeta potential?
 - ii) Give limitation of Helmholtz theory of Double layer.
 - iii) Define the terms activity and activity coefficient.
 - iv) What is diffusion? Explain with suitable example.
 - v) Why does Debye-Huckel limiting law is referred as limiting law.
- b) Describe the Gouy-Chapman diffuse layer theory. **[3]**
-
- Q5) a)** Attempt any three of the following. **[9]**
- i) Write the Butler-Volmer equation and explain the terms.
 - ii) Write a note on lithium ion battery.
 - iii) Deduce Debye-Huckel limiting law.
 - iv) What are the ways of transport of ion?
- b) Write a note on Tafel plot. **[3]**
-
- Q6) a)** Attempt any two of the following. **[8]**
- i) Derive the Einstein relation between absolute mobility and the diffusion coefficient.
 - ii) Find the ionic strength of following solution. Assuming complete dissociation 400ml 0.2m Na_3PO_4 + 100 ml 0.4m ZnCl_2 .
 - iii) Derive the expression for mean activity coefficient for finite size ion.
- b) Attempt any two of the following. **[4]**
- i) Explain the terms absolute mobility and conventional mobility with their units.
 - ii) What is liquid junction potential?
 - iii) Define the terms:
 - 1) Fuel cell
 - 2) Primary batteries



Total No. of Questions : 3]

SEAT No. :

PD3165

[6476]-403

[Total No. of Pages : 3

M.Sc.-II

PHYSICAL CHEMISTRY

CHP-660 (A) MJ : Material Chemistry
(2023 Credit Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right side indicates full marks.
- 3) Use of logarithmic table, calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1. Avogadro Number	N	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^4 \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ Js}$
4. Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$ $= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
5. 1 eV		
6. Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	$= 96487 \text{ C equivalent}^{-1}$
8. Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$ $= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
9. 1 cal		
10. 1 amu		$= 1.673 \times 10^{-24} \text{ kg}$
11. Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Answer the following. (Any 4) **[8]**
- i) Write general formula for 1-2-3 type super conductors with one examples.
 - ii) What is photolithography? mention of its uses.
 - iii) What is significance of high critical temperature in super conductors?
 - iv) Explain the role of dielectric material in a capacitor.
 - v) Differentiate between half-wave and full-wave rectifier.
- b) Explain the principle of DC sputtering system with the help of suitable diagram. **[3]**
-
- Q2) a)** Attempt any three of the following. **[9]**
- i) Explain three types of capacitor on the basis of dielectric material.
 - ii) What is superconductivity? Explain the types of superconductivity.
 - iii) Explain MOCVD technique.
 - iv) What are the characteristics of 2-1-4 material.
- b) Discuss in detail p-n-p transistor with help of neat diagram. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) Explain the concept of anisotropy in high tech materials.
- ii) What is rectifier? Explain half wave rectifier.
- iii) Differentiate between physical and chemical deposition techniques for thin films.

b) Attempt any two of the following. **[4]**

- i) Give two examples of high critical temperature super conductor.
- ii) What is sputtering in thin film deposition?
- iii) What are optical phonon modes?



Total No. of Questions : 3]

SEAT No. :

PD3166

[Total No. of Pages : 2

[6476]-404

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-660-(B) MJ : Chemistry of Catalysts
(2023 Credit Pattern) (Semester-IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table, calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1. Avogadro Number	N	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
2. Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^4 \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3. Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ Js}$
4. Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6. Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	$= 96487 \text{ C equivalent}^{-1}$
8. Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		$= 1.673 \times 10^{-24} \text{ kg}$
11. Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Attempt any four of the following : **[8]**
- i) Give any four factors which affects the activity of catalyst.
 - ii) Explain the term heterogeneous catalysis.
 - iii) What are auto-exhaust catalysts?
 - iv) Define Photocatalysis.
 - v) Explain Negative Catalysis.
- b)** Describe hydrolysis method for preparation of catalysts. **[3]**
-
- Q2) a)** Attempt any three of the following. **[9]**
- i) Enlist the steps in Langmuir-Hinshelwood mechanism.
 - ii) Describe any one thermal method for catalyst characterization.
 - iii) How is surface area of a powdered solid measured?
 - iv) Explain the principle of Green Chemistry.
- b)** Describe the methods used for activation of catalysts. **[3]**
-
- Q3) a)** Attempt any two of the following. **[8]**
- i) Explain photocatalytic water splitting.
 - ii) Discuss hydrothermal method for catalyst preparation.
 - iii) Describe types of catalysis.
- b)** Attempt any two of the following. **[4]**
- i) Define promotion and deactivation.
 - ii) State principle of AES in catalyst characterization.
 - iii) Explain VOCs.



Total No. of Questions : 3]

SEAT No. :

PD3167

[Total No. of Pages : 2

[6476]-405

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-660(C) MJ : Biophysical Chemistry
(2023 Credit Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of logarithmic table, calculator is allowed.
- 4) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$ $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3.	Planck Constant	h	$= 6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ Js}$
4.	Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5.	1 eV		$= 23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
6.	Gas Constant	R	$= 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	$= 96487 \text{ C equivalent}^{-1}$
8.	Speed of light	c	$= 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9.	1 cal		$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10.	1 amu		$= 1.673 \times 10^{-24} \text{ kg}$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

- Q1) a)** Attempt any four of the following : **[8]**
- i) Explain the functions of cell membrane.
 - ii) Give different test of proteins.
 - iii) Define biological cell and mention its constituents.
 - iv) State and explain Bragg's law.
 - v) Enlist two functions of proteins.
- b)** Explain problem of protein folding. **[3]**
-
- Q2) a)** Attempt any three of the following : **[9]**
- i) Derive mechalis-mention equation for enzyme catalysis.
 - ii) Explain primary, secondary, tertiary structure of proteins.
 - iii) Describe chain configuration and conformation of macromolecule.
 - iv) Distinguish between RNA and DNA.
- b)** Explain hydrolysis of ATP. **[3]**
-
- Q3) a)** Attempt any two of the following : **[8]**
- i) Write a note on competition and inhibition.
 - ii) What are biopolymer? State and explain their characteristics and applications.
 - iii) Explain ionic effect on protein-nucleic acid interactions.
- b)** Attempt any two of the following : **[4]**
- i) Write the Handerson Hasselbalch equation of explain the terms.
 - ii) What are polypeptide and proteins?
 - iii) What is the principle of circular dichorism.



Total No. of Questions : 6]

SEAT No. :

PD3168

[Total No. of Pages : 3

[6476]-406

M.Sc.-II

INORGANIC CHEMISTRY

CHI 651 MJ: Heterogeneous Catalysis and its Applications

(2023 Credit Pattern) (Semester -IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicates full marks.*
- 4) *Use of Logarithmic table and calculator are allowed.*
- 5) *Answers to the two sections should be written in separate sections.*

SECTION-I

(Heterogeneous Catalysis)

Q1) a) Answer the following: [8]

- i) Enlist various types of adsorption isotherms.
- ii) How do you prepare Pt/Al₂O₃ Catalyst by wet impregnation method?
- iii) Define the term PBU and SBU.
- iv) What do you mean by forming of catalyst? Give the advantages of formed catalyst.

b) Discuss in brief the classification of heterogeneous catalyst. [3]

Q2) a) Answer any one of the following. [6]

- i) Give an account of factors influencing on zeolite synthesis.
- ii) Discuss temperature Programmed techniques used for characterisation of heterogeneous catalysts.

b) Answer any two of the following. [6]

- i) Discuss hydrothermal method for zeolite synthesis.
- ii) Describe BET adsorption isotherm.
- iii) Discuss the method for preparation of Raney-Nickel catalyst.

P.T.O.

- Q3) a)** Answer any one of the following. **[6]**
- i) What do you mean by supported metal catalyst? Discuss in detail the role of support in supported metal catalyst.
 - ii) Discuss in detail origin of acidic sites in zeolite framework structure.
- b)** Write notes on any two of the following. **[6]**
- i) MFI type zeolite
 - ii) Catalyst deactivation
 - iii) Characterization of zeolite using XRD

SECTION-II

(Applications of Heterogeneous catalysis)

- Q4) a)** Answer the following. **[8]**
- i) What is catalytic cracking?
 - ii) How pyrophyllite clay is formed?
 - iii) What is Fischer-Tropsch reaction? Which catalyst is used therein?
 - iv) What is F.C. alkylation reaction? Give typical reaction condition for it.
- b)** How do you convert alcohol to carboxylic acid? Which catalyst is used for it? **[3]**
- Q5) a)** Answer any one of the following. **[6]**
- i) What do you mean by shape selective catalysis? Discuss the use of zeolite as shape selective catalyst.
 - ii) Discuss the use of HPA as a catalyst for biomass conversion to useful products.
- b)** Answer any two of the following. **[6]**
- i) Discuss the use of porous material like MCM-41 as a catalyst.
 - ii) What is the role of Bismuth in ammoxidation of propylene.
 - iii) Discuss the importance of perovskite materials in catalytic converter.

- Q6) a)** Answer any one of the following. **[6]**
- i) Semiconducting oxide are very good photo catalyst. Explain it with suitable example.
 - ii) Give an account of steam reforming of naptha using heterogeneous catalyst.
- b)** Write a note on any two of the following. **[6]**
- i) Catalytic converter
 - ii) Conversion of methanol to gasoline
 - iii) Use of zeolite as a hydrogen transfer catalysts



Total No. of Questions : 6]

SEAT No. :

PD3169

[Total No. of Pages : 3

[6476]-407

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 652 - MJ : Solid State Chemistry and Nanomaterials

(2023 Credit Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagrams must be drawn whenever necessary.
- 3) Figures to the right indicates full marks.
- 4) Use of logarithm table and calculator are allowed.
- 5) Answer to the two sections should be written in separate sections.

SECTION - I

(Solid State Chemistry)

Q1) a) Answer the following. **[8]**

- i) Define super conductivity with suitable example.
 - ii) What do you mean by diffusion? Discuss with suitable example.
 - iii) What are piezo electric materials? Explain with suitable example.
 - iv) What is glass transition temperature?
- b) Discuss the terms biomaterials and biocompatibility with suitable example. **[3]**

Q2) a) Answer any one of the following. **[6]**

- i) Discuss the sol-gel processing method for ceramis. Discuss applications of ceramics in various fields.
 - ii) Discuss different types of biomaterials with suitable example and give applications of biomaterials.
- b) Answer any two of the following. **[6]**
- i) What is hysteresis loop? Discuss their classification.
 - ii) Discuss in short, concept of Non-stoichiometry with suitable example.
 - iii) Discuss properties and classification of super conductors.

P.T.O.

- Q3) a)** Answer any one of the following. **[6]**
- i) Discuss difference between blended and non - portland cements. Explain applications of cementitious materials.
 - ii) Discuss about glass fibers, aramid fibers & carbon fibers. Explain applications of composite materials.
- b)** Answer any two of the following. **[6]**
- i) Define 1) Critical temperature, 2) Critical field
 - ii) Discuss types of biomaterials
 - iii) What do you mean by spinels? Explain applications of magnetic materials.

SECTION - II
(Nanomaterials)

- Q4) a)** Answer the following. **[8]**
- i) What is nanotoxicology?
 - ii) What are quantum dots? Explain with example.
 - iii) What are carbon nanotubes?
 - iv) Define the term nano composite with suitable example.
- b)** Explain the size dependent properties of nanomaterials with respect to **[3]**
- i) Colour
 - ii) Magnetic property
- Q5) a)** Answer any one of the following. **[6]**
- i) Explain in detail about classification of nanotechnology with illustration of examples.
 - ii) Discuss synthesis of nanomaterials by following methods.
 - 1) Co-precipitation method
 - 2) Hydrothermal Method
- b)** Answer any two of the following. **[6]**
- i) Explain about multiwalled carbon nanotubes.
 - ii) Explain the importance and need of computational nanotechnology.
 - iii) Discuss in brief about wet and dry nanotechnology.

Q6) a) Answer any one of the following. [6]

- i) Explain in detail about 0D, 1D, 2D and 3D nanostructures.
- ii) Explain applications of nanomaterials with respect to following fields.
 - 1) Optical applications
 - 2) Magnetic applications
 - 3) Drugs and therapeutic applications

b) Answer any Two of the following. [6]

- i) Explain the term nanophotonics? Discuss use of nanophotonics in solar cells.
- ii) Discuss top down and bottom up approach for nanomaterial synthesis
- iii) Discuss in brief about natural and artificial nanoparticles with suitable example



Total No. of Questions : 3]

SEAT No. :

PD3170

[Total No. of Pages : 2

[6476]-408

M.Sc. -II

INORGANIC CHEMISTRY

CHI-660 (A) MJ : Industrial Applications of Inorganic Chemistry

(2023 Credit Pattern) (Semester -IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn whenever necessary.*
- 3) *Figures to the right indicate full marks.*

Q1) a) Answer the following. [8]

- i) Define Electrodeposition.
- ii) How can SO₂ emission can be controlled?
- iii) What is meant by anticorrosive agent? Name the types of corrosion inhibitors
- iv) Why global warming occurs?

b) Discuss various safety aspects in the refinery. [3]

Q2) a) Attempt any one of the following. [6]

- i) What is metal finishing? Which chemicals are used in metal finishing. Explain in detail electro depositions of copper.
- ii) Define corrosion inhibitor. Classify corrosion inhibitors, Give use of corrosion inhibitor

b) Attempt any two of the following. [6]

- i) Write short note on sporting and military explosives.
- ii) Explain advantages and disadvantages of green chemistry.
- iii) What are the effects of industrial gases? What are the major causes of industrial pollution?

P.T.O.

- Q3) a)** Attempt any one of the following. **[6]**
- i) What are the major disadvantages associated with solid propellants compared to liquid propellants?
 - ii) Define green chemistry. How green chemistry differs from cleaning up pollution?
- b)** Attempt any two of the following. **[6]**
- i) Write short note on “Handlings and storage of explosives”
 - ii) Explain the manufacturing process of acetylene gas
 - iii) Explain chemical storage-safety issues.



Total No. of Questions : 3]

SEAT No. :

PD3171

[Total No. of Pages : 2

[6476]-409

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 660(B) - MJ : Inorganic Medicinal Chemistry

(2023 Credit Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Draw neat and labelled diagram whenever necessary.

Q1) a) Answer the following questions. **[8]**

- i) Give the medicinal uses of gold complexes?
- ii) Discuss the binding of bismuth to ligand?
- iii) What is the effect of binding of cis - platin to DNA with respect to structure of DNA.
- iv) What is chrysotherapy? Explain with example.

b) Attempt the following. **[3]**

Explain nuclease activity of $[\text{Cu}(\text{Phen})_x]^+$ complex with the help of suitable diagram.

Q2) a) Attempt any one of the following. **[6]**

- i) What is oxidation state of vanadium in amavadin? Explain it's structural features and insulin modification.
- ii) Explain in detail mechanism of action and tumour resistance cis platin.

b) Attempt any two of the following. **[6]**

- i) Explain in brief anti-HIV drug and their mechanism of action.
- ii) What do you mean by intercalation? Explain with suitable diagram.
- iii) What are the steps involved in drug development?

P.T.O.

Q3) a) Attempt any one of the following. **[6]**

- i) Discuss the role of distribution of lithium in the body cells & mechanism of action.
- ii) Write a note on
 - 1) Platinum based anticancer drugs
 - 2) Helicobacter pylori
 - 3) Rheumatoid arthritis

b) Answer any two of the following. **[6]**

- i) Draw the structure of DMSA & write it's uses.
- ii) Explain in brief about "Non Tc based" renal imaging agents.
- iii) Explain the neurotoxicity and nephrotoxicity occurring due to cis-platin.



Total No. of Questions : 3]

SEAT No. :

PD3172

[Total No. of Pages : 2

[6476]-410

M.Sc. - II

INORGANIC CHEMISTRY

**CHI - 660(C) MJ : Inorganic Chemistry Applications in Environment
(2023 Credit Pattern) (Semester - IV)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicates full marks.*

Q1) a) Answer the following. **[8]**

- i) Write importance and working of grit chamber.
- ii) Explain the role of screening chamber in waste water treatment.
- iii) Explain about suspended solids & sediments in water pollution.
- iv) Define high strength with one source.

b) Explain in detail about aerated lagoon. **[3]**

Q2) a) Answer any one of the following. **[6]**

- i) Explain various applications of biotechnology in treatment of waste water.
- ii) Discuss geothermal energy for generation of electrical power write its merits and demerits.

b) Attempt any two of the following. **[6]**

- i) Write a note on secondary sludge in waste water treatment.
- ii) Explain about anaerobic treatment.
- iii) Define fuel cell & write about alkaline fuel cell.

P.T.O.

Q3) a) Attempt any one of the following. **[6]**

- i) Define biomass and explain about production of biomass.
- ii) Explain about polymer electrolyte membrane and phosphoric acid fuel cell.

b) Answer any two of the following. **[6]**

- i) Explain in detail about biodiesel.
- ii) Write significance of microorganisms in treatment of wastewater.
- iii) Define water pollutants and explain about disease - causing agents in pollute of water.



Total No. of Questions : 6]

SEAT No. :

PD3173

[Total No. of Pages : 5

[6476]-411

M.Sc.-II

ORGANIC CHEMISTRY

CHO-651-MJ : Chemistry of Natural Products

(2023 Credit Pattern) (Semester -IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Answers of the 2 sections should be write on seperate answer books.

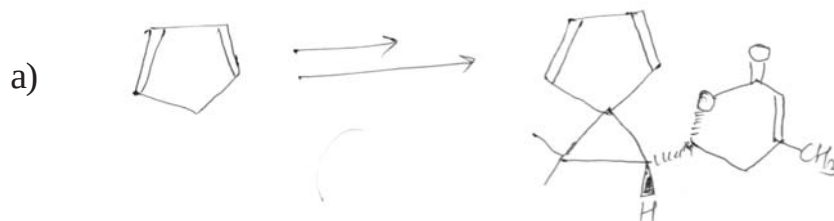
SECTION-I

Q1) a) Answer the following (Any 4) [8]

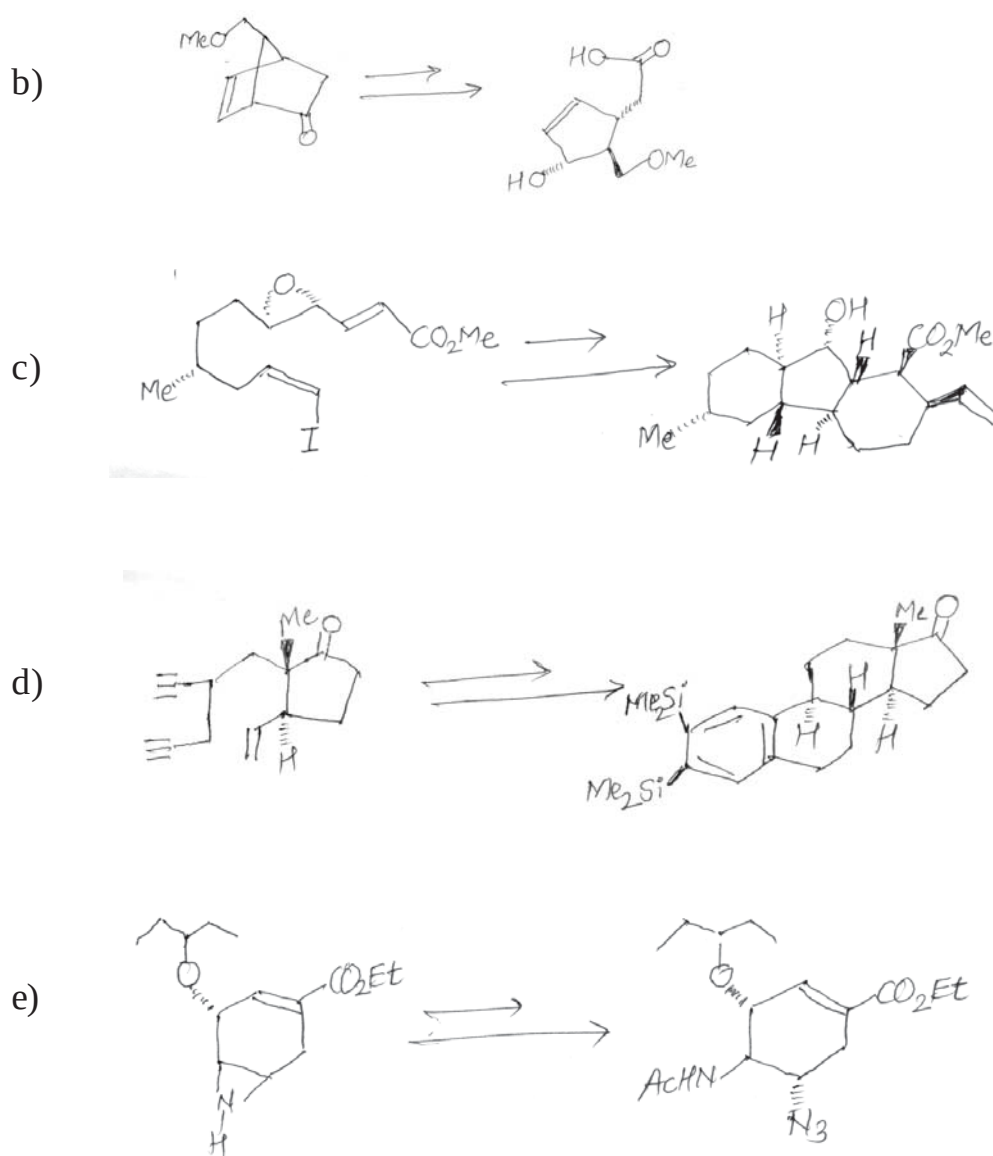
- i) Give the chair structure of menthol with correct stereochemistry.
- ii) Write a role of following reagents in the synthesis
 - 1) H_2 Pt $(\text{PPh}_3)_4\text{Cl}$
 - 2) NaH, CbzCl, THF.
- iii) Write a note on Stark-Zhao olefination'
- iv) Explain Diel's Alder approach ion Natural product synthesis
- v) Write two protecting reagents for carbonyl group with suitable example.

b) Write retrosynthesis of menthol. [3]

Q2) Outline the steps involved in the following synthetic sequence (Any four) [12]

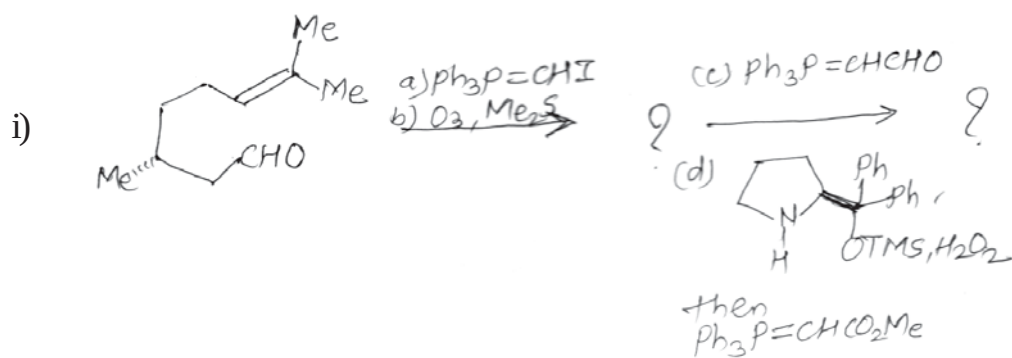


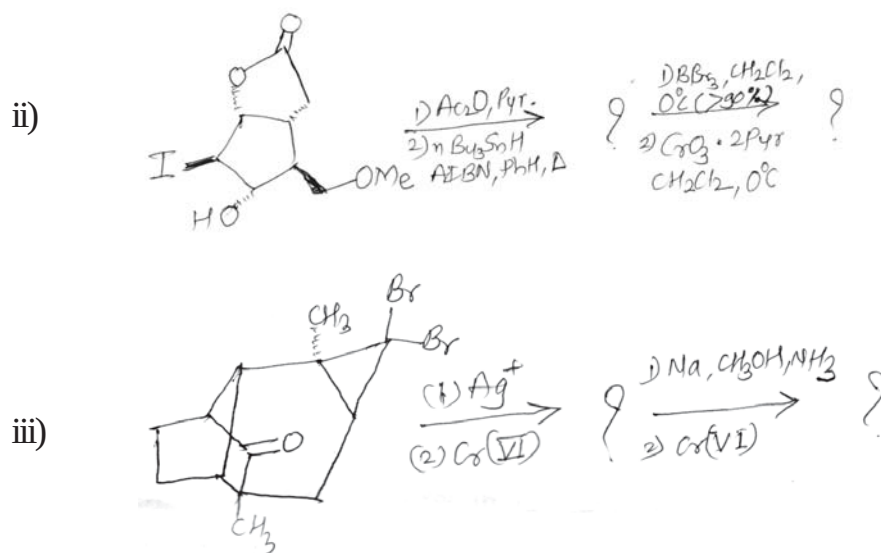
P.T.O.



Q3) a) Predict the Product (Any two)

[8]



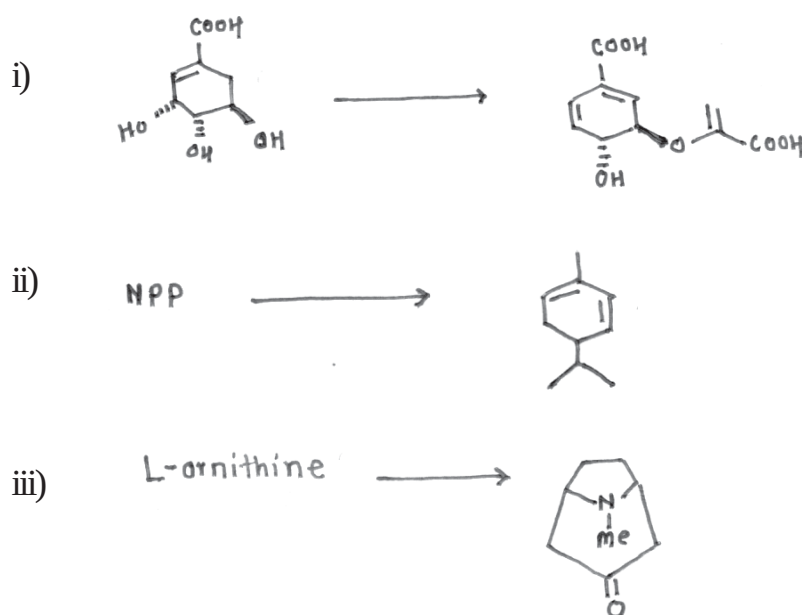


b) Attempt any two of the following. [4]

- Write a note on 'Cyclotrimerization reaction'.
- Write a short note on 'Ugi-adduct in the synthesis of Atrovastatin'.
- Write ionic elimination reaction of menthyl chloride and neo-menthyl chloride.

SECTION-II

Q4) a) Suggest biogenetic scheme for any four of the following. [8]



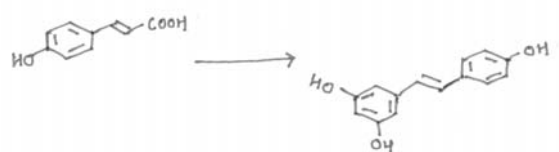


b) Write steps involved in the conversion of acetyl CoA to Mevalonic acid. [3]

Q5) a) Write the steps involved in any three of the following. [9]



b) Complete the following biogenesis [3]



Q6) a) Attempt any two of the following:

[8]

i) Complete the given biogenesis



ii) Complete the steps involved in the given biogenesis.



iii) Complete the following biosynthetic steps.



b) Write short note on any two of the following.

[4]

- Irregular monoterpenes.
- Role of PAL and TAL in natural product synthesis.
- Oxidative deamination.



Total No. of Questions : 6]

SEAT No. :

PD3174

[Total No. of Pages : 5

[6476]-412

M.Sc. - II

ORGANIC CHEMISTRY

**CHO-652-MJ : Advanced Synthetic Organic Chemistry
(2023 Credit Pattern) (Semester-IV) (NEP) (4-Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

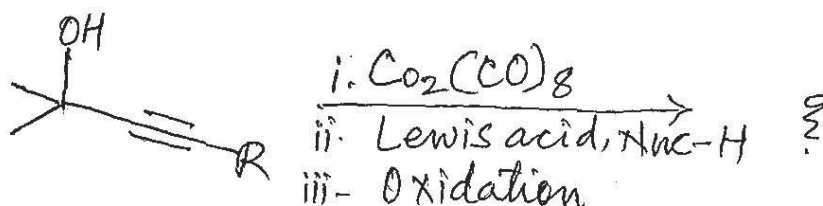
- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Answer to the two sections should be written on separate answer book.*

SECTION-I

Q1) a) Answer the following. (any 4) **[8]**

- i) What is the Collmann reagent? How is it useful in the organic synthesis?
- ii) Explain Nicolas reaction with suitable example.
- iii) Explain the regioselectivity in Heck-Mizoroki reaction.
- iv) What is Noyori reduction? Explain with suitable example.
- v) What is the role of Copper Halide in the Sonogashira coupling reaction?

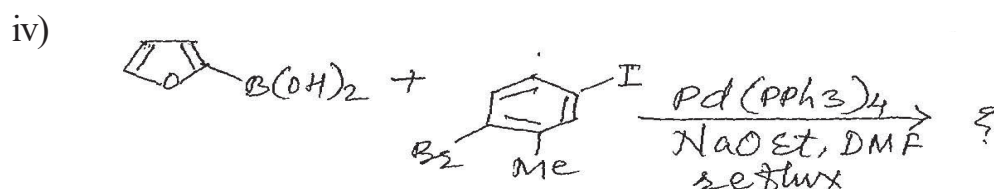
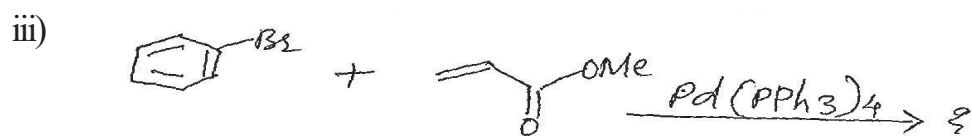
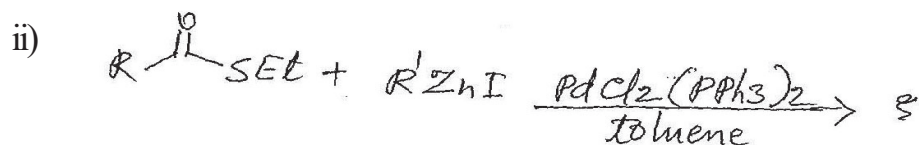
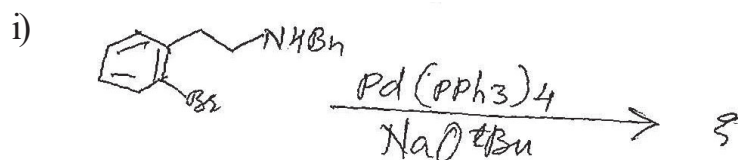
b) Predict the product and suggest the mechanism. **[3]**



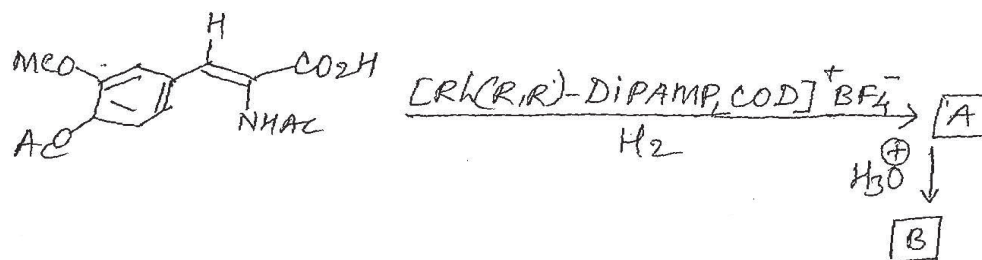
P.T.O.

Q2) a) Predict the product and explain the mechanism (any 3).

[9]



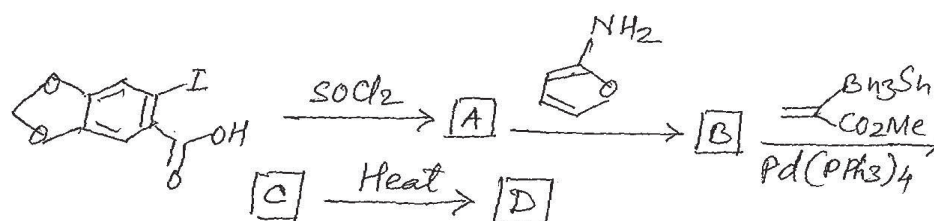
b) Give correct products with enantioselectivity of following reaction. [3]



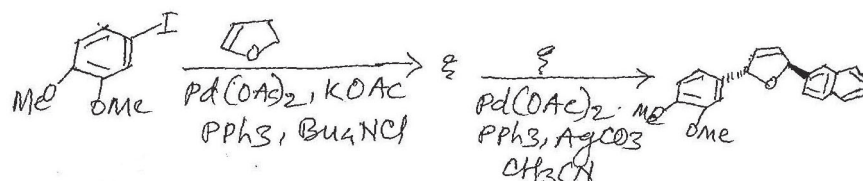
Q3) a) Attempt any two of the following.

[8]

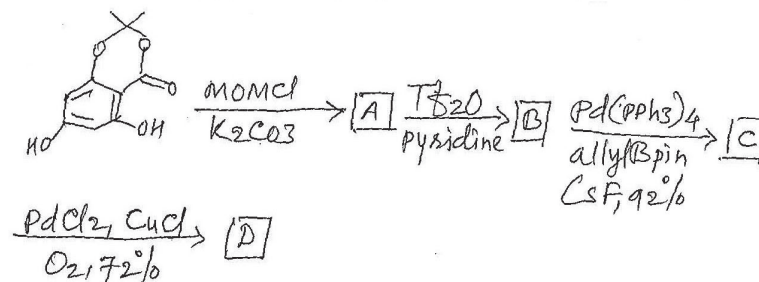
i) Predict the product A to D for the following synthesis.



- ii) Complete the following transformation with explanation.

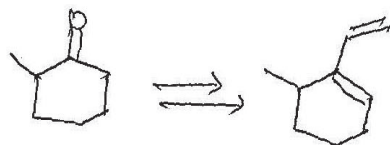


iii)

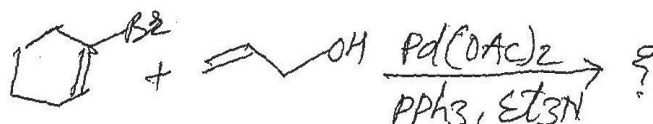


- b) Attempt any two of the following. [4]

- Write a short note on Vollhardt co-trimerization with suitable example.
- Explain the following product formation.



- iii) Give the correct product for the following transformation.

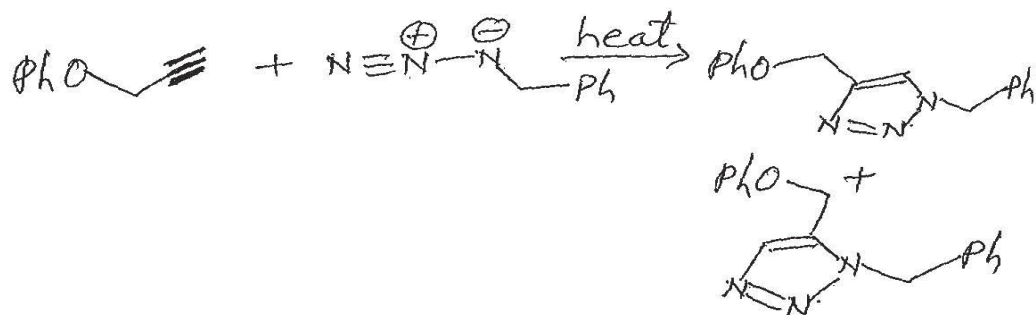


SECTION-II

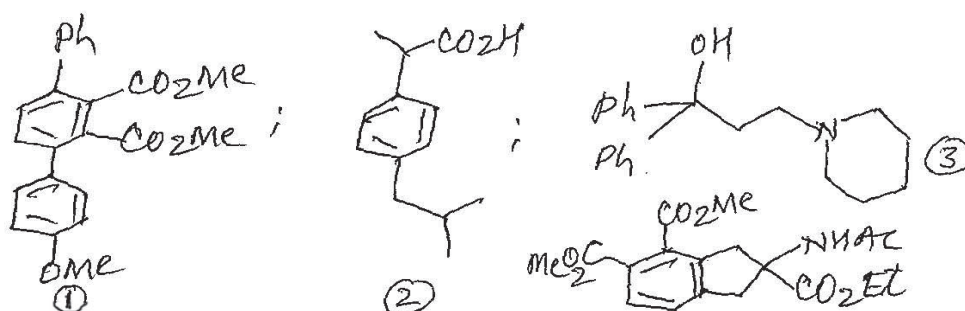
- Q4) a) Answer the following. (Any 4) [8]

- What is the driving force involved in the RCM? Explain with suitable example.
- Why sodium ascorbate is used in the click chemistry? Explain with an example.
- What is double disconnection? Explain with suitable example.
- What are donor and acceptor synthons?
- Discuss Schrock catalyst in metathesis.

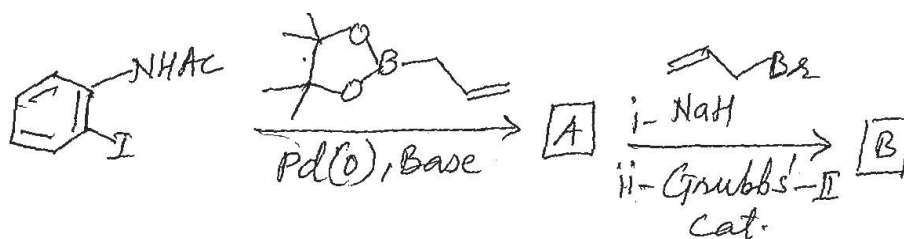
- b) Explain the formation of the product with possible mechanism. [3]



- Q5) a) Using retro synthetic analysis, suggest the suitable method for the synthesis of following molecules. (Any 3) [9]

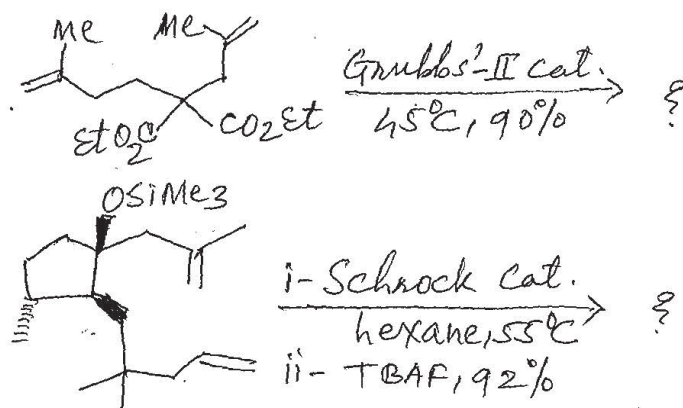


- b) Predict the product for the following transformation. [3]

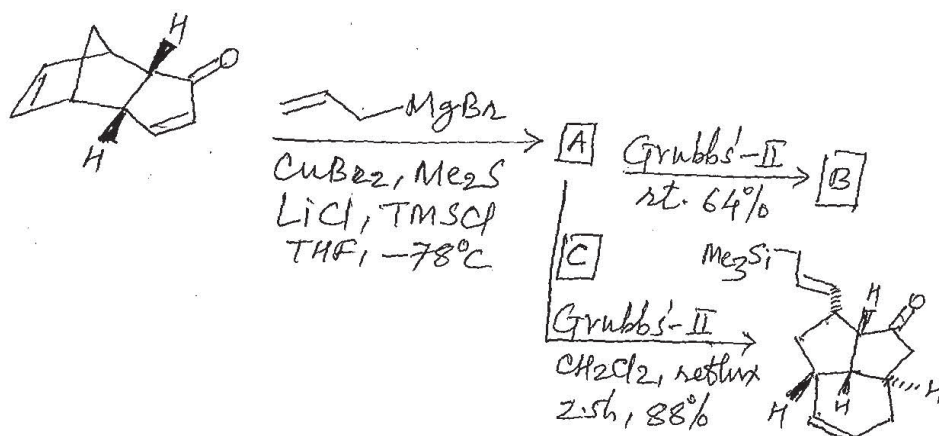


- Q6) a) Attempt any two of the following. [8]

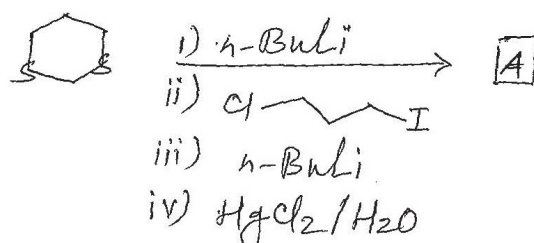
- i) Predict the product of the following reactions.



ii) Predict the products and reagent.



iii) Predict the products 'A' and explain the formation.



b) Attempt any two of the following. [4]

- Explain and give the structure of the Grubbs's 2nd generation catalyst.
- What is the driving force in enzyme metathesis reaction? Explain with a suitable example.
- What is Functional Group Interconversion? Explain with an example.



Total No. of Questions : 3]

SEAT No. :

PD3175

[Total No. of Pages : 3

[6476]-413

M.Sc.-II

ORGANIC CHEMISTRY

CHO-660(A)MJ: Asymmetric Synthesis

(2023 Credit Pattern) (Semester -IV)

Time : 2 Hours]

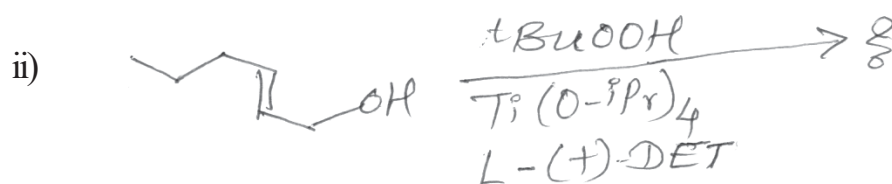
[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.

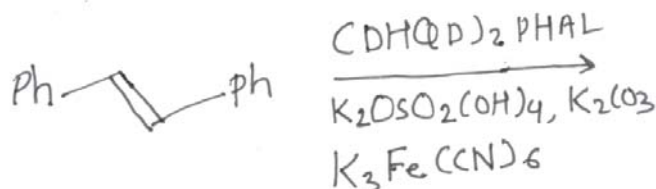
Q1) a) Answer any four of the following.

[8]



iii) What is Felkin-Anh's rule in diastereoselective reactions?

iv) Predict the product with proper stereochemistry



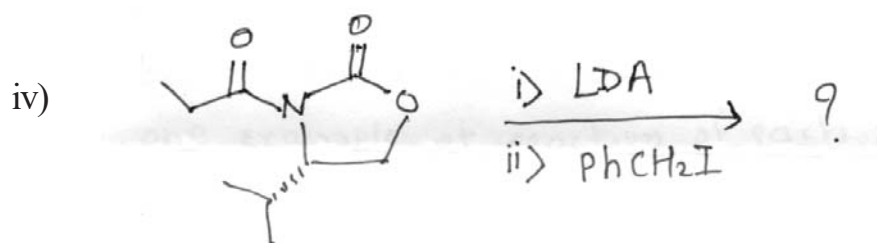
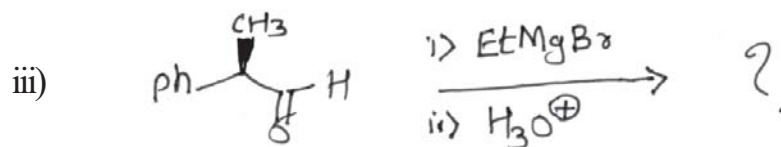
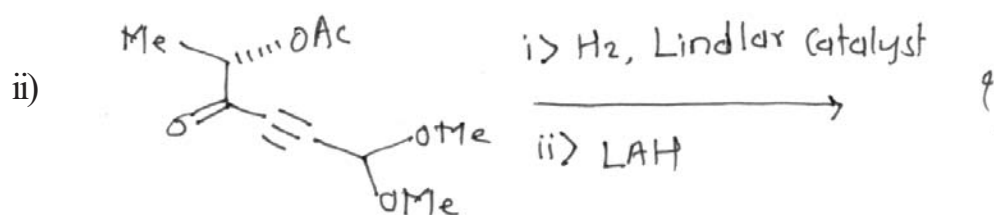
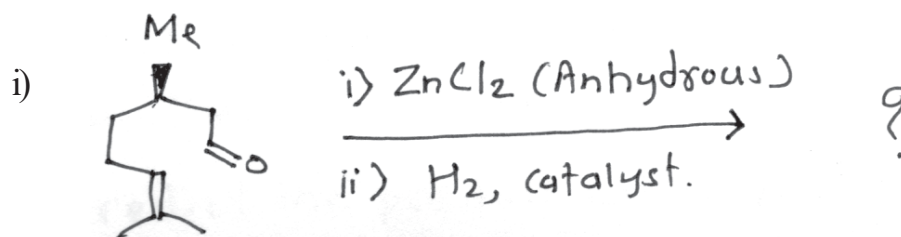
v) What are stereotopic Ligands?

b) Write the synthesis of s-sulcatol from s-ethyl lactate.

[3]

P.T.O.

Q2) a) Predict the product/s with mechanism for any three of following [9]

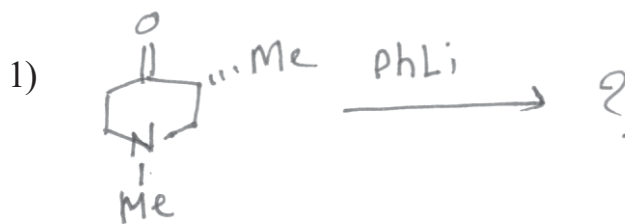


b) Explain the significance of sharpless Asymmetric epoxidation. [3]

Q3) a) Attempt any two of following.

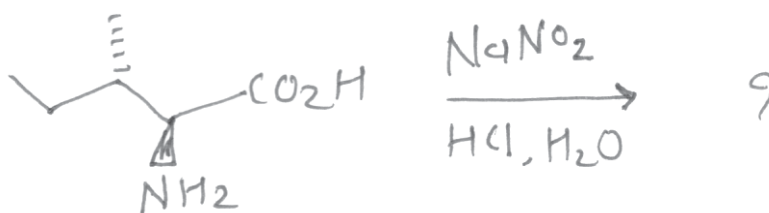
[8]

i) Predict the product with mechanism for following reaction.



ii) Explain the role of CBS in asymmetric synthesis with examples.

iii) Predict the product with mechanism and give its proper stereochemistry



b) Answer Any two of the following

[4]

i) Explain distereoselective reaction with examples.

ii) Explain the role of S-BINAP and R-BINAP with one example of reaction of each reagent.

iii) Write note on Asymmetric hydrogenation.



Total No. of Questions : 3]

SEAT No. :

[Total No. of Pages : 2

PD3176

[6476]-414

M.Sc. - II

ORGANIC CHEMISTRY

CHO-660-(B) MJ : Applied Organic Chemistry

(2023 Credit Pattern) (Semester-IV) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*

Q1) a) Answer the following (Any 4) **[8]**

- i) Write down the impurities in drug products.
 - ii) What are photochromic dyes? Give its examples.
 - iii) What is curing agent? Give its examples.
 - iv) What are metal organic frameworks (MOF's)? Mention one of their common application.
 - v) Define branched polymer and give any two examples of it.
- b) Discuss factors affecting synthesis of metal organic frameworks (MOF's). **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) What is mean by active pharmaceutical ingredients (API)? Discuss it with suitable examples.
 - ii) How fluorescent dyes useful in biological imaging?
 - iii) Give synthesis of nylon-66.
 - iv) What kind of dyes are used in dye-sensitized solar cells (DSSCs)?
- b) Draw the structure of Rapamycin and discuss it's biological importance. **[3]**

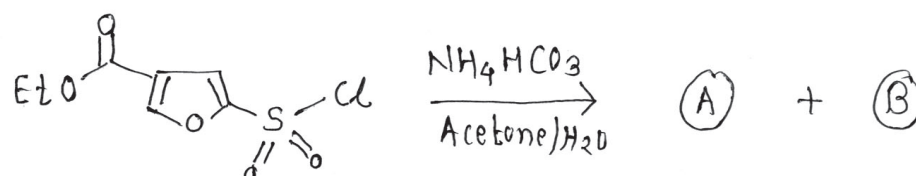
P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) How will you synthesize melamine-formaldehyde and what are its applications?
- ii) Classify the different types of impurities found in pharmaceutical substances.
- iii) Explain the applications of functional dyes in laser printing and photo copying.

b) Attempt any two of the following. **[4]**

- i) Explain addition polymerization with appropriate examples.
- ii) Write a note on estimation of impurity in drugs.
- iii) Predict the product.



Total No. of Questions : 3]

SEAT No. :

PD3177

[Total No. of Pages : 2

[6476]-415

M.Sc. - II (Organic Chemistry)

CHO 660(C) MJ : INDUSTRIAL ORGANIC CHEMISTRY

(2023 Credit Pattern) (Semester - IV) (2 Credits)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.

Q1) a) Attempt any four of the following. **[8]**

- i) Explain the term petroleum refining.
- ii) What is fermentation technology?
- iii) Enlist the drugs affecting the nervous system.
- iv) Draw the structure of aspirin.
- v) What is the product formed when benzene is reduced?

b) Write note on isolation of enzymes using fermentation technology. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) What are zeolites? Explain their use as catalyst in petroleum refining.
- ii) What is use of microorganisms in production of commercial chemicals?
- iii) What are the properties of drug?
- iv) Give the difference between pharmaceutical industry and heavy chemical industry.

b) How is cumene hydroperoxide used for phenol production? Mention the mechanism. **[3]**

P.T.O.

Q3) a) Attempt any two of following. **[8]**

- i) Explain the Fischer - Tropsch reaction? How does it help in making industrial chemicals?
- ii) What is Reppe chemistry? Explain any two important reactions involved in Reppe chemistry.
- iii) What are antibacterial agents? Describe the properties of antibacterial agents.

b) Attempt any two of following. **[4]**

- i) Define cracking in petroleum refining. Explain its types.
- ii) Write any three chemicals obtained from ethylene.
- iii) Explain the term analgesics? Give their examples.



Total No. of Questions : 6]

SEAT No. :

PD3178

[6476]-416

[Total No. of Pages : 4

Second Year M.Sc.

ANALYTICAL CHEMISTRY

CHA-651 MJ : Applied Analytical Spectroscopy

(2023 Credit Pattern) (Semester - IV) (NEP) (Credit - 4)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions of the respective section are compulsory.
- 2) Answers of two sections should be written in Separate answer books.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic table/non-programmable calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

SECTION - I

(Atomic Absorption and Emission Spectroscopy)

Q1) a) Attempt any four of the following. [8]

- i) What is error? Distinguish between random error and systematic error.
 - ii) What is selective extraction? Which is the suitable extracting reagent for extraction of aluminum from aqueous medium.
 - iii) Explain characteristics of an ideal spray chamber.
 - iv) Distinguish between spectral & chemical interferences.
 - v) What is inorganic mass spectroscopy? Give its application.
- b) The flame test barium involves placing of barium containing compound in a Bunsen burner flame. The barium compound is then decomposes gives barium atoms which sub-sequently undergo an electronic transition of energy $3.62 \times 10^{-19}\text{J}$. What is the wavelength of the emission line of barium in nm? [3]

Given: Planck's constant = $6.626 \times 10^{-34}\text{Js}$

velocity of light = $3.0 \times 10^8\text{ms}^{-1}$.

P.T.O.

Q2) a) Attempt any three of the following. **[9]**

- i) Explain working of electrothermal vapourization technique.
- ii) Give the applications of ICP-MS in environmental science.
- iii) What is mass analyzer? Explain any one with schematic diagram.
- iv) Explain charge transfer device in AES.

b) A 5.0 mL sample of blood was treated with tri-chloro-acetic acid to give precipitate of proteins. After centrifugation the resulting solution was brought to pH = 3.0 and extracted with 2.0 mL portion of methyl isobutyl ketone containing the organic lead complexing agent. The 1.0 mL extract was further diluted to 2.0 mL and aspirated into an air-acetylene flame and yielding an absorbance of 0.502 at 283.3 nm. Another 1.0 mL extract is spiked with 1.0 mL standard solution containing 0.500 ppm of lead followed by analysis in same way, and yielding an absorbance of 0.999 at same wavelength. Calculate ppm of lead in the blood sample. **[3]**

Q3) a) Attempt any two of the following. **[8]**

- i) What is fusion? What types of sample are decomposed by fusion? Explain the application of any two fusion reagent in sample treatment.
- ii) With the help of schematic diagram explain the cold-vapour technique of determination of mercury by AAS.
- iii) What is plasma? Enlist the different types of plasma. Explain any one in detail.

b) Attempt any two of the following. **[4]**

- i) Write the ion-exchange equilibrium involved in pre-concentration and de-sorption of metal ion on strong-acid cation exchanger resin.
- ii) How calcium & magnesium are determined in tap water by AAS technique?
- iii) What mass of AgNO_3 (mw = 169.90) would need to prepare 100 mL of the 100 ppm stock solution of silver (At. wt = 107.9)

SECTION - II

(Molecular Spectroscopic Methods)

Q4) a) Attempt any four of the following. **[8]**

- i) Give the statement of Beer's law. What are the causes for deviation in Beer's law.
- ii) Define phosphorescence.
- iii) Give the principle of photoelectron spectroscopy.
- iv) What is the ratio of lines in ESR spectra of CH_3 free radical.
- v) Explain the term quantum yield?

b) 4.8 ppm 10 ml Zn (II) solution was extracted three times with 5 ml CCl_4 containing 8-hydroxy quinoline and combined extract was diluted to the 100 ml. Similar treatment is given to sample containing Zn (II). Fluorescence intensity for standard is 100 while sample is 78. Calculate mg of Zn (II) in 1000 ml sample solution. **[3]**

Q5) a) Attempt any three of the following. **[9]**

- i) Draw the block diagram of double beam spectrophotometer. Explain any two of them.
- ii) Which of the following nuclei are ESR active? Why ^1H , ^{13}C , ^{23}Na .
- iii) Explain in detail the variable factor affecting the fluorescence.
- iv) What is free radical? How the splitting of lines take place if free radical contain atom with $1/2$ nuclear spin?

b) If an unpaired electron in a particular environment has a g-factor 2.215. Calculate the magnetic field required to cause the electron to resonate at frequency of 9.5 GHz.

(Given $\mu_B = 9.285 \times 10^{-34} \text{J/T}$ $h = 6.6226 \times 10^{-34} \text{Js}$) **[3]**

Q6) a) Attempt any two of the following. **[8]**

- i) What is chemiluminescence? Explain one application in detail.
- ii) Draw ESR spectrum of $(\text{CH}_2-\text{CH}_3)$ ethyl free radical. Why each line in triplet is splitted in quarted?
- iii) Explain the Instrumentation of AES with suitable diagram.

b) Attempt any two of the following. **[4]**

- i) Explain the selection rule in ESR.
- ii) Explain the characteristics at photoelectron spectra.
- iii) Give the application at XPS.



Total No. of Questions : 6]

SEAT No. :

PD3179

[Total No. of Pages : 3

[6476]-417

M.Sc. - II

ANALYTICAL CHEMISTRY

CHA - 652 - MJ : Chemical Methods of Pharmaceutical Quality Control
(2023 Credit Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicates full marks.
- 3) Use of scientific calculator is allowed.

SECTION - I

Q1) a) Attempt any four of the following. **[8]**

- i) What are parenteral preparations?
- ii) Define ointment.
- iii) Write in brief about uniformity of weight of single dose preparation.
- iv) What is Hydroxyl value?
- v) Define Infusion.

b) Explain in detail the limit test for sulphate. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Define Acid value explain in detail the method of estimation of acid value.
- ii) Write a note on optical rotation & specific optical rotation.
- iii) Explain the identification test of Barbiturates with the principle.
- iv) Differentiate between coated tablet & uncoated tablet.

b) A sample of oil weighing 4.5g was subjected to saponification with 50.0 ml alcohol KoH. It was titrated against 0.5N Hcl & it required 12.0ml titrant. If blank reading was 50.0mL calculate saponification value of oil.

[Molecular weight of KoH = 56.1g] **[3]**

P.T.O.

- Q3) a)** Attempt any two of the following. **[8]**
- i) Discuss in detail the dissolution test for tablets & Capsules.
 - ii) Give a detailed account of assay of Insulin.
 - iii) What are capsules? Explain in detail the types of capsules.
- b)** Attempt any two of the following. **[4]**
- i) Define oral powder.
 - ii) What is iodine value?
 - iii) Write a short note on loss on drying.

SECTION - II

- Q4) a)** Answer the following (any 4). **[8]**
- i) Give any four methods of identification of pharmaceutical product.
 - ii) Define 'dosage form' and API.
 - iii) Explain role of excipients.
 - iv) What are residual solvents? Give any two examples of residual solvents.
 - v) What is the basis of identification of pharmaceutical ingredient by LC method?
- b)** 0.2 g of ferrous fumarate (m.w. 169.9) was dissolved in 25ml water and Titrated against 0.1 M ceric sulphate. The titration reading was 12.1ml. Calculate percent purity and comment on the assay is passed or failed by sample if expected purity is 99 to 101%. **[3]**
- Q5) a)** Attempt any three of the following. **[9]**
- i) Describe the assay of paracetamol by UV-Spectroscopy.
 - ii) What are requirements for the content of an application for marketing authorization in pharmaceutical industry?
 - iii) What is non-aqueous acid-base titration? Explain assay of lidocaine by non-aqueous acid-base titration.
 - iv) Write a note on identification by optical rotation.
- b)** 0.09 g of hydrocortisone was dissolved in ethanol and diluted to 100ml of solvent. 2ml of this solution was diluted to 100ml. The absorbance of this solution was measured at 241 nm and found to be 0.76. Calculate the content of hydrocortisone in given sample. [Specific absorbance 440, 1cm, 1%] **[3]**

Q6) a) Attempt any two of the following. **[8]**

- i) What is pharmacopoeia monography? Describe its contents.
- ii) Explain different types of impurities according to ICH guidelines.
- iii) Explain assay of fentanyl in fentanyl citrate injection by LC method.

b) Attempt any two of the following. **[4]**

- i) Explain role of quality control in pharmaceutical industry.
- ii) What is loss on drying?
- iii) What are related substances?



Total No. of Questions : 3]

SEAT No. :

PD3180

[Total No. of Pages : 2

[6476]-418

M.Sc. -II

ANALYTICAL CHEMISTRY

CHA 660(A) MJ: Bioanalytical Chemistry

(2023 Credit Pattern) (Semester -IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*

Q1) a) Attempt any four of the following. **[8]**

- i) Define pre and post derivatisation.
- ii) Give general aspects of Injection.
- iii) Explain the adaptive immunity & clonal selection.
- iv) Give the types of electrophoresis.
- v) Give the characteristics of Ideal detector.

b) Explain in detail Isoelectric focousing capillary electrophoresis. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Derive the equation for electrophoretic mobility.
- ii) Describe in detail pregnancy test on urine by using ELISA.
- iii) Write a short note on Kubelka-Munk equation.
- iv) Explain in detail direct ELISA.

b) Explain in detail factors affecting on electrophoretic mobility. **[3]**

P.T.O.

- Q3) a)** Attempt any one of the following. **[8]**
- i) Explain in detail Hydrodynamic Injection system.
 - ii) Explain various types of gel media in gel electrophoresis.
 - iii) Why capillary electrophoresis is more preferable than electrophoresis? Explain its advantages and disadvantages.
- b)** Attempt any one of the following. **[4]**
- i) Enlist the fluorescent tags and explain in detail derivatisation method.
 - ii) Write note on optical method for detection of separated components in electrophoresis.



Total No. of Questions : 3]

SEAT No. :

PD3181

[Total No. of Pages : 2

[6476]-419

M.Sc. - II

ANALYTICAL CHEMISTRY

CHA - 660 (B) - MJ : Automation and Sensor

(2023 Pattern) (Semester - IV) (Credit Pattern)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of log tables and calculators are allowed.*

Q1) a) Answer any four of the following. **[8]**

- i) What is parallel integration.
- ii) What is continuous flow analysis?
- iii) What is miniaturized analytical system?
- iv) Define biosensor.
- v) What is lab automation?

b) Discuss objectives of automation in analytical chemistry. **[3]**

Q2) a) Attempt any three of the following. **[9]**

- i) Discuss basic instrumentation of Flow Injection Analysis (FIA).
- ii) Give the brief account of biotransduction.
- iii) How would you design an optical biosensor to measure glucose?
- iv) Discuss optical sensors.

b) Give an account of Laminar - H filter for extraction of low molecular weight components during sampling. **[3]**

P.T.O.

Q3) a) Attempt any two of the following. **[8]**

- i) Explain the potentiometric sensors.
- ii) Define microfabrication. Explain silicon micromatching.
- iii) Explain surface acoustic wave sensor.

b) Attempt any two of the following. **[4]**

- i) Write note on serial integration.
- ii) Give uses of chemical sensor.
- iii) What is control loop? Give it's types.



Total No. of Questions : 3]

SEAT No. :

PD3182

[Total No. of Pages : 2

[6476]-420

M.Sc. - II

ANALYTICAL CHEMISTRY

CHO-660-(C) MJ : Analytical Techniques of Polymer Characterization
(2023 Credit Pattern) (Semester-IV)

Time : 2 Hours]

[Max. Marks : 35

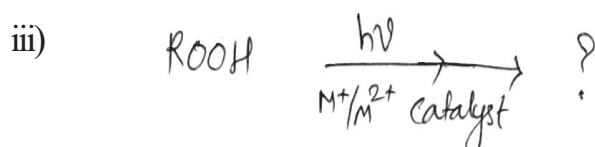
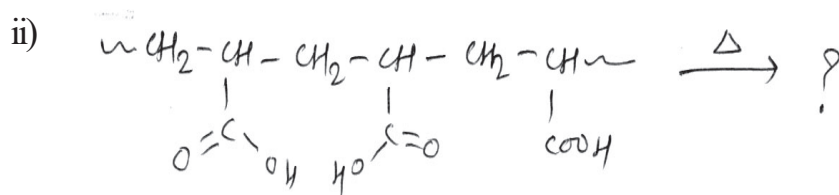
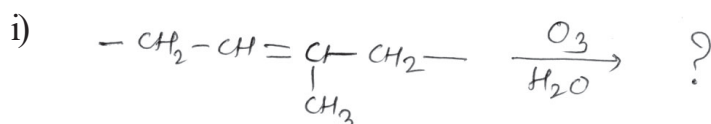
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Use of scientific calculator is allowed.

Q1) a) Attempt any four of the following. [8]

- i) How a polymer can be identified on the basis of its solubility?
- ii) What is the number average molecular weight of polymer?
- iii) Write the Bragg's equation and explain the terms involved in it.
- iv) What do you mean by radiation degradation of polymer?
- v) Define:
 - 1) Tensile stress
 - 2) Shear stress

b) Identify the product in the following reactions. [3]



P.T.O.

Q2) a) Attempt any three of the following. [9]

- i) Distinguish between thermoplastics and thermosets.
 - ii) Explain the role of NMR-spectroscopy in the structure elucidation of polymeric material.
 - iii) Write all of the possible isomers that can result from the addition polymerization of butadiene.
 - iv) A polymeric material has a relaxation time of 100 days at 27°C, when a stress of 4.0MPa is applied. How many days will be required to decrease the stress to 3.2 MPa?
- b) A student uses viscometry to measure the intrinsic viscosity of a polymer. It is found that the intrinsic viscosity is 128 ml/g. If the Mark-Houwink constant is 0.92×10^{-2} and $a=0.69$, calculate the viscosity average molecular weight of a polymer. [3]

Q3) a) Attempt any two of the following. [8]

- i) Describe turbidimetric titration method for determination of molecular weight of a polymer.
 - ii) Explain the following terms.
 - 1) Impact testing
 - 2) Tear resistance
 - iii) When 100g of PVC is mixed with 25g of a plasticizer, the T_g of a polymer is lowered from 87 to 0°C. What T_g is to be expected from a mixture of 100g of PVC with 100g of the plasticizer.
- b) Attempt any two of the following. [4]
- i) What are composite polymers?
 - ii) Draw a schematic diagram of a typical FTIR spectrometer.
 - iii) Calculate the degree of polymerisation of a sample polyethylene, $(CH_2-CH_2)_n$, which has a molecular weight of 100000g/mole.

