

Total No. of Questions : 8]

SEAT No. :

PE-5272

[Total No. of Pages : 3

[6510]-101

First Year M.Sc.

PHYSICAL CHEMISTRY

CHP-110 : Fundamental of Physical Chemistry - I

(2019 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Physico - Chemical Constant

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		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
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	=	$96487 \text{ C equiv}^{-1}$
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) Attempt the following: **[10]**

- a) Write the Gibb's -Helmholtz equation and give the significance of the terms involved in it.
- b) State Henry's law.
- c) What is black body radiation? Explain ultraviolet catastrophe.
- d) Write the Huckel determinant for ethylene molecule.
- e) State de-Broglie hypothesis.

Q2) Attempt any two of the following: **[10]**

- a) Obtain an expression for entropy change in an ideal gas a function of temperature and pressure.
- b) Write a note on exact and inexact differential.
- c) Show that depression in freezing point is a colligative property.
- d) What are partial molar quantities? Explain one method to determine any partial molar quantity.

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

- a) Explain photoelectric effect. Give its significance.
- b) Normalize the wave function $\psi = A \sin \frac{n\pi}{a} \cdot x$
- c) Discuss the assumptions of Huckel molecular orbital theory.
- d) Set up the secular determinant and write the secular equation for benzene.

Q4) Solve any one of the following: **[5]**

- a) 17gm hydrogen gas is mixed with 12gm helium gas at 300K. Find the entropy change [Atomic weight: H = 1, H_e = 4]
- b) By how much the freezing point of benzene at 5.53° C, be reduced if 10gm. benzene is added to 100gm benzene.
[ΔH_f for benzene = 9.836 kJ mole⁻¹ , Atomic weight C=12, H=1]

SECTION - II

Q5) Attempt the following: **[10]**

- a) Write the significance of Arrhenius equation.
- b) What are the limitations of continuous flow method?
- c) What is stirring approximation?
- d) Define the term rate and reaction rate constant.
- e) In a reaction $R \xrightleftharpoons[k^1]{K} P$, Evaluate $k + k^1$.

Q6) Attempt any two of the following: **[10]**

- a) Derive Eyring equation using activated complex theory.
- b) Describe the Lindemann theory of unimolecular reactions.
- c) Describe the relaxation technique used to study the fast reactions and give the expression for relaxation time for the first order reaction.
- d) Explain the steady state approximation with suitable example.

Q7) Attempt any two of the following: **[10]**

- a) Obtain an expression for Boltzmann distribution law.
- b) Derive Michaelis-Menten equation for enzyme catalysed reactions.
- c) Explain the thermal and chain branching explosion reactions. Draw and explain the graph of explosion limit.
- d) Derive an expression for the molecular vibrational partition function of an ideal diatomic gas.

Q8) Solve any one of the following: **[5]**

- a) Calculate the frequency factor for a reaction having a rate constant 4.0×10^{-7} units at 227°C , if the energy of activation is 100kJ mol^{-1} .
- b) Evaluate the translational partition function for oxygen atoms at 300K contained in a volume of 22.414 dm^3 .



Total No. of Questions : 6]

SEAT No. :

PE-5273

[Total No. of Pages : 3

[6510]-102
First Year M.Sc.
CHEMISTRY
CHI-130 : Molecular Symmetry and Chemistry of Main
Group Elements
(2019 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 book.*
- 3) *Figures to right indicate full marks.*
- 4) *Use of log tabels, character tables and calculator is allowed.*

SECTION - I

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

- i) Sketch dihedral Planes (σ_d) in allene molecule.
 - ii) List out symmetry element and point group for CCl_4 .
 - iii) Find the product of $i \times c_2^{(X)}$ using matrix multiplication method.
 - iv) Find the order of group and number of classes in 1,4-dichlorobenzene.
- b) Assign the correct mulliken symbol for $\bar{1}, \bar{2}, \bar{3}$ with their justification. **[3]**

	E	$2C_4$	C_2
$\bar{1}$	1	1	1
$\bar{2}$	1	-1	1
$\bar{3}$	2	0	-2

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

- i) Derive the character table for C_{2v} point group using orthogonality theorem.
- ii) Draw all symmetry operation and assign the proper point group giving reason for following molecule
 - 1) CCl_4
 - 2) $[\text{Pt}(\text{Cl})_4]^{2-}$

P.T.O.

- b) Attempt any two of the following: [6]
- Define order of group and explain D_{4h} point group with suitable example.
 - Write all the associative operation with S_6 axis.
 - Show the axis of rotation in NH_3 .

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

- Find the reducible representation for BCl_3 molecule with D_{3h} point group considering σ -bond as a basis of representation and thus find out the orbitals offered to σ -bond formation in the molecule.

[Given : Character table for D_{3h} point group]

- Find out the irreducible representation component for the following:

C_{3v}	E	$2C_3$	$3\sigma_v$
$\overline{RR}$	15	0	3

[Given: Character table for C_{3v} point group]

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

- Classify the following molecule into appropriate point group.
 - C_6H_6 (Benzene)
 - Pyridine
 - $CHCl_3$
- Find whether the following operation is commutative or non commutative for $\sigma_v' \times \sigma_v''$ in NH_3 .
- Explain with the help of example improper axis of rotation operation.

Character tables:

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$		
A'_1	1	1	1	1	1	1		$x^2 + y^2, z^2$
A'_2	1	1	-1	1	1	-1	R_z	
E'	2	-1	0	2	-1	0	(x, y)	$(x^2 - y^2, xy)$
A''_1	1	1	1	-1	-1	-1		
A''_2	1	1	-1	-1	-1	1	z	
E''	2	-1	0	-2	1	0	(R_x, R_y)	(x^2, y^2)

C_{3v}	E	$2C_3$	$3\sigma_v$
A_1	1	1	1
A_2	1	1	-1
E	2	-1	0

SECTION - II

- Q4) a)** Answer the following: [8]
- What are saline hydrides? Explain with examples.
 - BF_3 is weak acid as compared to BBr_3 , explain.
 - What are pseudohalogens? Give any two examples.
 - Give the principle for separation of alkali metals by using crown ethers.
- b) What are oxoanions of phosphorous? Give any two examples. [3]
- Q5) a)** Answer any one of the following: [6]
- Write a note on fullerene and fullerene metal complexes.
 - Classify the following compounds into closo/nido/arachno/hypho boranes.

1) $\text{B}_{10}\text{H}_{14}$	2) B_8H_{16}
3) $(\text{B}_9\text{H}_{14})^-$	4) $(\text{B}_{11}\text{H}_{13})^{2-}$
5) B_4H_{10}	6) B_2H_6
- b) Answer any two of the following: [6]
- Give an account of P-N compounds.
 - Write a note on electron rich hydrides.
 - Give synthesis, reactions and properties of organomagnesium compounds.
- Q6) a)** Answer any one of the following: [6]
- Give an account of alluminosilicates.
 - Draw the structures of following:

1) 15-crown-5
2) NH_3
3) $[\text{Cl}_2\text{PN}]_3$
4) XeO_3
5) N_2O_4
6) $(\text{Si}_3\text{O}_9)^{6-}$
- b) Answer any two of the following: [6]
- Write a note on nitrogen activation.
 - Give the synthesis and properties of borazine.
 - Give an account of Xenon-Fluorine compounds.



[6510]-103

First Year M.Sc.

CHEMISTRY

**CHO-150 : Basic Organic Chemistry
(2019 Pattern) (Semester - I)**

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

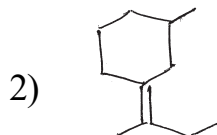
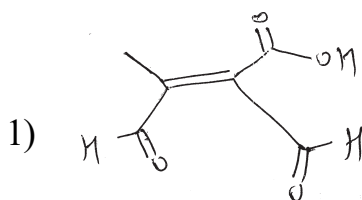
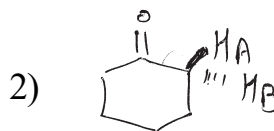
- 1) Section - I and II carry equal marks.
- 2) Q1 and Q5 are compulsory.
- 3) Attempt any two questions from Q2 to Q4.
- 4) Attempt any two questions from Q6 to Q8.
- 5) Answer to the two sections should be written in separate answer books.

SECTION - I

Q1) a) Attempt the following:

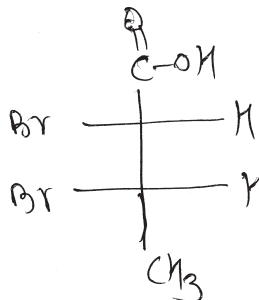
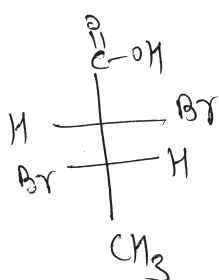
[8]

i) Assign E/Z configuration to the following:

ii) Assign PRO-R/PRO-S of labelled hydrogen H_A and H_B .

iii) Draw the Newman projection of trans decalin.

iv) Give the stereochemical relationship between following compound.

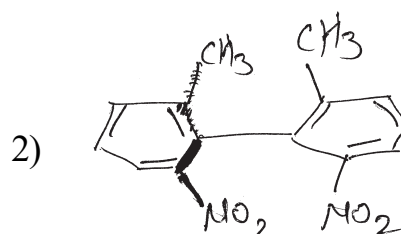
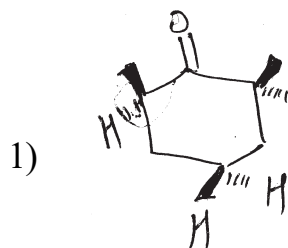


P.T.O.

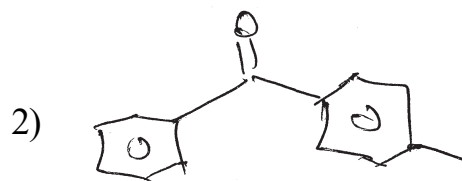
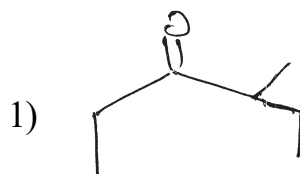
- b) Why chair conformation is more stable than boat conformation in case of cyclohexane? [3]

Q2) a) Attempt the following: [6]

- i) Assign R/S configuration.

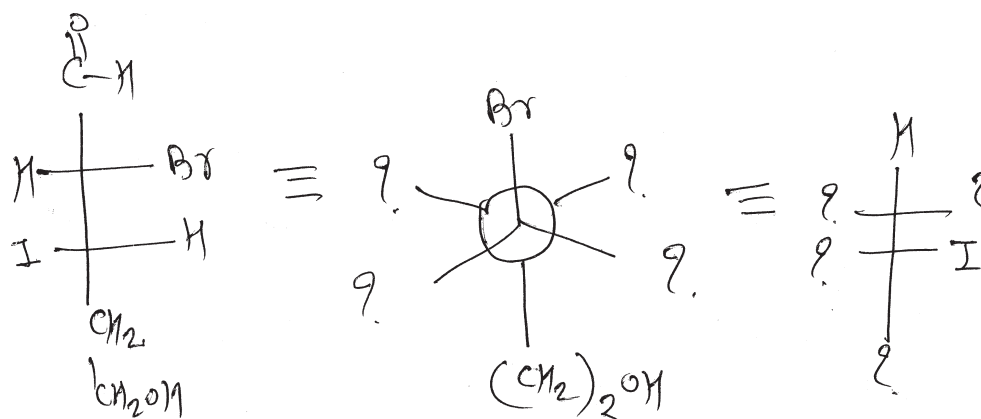


- ii) Assign Re/Si face.



b) Attempt the following: [6]

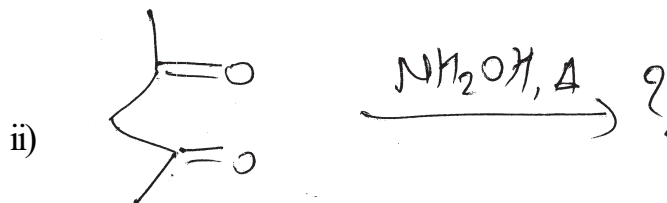
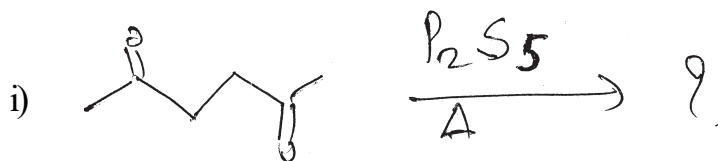
- i) Convert the following in perspective formulae.



- ii) Explain stereospecific reaction with suitable example.

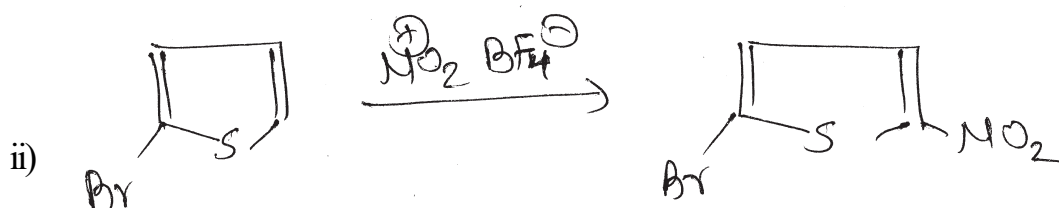
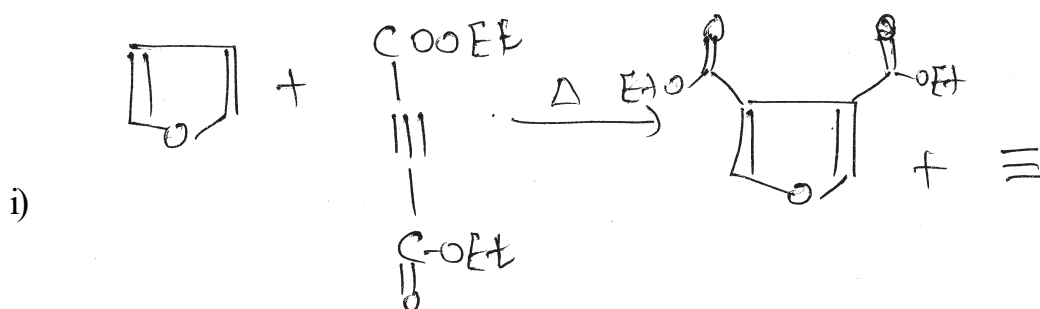
Q3) a) Predict the products with mechanism.

[6]



b) Suggest the mechanism of the following:

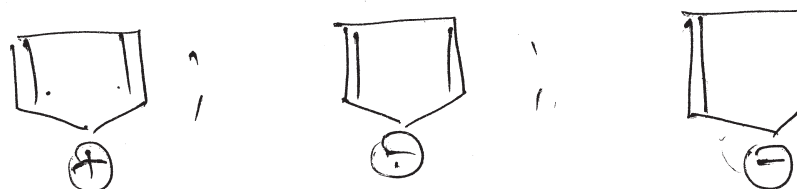
[6]



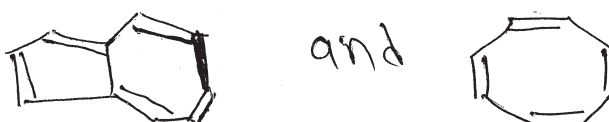
Q4) a) Attempt the following:

[6]

i) Identify aromatic, antiaromatic and non-aromatic compound.



ii) Comment stability of the following compounds.



b) Write not on Paal-Knorr synthesis.

[6]

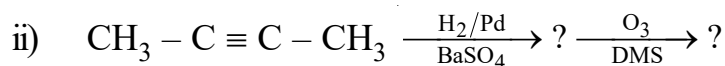
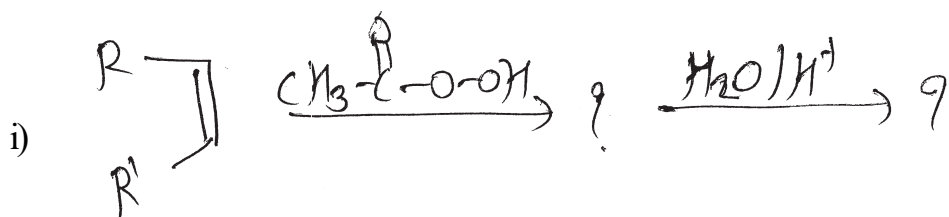
SECTION - II

Q5) a) Attempt the following: [8]

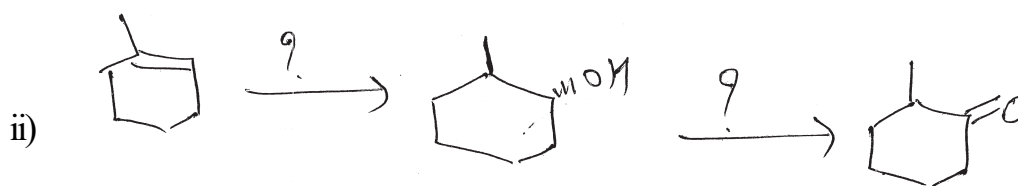
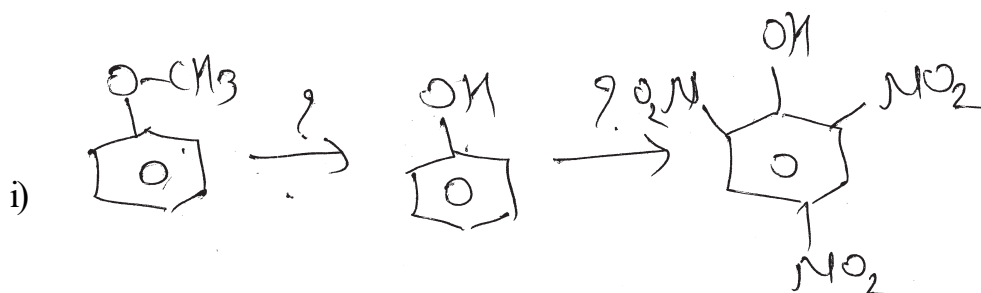
- i) Discuss the stability of free radicals.
- ii) Explain Benzil-Benzilic acid rearrangement.
- iii) Discuss the use of $\text{Pb}(\text{OAc})_4$.
- iv) Why CrO_3 is not useful for formation of aldehyde from primary alcohol.

b) Explain NGP with suitable example. [3]

Q6) a) Predict the products with mechanism. [6]



b) Suggest the reagent's in the following conversion. [6]



Q7) a) Attempt the following: [6]

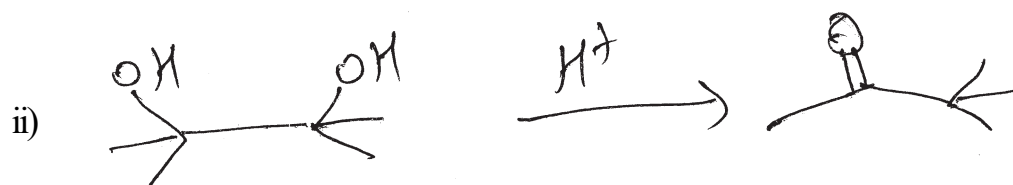
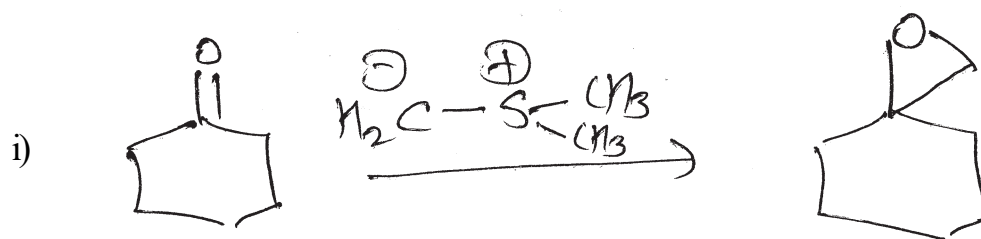
- i) Hoffmann Rearrangement
- ii) Wolff Rearrangement

b) Attempt the following: [6]

- i) Explain the role of phosphorous ylide in organic synthesis.
- ii) Give any two methods for synthesis of primary alcohol.

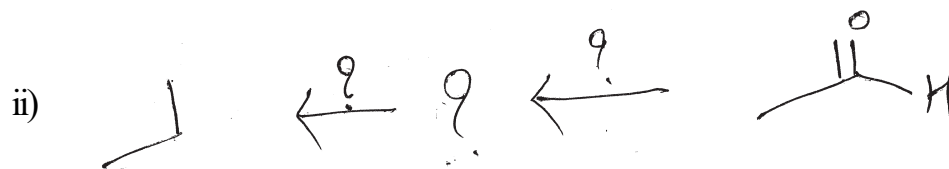
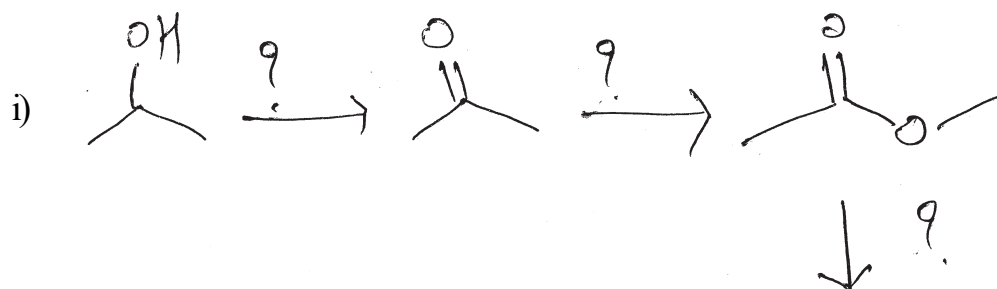
Q8) a) Suggest the mechanism of the following reactions.

[6]



b) Complete the following reaction sequence.

[6]



~~~~~

Total No. of Questions : 4]

SEAT No. :

PE-5275

[Total No. of Pages : 7

[6510]-104

First Year M.Sc.

CHEMISTRY

CHG-190, CBOP-1 : General Chemistry  
(2019 Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Question-1 is compulsory.
- 2) Question 2-4 carry equal marks and solve any two from question 2-4.
- 3) Figures to the right indicate full marks.

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

- i) What is photoconductivity?
- ii) What is f center?
- iii) What are stoichiometric and non-stoichiometric compounds?
- iv) Draw the circuit diagram for FET.
- v) Calculate no. of atoms per unit cell in FCC crystal structure.

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

Cadmium sulfide show absorbance at 2-60eV calculate band gap in AM and predict that do it will show photoconductivity in visible radiations.

**Q2) a)** Solve the following: [6]

- i) Explain the synthesis of cds nanoparticles.
- ii) Explain sol-method for synthesis of solids.

**b)** Solve the following: [6]

- i) What is p-n junction? Explain the p-n junction in reverse and forward bias.
- ii) Explain construction and working of fuel cell.

P.T.O.

- Q3)** a) Solve the following: [6]
- i) Write note on solid electrolytes.
  - ii) Write note on superconductivity.
- b) Solve the following: [6]
- i) Explain ceramic method for synthesis of solid. Give disadvantages of this method.
  - ii) Write note on colour centers.
- Q4)** a) Explain band theory with respect to Li metal and give the difference among conductors, semiconductors and insulators. [6]
- b) Solve the following: [6]
- i) Define and explain Frankel defects under what condition Frankel defects are observed.
  - ii) Write note on structure of  $\text{YBa}_2\text{Cu}_3\text{O}_7$ .



Total No. of Questions : 4]

SEAT No. :

PE-5275

[6510]-104

First Year M.Sc.

CHEMISTRY

**CHG-190 : Introduction to Chemical Biology - I**  
**(2019 Pattern) (Semester - I)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates:*

- 1) Question-1 is compulsory.*
- 2) Question 2 to 4 carry equal marks.*
- 3) Solve any two questions from 2 to 4*
- 4) Draw diagram wherever necessary.*

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

- i) What do you mean by rancidity of lipids.
- ii) State any two physico chemical properties of amino acids.
- iii) Name the sialic acid mostly found in structure of glycoprotein and glycolipids.
- iv) What is the role of integral protein in cell membrane?
- v) Draw the structure of acidic amino acids.

**b)** What is facilitated diffusion? Explain with suitable example. **[3]**

**Q2)** Attempt the following questions:

- a) Comment on structure and function of different organelles of eukaryotic cell. **[6]**
- b) Give the characteristics of peptide bond. **[3]**
- c) Comment on fluid mosaic model of cell membrane by Singer and Nicholson. **[3]**

**Q3)** Answer the following questions.

- a) What are the different types of transport? Explain  $\text{Ca}^{+2}\text{ATPase}$  pump. [6]
- b) What are homopolysaccharides? Explain structure and function of glycogen. [3]
- c) Draw the structures of amino acid containing nonpolar aliphatic side chains. [3]

**Q4)** Solve the following questions.

- a) Classify lipids with suitable example. [6]
- b) Give details of forces involved in stabilizing the tertiary structure of protein. [3]
- c) Explain the following in brief. [3]
  - i) Protein denaturation
  - ii)  $\alpha$ -helical structure



PE-5275

[6510]-104

First Year M.Sc.

CHEMISTRY

CHG-190 : Chemical Mathematics

(2019 Pattern) (Semester - I)

Time : 2 Hours]

[Max. Marks : 35

*Instructions to the candidates:*

- 1) Question-1 is compulsory.
- 2) Question 2-4 carry equal marks.
- 3) Solve any two questions from 2 to 4
- 4) Figures to the right side indicate full marks.
- 5) Use of log tables or non programmable calculator is allowed.

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

i) Give the derivative of

1)  $\sin x$

2)  $\sec x$

ii) Define

1) Conjugate point

2) CUSP

iii) Give the rule for differentiation a function of a function.

iv) State whether the following differential equation is exact or inexact.

$$(x^2y + x)dy + (xy^2 - y)dx = 0$$

v) Find the order of the following determinant

$$\begin{bmatrix} -1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ -2 & 2 & 5 & 0 \\ 0 & 0 & 2 & 1 \end{bmatrix}$$

**b)** Write a note on Taylor theorem. **[3]**

**Q2) a) Solve the following:** [6]

i) Differentiate the following w.r.t.  $x$

$$\left(x + \frac{1}{x}\right)^3$$

ii) Integrate the following w.r.t. independent variable

$$\int x^3 + 3x^2 + 8x dx$$

**b) Solve the following:** [6]

i) Find the determinant of

$$\begin{bmatrix} 9 & 6 & 7 \\ 5 & 3 & 2 \\ 1 & 8 & 1 \end{bmatrix}$$

ii) Give any two differential equations in Physical Chemistry.

**Q3) a) Solve the following:** [6]

i) Differentiate the following w.r.t.  $x$

$$(3x + 4)^{x+6}$$

ii) Evaluate the following integral by substitution method

$$\int (ax + b)^{10} dx$$

**b) Solve the following:** [6]

i) Find the co-factor of

$$\begin{bmatrix} 3 & 6 & 9 \\ 4 & 5 & 2 \\ 3 & 6 & 4 \end{bmatrix}$$

ii) Find out whether the following equation exhibits a maxima or minima

$$y = 2x^3 + 4x^2 - 36x + 16$$

**Q4) a)** Solve the following: **[6]**

i) If  $x = at^3$   $y = 2at^2$

find  $dy/dx$

ii) Integrate

$$\int_0^4 (x+1)(x^3-2)dx$$

**b)** Solve the following: **[6]**

i) If  $A = \begin{bmatrix} 2 & 6 & 3 \\ 1 & 9 & 3 \end{bmatrix}$   $B = \begin{bmatrix} 3 & 2 \\ 8 & 5 \\ 9 & 4 \end{bmatrix}$  find AB.

ii) Give any three rules of partial derivatives with suitable examples.



Total No. of Questions :8]

SEAT No. :

PE-5276

[Total No. of Pages : 4

**[6510]-201**  
**First Year M.Sc.**  
**CHEMISTRY**  
**CHP-210 : Molecular Spectroscopy and**  
**Nuclear Chemistry**  
**(2019 Pattern) (Semester - II)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

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

**Physico - Chemical Constant**

|                         |           |   |                                                                                                                                                         |
|-------------------------|-----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Avogadro Number      | N         | = | $6.022 \times 10^{23} \text{ mol}^{-1}$                                                                                                                 |
| 2. Boltzmann Constant   | k         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J s}$                                                                          |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equiv}^{-1}$                                                                                                                            |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.184 \times 10^7 \text{ erg}$<br>$= 4.184 \text{ J}$                                                                                                  |
| 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.**

## SECTION - I

**Q1) Attempt the following: [10]**

- a) What is the effect of isotopic substitution on the nature of the rotation spectrum?
- b) Define zero point energy. Give its significance.
- c) State the conditions for Raman activity.
- d) What is Born-Oppenheimer approximation?
- e) Give any two applications of Mossbauer spectroscopy.

**Q2) Attempt any two of the following: [10]**

- a) What is centrifugal distortion constant? Derive the relation between centrifugal distortion constant and rotational constant.
- b) Sketch and explain the different stretching vibrational frequencies for  $\text{H}_2\text{O}$  and  $\text{CO}_2$  molecule.
- c) Write a brief account of the classical theory of Raman effect.
- d) Discuss the applications of IR spectroscopy.

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

- a) What is Fortrat Parabola? Obtain the expression for the band head in terms of  $B'$  and  $B''$ .
- b) Describe the instrumentation used in Mossbauer Spectroscopy.
- c) Write a note on predissociation spectra.
- d) Explain UPES with the help of a spectrum for CO molecule.

**Q4) Solve any one of the following: [5]**

- a) The rotational constant for  $^{79}\text{Br}^{19}\text{F}$  is  $0.35717 \text{ cm}^{-1}$ . What is the value of  $J$  for which the most intense line will be seen at 300K.
- b) The fundamental and first overtone transition for H-Br are centered at  $2559.26 \text{ cm}^{-1}$  and  $5028.11 \text{ cm}^{-1}$ . Calculate equilibrium vibrational frequency, anharmonicity constant and exact zero point energy of the molecule.

[Atomic weight for H = 1, Br = 80].

## SECTION - II

**Q5) Attempt the following:** **[10]**

- a) State Geiger-Nuttal's law
- b) Define the terms radiation track and spurs.
- c) What are prompt and delayed neutrons?
- d) Give the preparation of  $^{22}\text{Na}$  and  $^{35}\text{S}$ .
- e) What are the advantages of NAA?

**Q6) Attempt any two of the following:** **[10]**

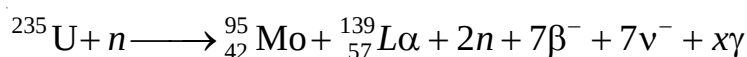
- a) Explain in detail the Auger effect.
- b) What are the various units for measurements of radiation energy? How are they related to each other?
- c) How are primary radiolytic products of water formed? Describe in brief Lea-Gray-platzman model.
- d) Derive the general expression for the activity of a daughter nuclide.

**Q7) Attempt any two of the following:** **[10]**

- a) Describe with suitable example how surface area of a powder can be determined with the help of radioisotope.
- b) Give the principle of NAA. How is it used to determine arsenic in human air?
- c) Explain the term neutron evaporation and spallation.
- d) Write a note on Fricke dosimetry.

**Q8) Solve any one of the following:** **[5]**

- a) Calculate the energy of following fission reaction



Given mass of  $^{235}\text{U}$  = 235.0439 amu

n = 1.0087 amu

$^{95}\text{Mo}$  = 94.9057 amu

$^{139}\text{La}$  = 138.9061 amu

b) Calculate the linear absorption coefficient of methanol.

Given  $\sigma = 0.211$  barn/electron, density of methanol =  $0.713 \text{ gm cm}^{-3}$ ,

Z of C = 6, H = 1, O = 8,

A of C = 12, H = 1, O = 16.



Total No. of Questions : 6]

SEAT No. :

PE-5277

[Total No. of Pages : 3

[6510]-202

First Year M.Sc.

INORGANIC CHEMISTRY

CHI-230 : Coordination and Bioinorganic Chemistry  
(2019 Pattern) (Semester - II)

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 book.
- 3) Neat and labelled diagram must be drawn wherever necessary.
- 4) Figures to the right side indicate full marks.
- 5) Use of calculators is allowed.

SECTION - I

Q1) a) Answer the following: [8]

i) Calculate the total degeneracy for the following state and configuration

- 1)  $3.3 T_{1g}$
- 2)  $(t_{2g})^3$

ii) Assign the J values and work out possible R.S. term symbols from the given data:

- 1)  $L = 2, S = 1$
- 2)  $L = 2, S = 1/2$

iii) Arrange the following terms in increasing order of energy and justify your answer:

- 1)  $2H^3F^3I^2S^1D$
- 2)  $4S^4P^3F^2G^3D$

iv) State and explain: Curie Law.

b) What is spin selection rule for electronic transition? Explain with suitable example. [3]

P.T.O.

- Q2) a)** Answer any one of the following: [6]
- Classify the following transitions in octahedral complex as orbitally allowed, vibronically allowed and forbidden transitions. Justify your answer:
    - $A_{2g} \rightarrow A_{2g}$
    - $A_{2g} \rightarrow T_{2g}$
    - $E_g \rightarrow E_g$
  - Prepare a table of microstates and obtain allowed R.S. term symbols for the  $P^2$  configuration.
- b)** Answer any two of the following: [6]
- Determine the ground state term symbol for:
    - $Ti^{2+}(Z = 21)$
    - $[Cr(H_2O)_6]^{3+}(Z = 24)$
  - $CO^{2+}(Td)$  complex shows 23% increase in its observed magnetic moment value. Calculate spin orbital coupling constant using following data ( $10 Dq = 3000 \text{ cm}^{-1}$ )
  - Write a note on nephelauxetic and spectrochemical series.
- Q3) a)** Answer any one of the following: [6]
- Determine the spin multiplicities at states arising from  $(eg)^2$  configuration when infinitely strong octahedral field is relaxed to strong field using Bethe's method of descending symmetry, correlation table and direct product table.
  - Give the splitting of I term in weak cubic field using character table for pure rotational point group (O) and reduction formula.
- b)** Answer any two of the following: [6]
- For hexaaquo  $Co(II)$  complex ion, three absorption bands are observed at  $8100 \text{ cm}^{-1}$ ,  $16000 \text{ cm}^{-1}$  and  $19400 \text{ cm}^{-1}$ . Calculate crystal field splitting parameter and nephelauxetic ratio. Comment on nature of M-L bond. (Given:  $B_0 = 971 \text{ cm}^{-1}$ )
  - How would you account for the magnetic moment listed against the following complex.  $[Ni(H_2O)_6]^{2+} \mu_{\text{obs}} = 3.23 \text{ B.M.}$
  - Write a note on : Racah parameters.

## **SECTION - II**

- Q4) a)** Answer the following: **[8]**
- i) What are two pair electron transfer metalloenzyme?
  - ii) What is nitrogen fixation? Which metalloenzyme involved in it?
  - iii) What are the functions of Na and K in biological system?
  - iv) What are the common oxidation state of Cr and Mn found in biological system?
- b) Explain the biopolymer effect. **[3]**
- 
- Q5) a)** Answer any one of the following : **[6]**
- i) What is function of iron-sulfur protein? Explain the different types of iron-sulfur protein.
  - ii) What is ionophore? Explain the types of ionophores.
- b) Write a note on any two of the following: **[6]**
- i) Transferrin
  - ii) Hemocyanin
  - iii) Magnesium in photosystem-I
- 
- Q6) a)** Answer any one of the following: **[6]**
- i) Explain in detail role of ran in photosystem - II.
  - ii) Explain the role of metal and complexes in medicine.
- b) Answer any one of the following: **[6]**
- i) Describe the suitable example of two types of electron transfer reaction in complexes.
  - ii) What are model complexes? Explain the types of model complexes.
  - iii) Explain geometrics and oxidation state of metal ion in biological system.



Total No. of Questions : 8]

SEAT No. :

PE-5278

[Total No. of Pages : 5

**[6510]-203**  
**First Year M.Sc.**  
**CHEMISTRY**  
**CHO-250 : Photochemistry, Pericyclic and Organic**  
**Spectroscopy**  
**(2019 Pattern) (Semester - II)**

*Time : 3 Hours]*

*[Max. Marks : 70*

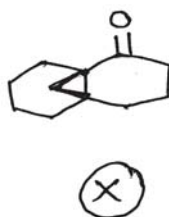
*Instructions to the candidates:*

- 1) *Q.No.1 and Q.No. 5 are compulsory.*
- 2) *Solve any two from Q-2 to Q-4 and any two from Q-6 Q-8.*
- 3) *Write both sections in separate answer sheet.*

**SECTION - I**

**[Photo chemistry and Pericyclic Reactoins]**

- Q1) a)** Construct co. relation diagram for  $\pi_s^4 + \pi_s^2$  cycle addition reaction and Explain whether these reactions are thermally allowed or photochemically. **[5]**
- b)** Attempt the following **[6]**
- i) Explain different physical process occurs when a molecule is excited photochemically with the help of Jablonski diagram.
  - ii) Product (⊗) formed by photochemical reaction. suggest the starting material and suitable mechanism for formation of it.

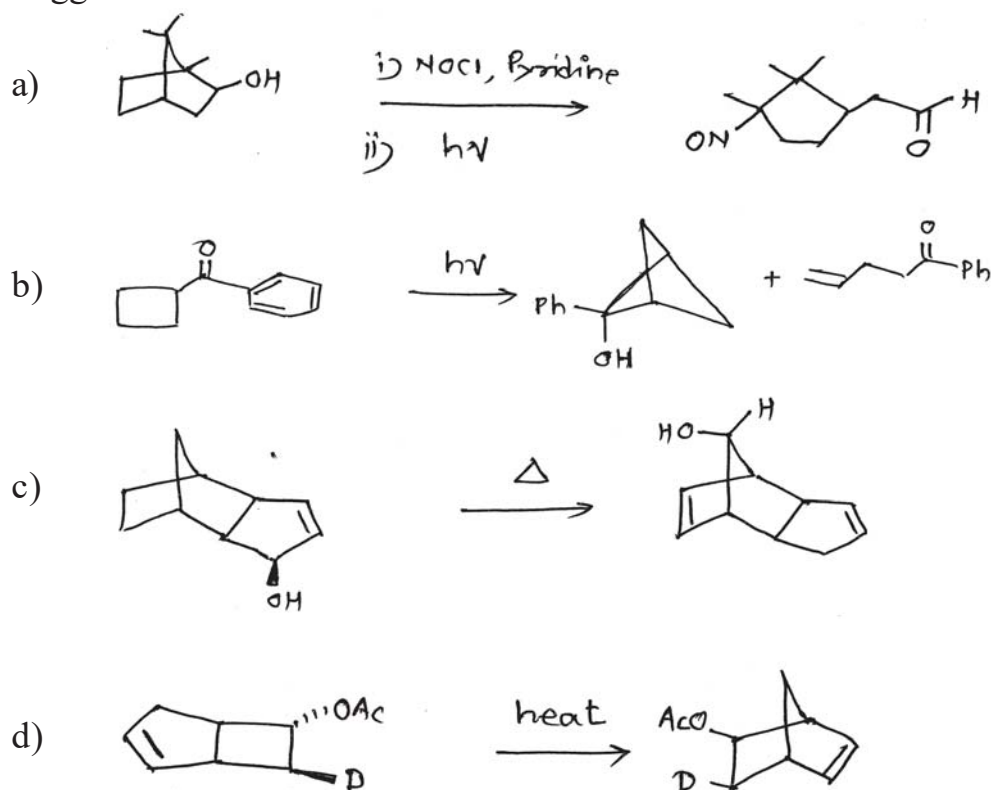


- Q2) Attempt all of the following.** **[12]**
- a) Explain Paterno Buchi reactions in photochemistry.
  - b) What is quantum yield? Give importance and calculation method for it.
  - c) By using FMO approach, predict the allowed rotatory process for pentadienyl cation in photochemical and thermal condition.
  - d) Write a note on 'Cope Rearrangement'

**P.T.O.**

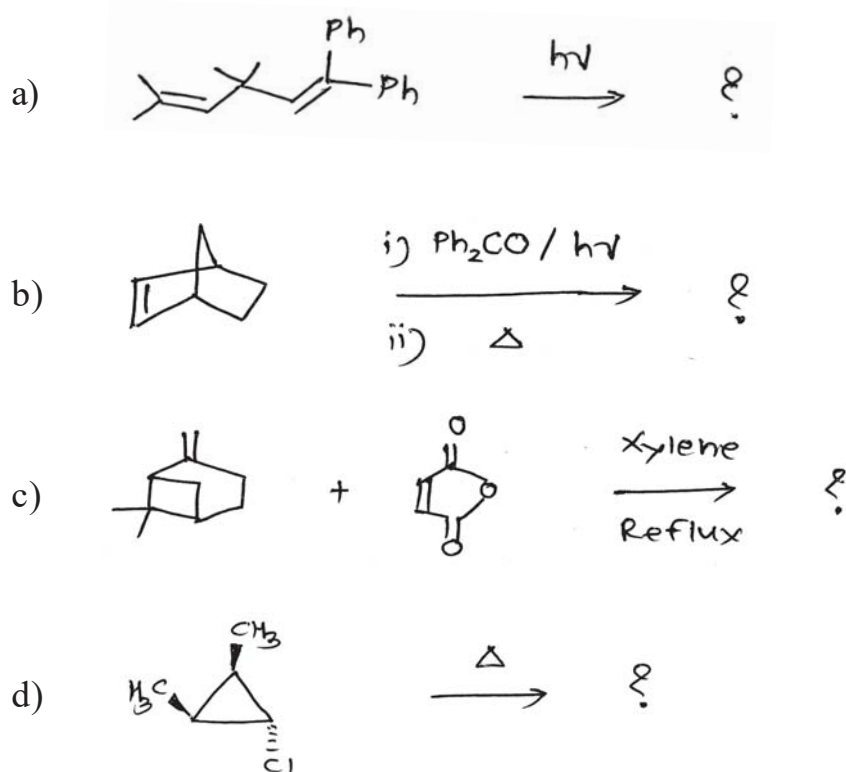
Q3) Suggest the mechanism.

[12]



Q4) Predict the product/s with mechanism.

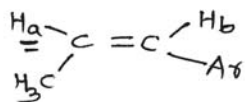
[12]



## SECTION - II

### [Spectroscopic Methods in Structure Determination of Organic Compounds]

- Q5) a)** Find line splitting pattern of given signal of  $H_a$  proton at  $\delta = 5$  ppm on 400 MHz. [3]

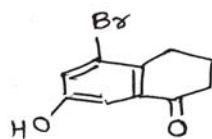


$$J_{H_a-H_b} = 12 \text{ Hz}$$

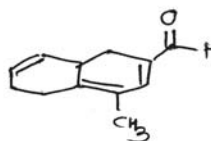
$$J_{H_a-CH_3} = 6 \text{ Hz}$$

- b)** Attempt the following [8]

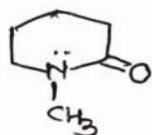
- i) Calculate  $\lambda_{\max}$  for the following compounds.



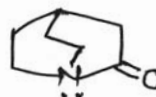
and



- ii) How will you distinguish following pair using IR spectroscopy?



and

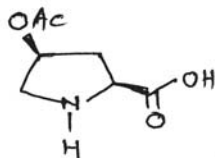


- iii) How will you distinguish cyclic isomers of  $C_4H_8O_2$  by CMR.  
iv) What is nitrogen rule in Mass spectrometry?

- Q6) a)** Write a note on any two of following [6]

- i) Field effect in IR spectroscopy  
ii) Spin-Spin splitting  
iii) Significance of molecular ion and base peak in mass spectrometry.

- b)** Assign various  $^{13}C$  signals for following compound. Justify assignments. [3]



21.3 (q)

41.9 (t)

57.7 (t)

64.5 (d)

73.9 (d)

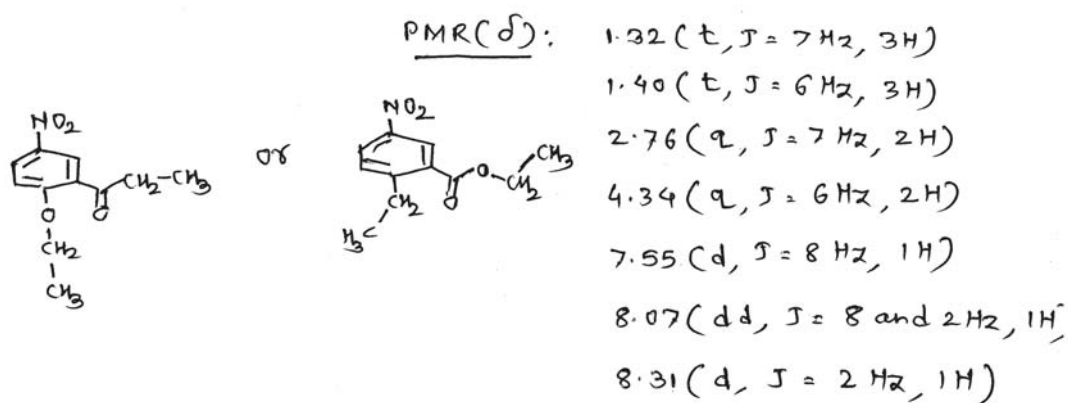
170.2 (s)

179.2 (s)

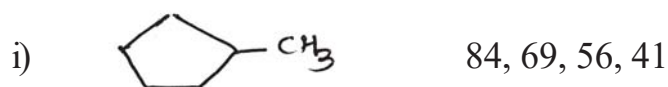
- c)** Explain the concept of magnetically equivalent and non-equivalent protons with suitable examples. [3]

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

- Increase in conjugation shifts absorption maxima to longer wavelength. Explain.
  - D<sub>2</sub>O exchange method in NMR spectroscopy.
  - <sup>13</sup>C – <sup>13</sup>C coupling not observed in CMR. Explain.
- b) Based on the given data, identify the correct structure from following and assign signals with justification. [3]



c) Give the genesis of ions in following compounds [3]



**Q8)** Deduce the structure of any THREE of the following using spectral data and justify your answer. [12]

- M.F:- C<sub>12</sub>H<sub>16</sub>O

IR:- 1710, 1603, 758, 688 cm<sup>-1</sup>

M.S. : 176 (M<sup>+</sup>), 119 (strong), 77, 43 (m/2)

PMR:- 1.41 (S, 6H)

(δ) 1.9S (S, 3H)

2.74 (S, 2H)

7.23 (S. 5H)

- ii) M.F:  $C_5H_{10}O$   
 UV: 280 nm ( $E = 20$ )  
 IR:  $1710\text{ cm}^{-1}$   
 M.S: 86, 71, 44, 43  
 ( $m/2$ )  
 PMR:- 1.1 (d,  $J = 7\text{ Hz}$ , 30 mm)  
 ( $\delta$ ) 2.0 (S, 15 mm)  
 2.6 (Septet,  $J = 7\text{ Hz}$ , 5 mm)
- iii) M.S:-  $C_4H_9ON$   
 IR:-  $1692\text{ cm}^{-1}$   
 CMR:- 12.1 (q), 26.5 (q), 29.3 (t), 175.2 (s)  
 ( $\delta$ )
- iv) M.F.:  $C_5H_6O_3$   
 IR:-  $1820, 1770\text{ cm}^{-1}$   
 PMR :- 1.95 (q,  $J = 6.5\text{ Hz}$ , 10 mm)  
 ( $\delta$ ) 2.72 (t,  $J = 6.5\text{ Hz}$ , 20 mm)



Total No. of Questions : 4]

SEAT No. :

PE-5279

[Total No. of Pages : 6

[6510]-204

First Year M.Sc.

CHEMISTRY

**CHG-290 : Material Characterization Technique  
(2019 Pattern) (Elective Option - A) (Semester - II)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates:*

- 1) *Question No.1 is compulsory.*
- 2) *Questions 2 to 4 carry equal marks.*
- 3) *Solve any two questions from Q.No.2 to Q.No.4.*
- 4) *Figures to right indicate full marks.*

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

- i) Give the equation for X-ray intensity passing through a thickness  $\eta$ .
- ii) Give any two matrix effects in XRF.
- iii) Give the equation co-relating  $\lambda$  and  $V$  in XRD.
- iv) What is critical angle for total reflection in TRXRF.
- v) Give any two points of difference between optical and transmission microscopy.

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

Aluminum has FCC crystal structure with ' $a$ ' value  $4.025\text{\AA}$ . In a XRD spectrum with  $\text{CuK}\alpha = 1.5406\text{\AA}$ , Calculate  $\theta$  value for 1<sup>st</sup> and 2<sup>nd</sup> order reflection from [100] plane.

**Q2) a)** Answer the following: **[6]**

- i) How  $d$  value is determined from Bragg's equation and how it is related to the miller indices?
- ii) Compare SEM and TEM.

**b)** Answer the following: **[6]**

- i) Explain in detail the principle of EDS. How are EDS spectral peaks identified.
- ii) Compare XRD and selected area diffraction in TEM.

**P.T.O.**

- Q3) a)** Answer the following: [6]
- i) Explain the instrumentation of XRD.
  - ii) Explain the electromagnetic lenses used in TEM.
- b)** Answer the following: [6]
- i) What is an internal standard? Why internal standard is used in XRF for quantitative analysis. Give methodology for internal standard.
  - ii) Explain the sample preparation in SEM.
- Q4) a)** Answer the following: [6]
- i) Write a note on peak broadening in XRD.
  - ii) Sketch a neat labelled diagram of the structure of a scanning electron microscope.
- b)** Answer the following: [6]
- i) Explain the sample preparation in XRF. Give the environment in XRF.
  - ii) Write a note on electron sources used in TEM.



PE-5279

[6510]-204

First Year M.Sc.

CHEMISTRY

### CHG-290 : Organometallic and Inorganic Reaction Mechanism

(2019 Pattern) (Elective Option - B) (Semester - II)

Time : 2 Hours]

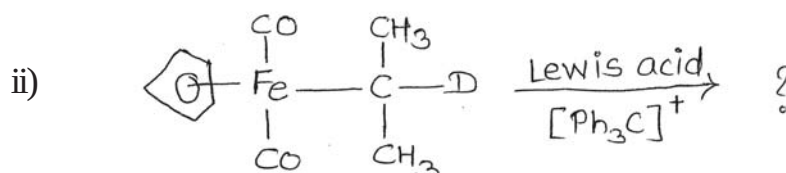
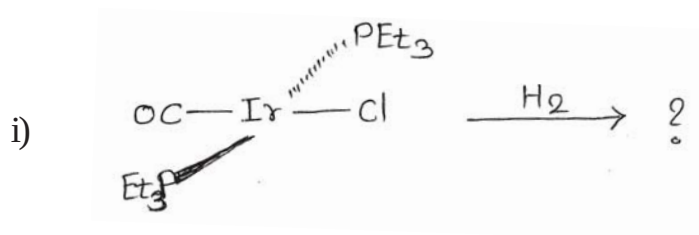
[Max. Marks : 35

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Questions 2 to 4 carry equal marks.
- 3) Solve any two questions from Q.No.2 to Q.No.4.
- 4) Figures to right indicate full marks.

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

- i) Determine valence electron counts for the following complexes:
  - i)  $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CO})_2\text{Cl}]$
  - ii)  $[\text{RhCl}(\text{PPh}_3)_3]$
- ii) On the basis of  $18e^-$  rule find the charge on the following complexes:
  - i)  $[\text{Ti}(\text{CO})_6]^x$
  - ii)  $[\text{Re}(\text{CO})_5(\text{PF}_3)]^y$
- iii) Predict the product and give the type for the following reaction



- iv) Define hydride elimination with suitable example.
- v) Give the rate law for interchange reaction.
- b) Explain water gas shift reaction with suitable example. [3]

- Q2)** a) Explain the role IR and NMR technique in characterization of organometallic compounds. [6]
- b) i) Write three possible mechanisms for carbonyl insertion with suitable example. [3]
- ii) Write a short note on linear free energy relationship in coordination compounds. [3]
- Q3)** a) Explain the hydroformylation process in organometallic compounds with reaction mechanism. [6]
- b) i) Draw orbitals for linear  $\pi$  system 1,3-butadiene [3]
- ii) Define inert and labile complexes. Classify following complexes into inert and labile [3]
- $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$  ;  $[\text{V}(\text{H}_2\text{O})_6]^{2+}$  ;  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
- Q4)** a) Explain kinetic reaction pathways for [6]
- i) Dissociative reaction
- ii) Associative reaction
- b) i) Discuss the any two methods for synthesis of binary carbonyl complexes with suitable example. [3]
- ii) Give an account of Pd-catalyzed cross-coupling cycle. [3]



**PE-5279**

**[6510]-204**

**First Year M.Sc.**

**CHEMISTRY**

**CHG-290 : Introduction to Chemical Biology - II  
(2019 Pattern) (Elective Option - C) (Semester - II)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates:*

- 1) *Question No.1 is compulsory.*
- 2) *Questions 2 to 4 carry equal marks.*
- 3) *Solve any two questions from Q.No.2 to Q.No.4.*
- 4) *Draw diagram whenever necessary.*

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

- i) What is Ori C sequence? Give its significance for initiation of DNA replication.
- ii) Explain in brief central dogma of molecular biology.
- iii) Give the principle of dialysis method used in protein purification.
- iv) What is the effect of temperature on enzyme activity?
- v) Give the reaction for following conversion  
pyruvate to lactate

**b)** Write a note on enzyme specificity. **[3]**

**Q2)** Attempt the following questions:

- a) Comment on preparatory and pay off phases of glycolysis pathway. **[6]**
- b) Discuss the elongation stage of transcription process. **[3]**
- c) Write a note on use of enzymes in industry. **[3]**

**Q3)** Answer the following questions:

- a) Explain with suitable example, types of reversible inhibition of enzymes. **[6]**
- b) Write a short account of double helical structure of DNA. **[3]**
- c) Enlist different types of chromatography methods for separation of proteins and amino acids. Give one example of cation exchange resin and anion exchange resin. **[3]**

**Q4)** Solve the following questions:

- a) Discuss in detail salient features of genetic code. Add a note on wobble hypothesis. **[6]**
- b) Explain gene therapy and methods involved in gene therapy. **[3]**
- c) What is active site of an enzyme? State its function in enzyme catalysis. **[3]**



[6510]-301

S.Y. M.Sc.

## PHYSICAL CHEMISTRY

## CHP-310 : Quantum and Solid State Chemistry

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

*Instructions to the candidates:*

- 1) Answer the two sections should be written in separate answer book.
- 2) Questions 1 and 5 are compulsory.
- 3) Answer any 2 questions out of Q. 2, Q. 3 and Q. 4 and any 2 questions out of Q. 6, Q. 7 and Q. 8.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic table, calculator is allowed.
- 6) 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         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ Js}$                                                                           |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.184 \times 10^7 \text{ erg}$<br>$= 4.184 \text{ J}$                                                                                                  |
| 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 | $m_e$     | = | $9.11 \times 10^{-31} \text{ kg}$                                                                                                                       |

## SECTION - I

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

- i) Find the term symbol for  $L = 2$ ,  $S = \frac{1}{2}$ .
- ii) State the condition for acceptable wave function.
- iii) Write the condition for operator to be Hermitian.
- iv) Find  $\left[ \frac{d}{dx}, x \right]$ .
- v) State the principle of variation method.

b) Construct the energy operator for  $H_2^+$  ion and  $H_2$  molecule. **[3]**

**Q2) a)** Attempt the following. **[6]**

- i) Give the steps involved in the application of the variation method.
- ii) Explain the regular and inverted multiplet.

b) Attempt the following **[6]**

- i) State whether each of the following entities is an operator or function.

a)  $\hat{A} f(x)$

b)  $\hat{A}\hat{B}$

c)  $\hat{B}\hat{A}f(x)$

- ii) Explain which information is obtained from term symbols.

**Q3) a)** Derive the expression for second order correction to energy of non-degenerate unperturbed level. **[6]**

b) Attempt the following : **[6]**

- i) Show that linear momentum operator  $(\hat{P}_x)$  is a Hermitian operator.
- ii) State the expression for raising and lowering operator. Explain the terms involved in it.

**Q4) a)** Discuss Hartree-Fock Scf method for multi electron system. **[6]**

b) Attempt the following: **[6]**

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

- ii) State the Russell-Saunders's rules to determine ground state of an atom.

## SECTION - II

- Q5) a)** Attempt any four of the following: [8]
- i) What is Defect? Enlist various types of line defects.
  - ii) State the Bravais law in relation to the crystal growth.
  - iii) Give the function of McLeod gauge and Pirani gauge.
  - iv) Distinguish between metal, semiconductor and insulator.
  - v) What is p-n junction?
- b) Write the equation for Frankel defect and explain the terms involved in it. [3]
- Q6) a)** Attempt the following [6]
- i) Explain the growth of crystal from vapour phase.
  - ii) Discuss the various rate laws for gas-solid reactions.
- b) Attempt the following: [6]
- i) Explain the mechanism of the following solid-solid reaction.  
$$\text{Cu}_{(s)}\text{AgCl}_{(s)} \longrightarrow \text{CuCl}_{(s)} + \text{Ag}_{(s)}$$
  - ii) Discuss the mechanism of diffusion in solids.
- Q7) a)** Sketch and explain the hysteresis loop observed for magnetization of an insulator crystal. [6]
- b) Attempt the following: [6]
- i) Write a note on extrinsic semiconductor.
  - ii) Calculate the specific heat capacity for Pb at 1K [ $\theta_D = 88\text{K}$ ].
- Q8) a)** Discuss Hall effect in semiconductor. [6]
- b) Attempt the following: [6]
- i) The average energy required to create one Schottky defect in the sample of sodium chloride at 25°C is 1.971 eV. If the observed interionic ( $\text{Na}^+ - \text{Cl}^-$ ) distance is 2.82 Å. Calculate the density of Schottky defects in the NaCl sample.
  - ii) Define Climb, Jog and Kink.



[6510]-302

S.Y. M.Sc.

**PHYSICAL CHEMISTRY****CHP-311 : Nuclear, Radiation and polymer chemistry  
(2019 Pattern) (Semester - III)***Time : 3 Hours]**[Max. Marks : 70**Instructions to the candidates:*

- 1) *Answers to the two sections should be written on a separate answer books.*
- 2) *Questions 1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of Q.2, Q3 and Q4 and any 2 questions out of Q.6, Q7 and Q8.*
- 4) *Figures to right indicate full marks.*
- 5) *Use of logarithmic table/calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

**Physico - Chemical Constant**

|     |                     |           |   |                                                                 |
|-----|---------------------|-----------|---|-----------------------------------------------------------------|
| 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         | = | $6.626 \times 10^{-16} \text{ erg s}$                           |
|     |                     |           | = | $6.626 \times 10^{-34} \text{ J s}$                             |
| 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       | $\beta_e$ | = | $-9.274 \times 10^{-24} \text{ J T}^{-1}$                       |
| 12. | Nuclear magneton    | $\beta_n$ | = | $5.051 \times 10^{-27} \text{ J T}^{-1}$                        |
| 13. | Mass of an electron | $m_e$     | = | $9.11 \times 10^{-31} \text{ kg}$                               |

## SECTION - I

- Q1) a)** Attempt any four of the following: **[8]**
- i) Explain the properties of Scintillators.
  - ii) Draw the neat labelled diagrams of RBS experiment.
  - iii) Discuss the principle of PIXE technique.
  - iv) Explain the role of moderator in nuclear reactor.
  - v) Define fissile and fertile nuclide.
- b) Describe general aspects of reactor design. **[3]**
- 
- Q2) a)** Attempt the following: **[6]**
- i) Write a note on Photonuclear reactions.
  - ii) Explain scattering reaction.
- b) Attempt the following: **[6]**
- i) Find excitation energy of a compound nuclear formed by bombarding  $^{20}\text{Ne}$  by 7 Mev deuterons.  
[Given: a of  $^{20}\text{Ne} = 19.59244 \text{ u}$   
 $d = 2.01402 \text{ u}$   
 $^{22}\text{Na} = 21.9447726 \text{ u}$
  - ii) Discuss merits and demerits of nuclear shell model.
- 
- Q3) a)** Explain the role of TI in NaI (T1) scintillators. **[6]**
- b) Attempt the following: **[6]**
- i) Explain the different types of nuclear research reactors.
  - ii) Discuss the working of semiconductor detectors.
- 
- Q4) a)** Describe the conservations of protons of neutrons in nuclear reaction. **[6]**
- b) Attempt the following: **[6]**
- i) Explain regeneration and breeding of fissile matter.
  - ii) Give the application of PIXE of RBS.

## SECTION - II

- Q5) a)** Attempt any four of the following: [8]
- i) Define Homo or heterochain polymer.
  - ii) Enlist the molecular forces involved in polymers.
  - iii) Explain copolymerisation.
  - iv) Define polydispersity and degree of polymerization.
  - v) Write the equation which relates the B.P elevation to molecular weight?
- b) Explain the method to determine the molecular weight by viscosity measurement. [3]
- 
- Q6) a)** Answer the following: [6]
- i) Discuss the classification of polymers on the basis of synthesis.
  - ii) Explain the methods to determine reactivity ratios.
- b) Answer the following: [6]
- i) Distinguish between thermoplastic and thermosetting polymer.
  - ii) Explain the concept of average molecular weight of polymers.
- 
- Q7) a)** Describe Ebulliometry method to determine molecular weight. [6]
- b) Answer the following: [6]
- i) A sample of polymer contains 0.5 mole fraction with molecular weight 100000 and 0.5 mole fraction with molecular weight 200000. Calculate  $\bar{M}_n$  and  $\bar{M}_w$ .
  - ii) Discuss Sedimentation equilibrium method.
- 
- Q8) a)** Describe vapour phase osmometry technique to determine molecular weight of polymer. [6]
- b) Answer the following: [6]
- i) Explain Flory theory for polymer solutions.
  - ii) Discuss addition and condensation polymerization.



Total No. of Questions : 8]

SEAT No. :

PE-5282

[Total No. of Pages : 3

[6510]-303

S.Y. M.Sc.

PHYSICAL CHEMISTRY

CHP-312 : Physicochemical Methods of Analysis

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answers to two sections should be written in separate answer book.
- 2) Question 1 and 5 are compulsory.
- 3) Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q. 6, Q.7.
- 4) Figures to right indicate full marks.
- 5) Use of logarithmic table/calculator is allowed.
- 6) 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         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J s}$                                                                          |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equiv}^{-1}$                                                                                                                            |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.184 \times 10^7 \text{ erg}$<br>$= 4.184 \text{ J}$                                                                                                  |
| 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.

## SECTION - I

- Q1) a)** Attempt any four of the following: **[8]**
- i) Define the term K.E. of ejected electron and Fermi energy level.
  - ii) What is mean by EXAFS? Give two application of X-ray absorption?
  - iii) What is the basic difference between DTA and DSC?
  - iv) Define absorptive edge and state it's use.
  - v) Draw a neat labelled block diagram of thermobalance.
- b) Discuss the application of DSC techniques. **[3]**
- 
- Q2) a)** Answer the following: **[6]**
- i) Explain any one analyser used in ESCA with neat labelled diagram.
  - ii) Calculate the short wavelength cutoff the lamp when an accelerating potential in an X-ray tube is 15.5 k.v.
- b) Answer the following: **[6]**
- i) Describe cylindrical mirror analyser used in ESCA.
  - ii) Explain the factors affecting DTA.
- 
- Q3) a)** Write a note on ESCA satellite peaks. **[6]**
- b) Answer the following: **[6]**
- i) Explain the various factors which affect thermogrametric analysis.
  - ii) Write Duane-Hunt equation and explain the term involved in it.
- 
- Q4) a)** Describe Heal-Flux DSC instrument. **[6]**
- b) Answer the following: **[6]**
- i) Explain Chemical analysis by X-ray absorption.
  - ii) 120 mg sample containing a mixture of NaCl (mol.wt. 58.5) and  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  (mol.wt.146) showed a loss of 7.00 mg at 140°C on TG curve. Determine the percentage of calcium oxalate in the sample.

## SECTION - II

- Q5) a)** Attempt any four of the following: [8]
- i) State the principles of amperometric titration.
  - ii) Give the factors affecting the photoluminescence.
  - iii) State the characteristics of plasma.
  - iv) State the principle of hydrodynamic voltammetry.
  - v) Draw a neat labelled diagram of typical ICP course.
- b) Explain 'T' route mechanism for electro chemiluminescence. [3]
- Q6) a)** Answer the following: [6]
- i) Write a technique of amperometric titration.
  - ii) Define singlet, doublet and triplet states.
- b) Answer the following: [6]
- i) Draw a neat labelled diagram of typical plasma and show different temperature zone in it.
  - ii) Describe quantitative analysis by chemiluminescence.
- Q7) a)** Enlist the advantages of coulometric titration. [6]
- b) Answer the following: [6]
- i) What is heavy atom effect observed in photoluminescence?
  - ii) At what value should the cathode potential be controlled if it is desired to separate silver from 0.005M solution of  $\text{Cu}^{2+}$  ions?  
[Given:  $E_{\text{oxi}}^{\circ} \text{Cu}^{2+} = -0.337\text{V}$ ]
- Q8) a)** Discuss briefly the technique of pulse voltammetry with it's advantages. [6]
- b) Answer the following: [6]
- i) Describe hydrodynamic voltammetry
  - ii) A controlled potential coulometric assay of 30mL  $\text{Cu}^{2+}$  solution was performed with the following electrochemic reaction.  $\text{Cu}^{2+} + 2\text{e}^{-} = \text{Cu}$ . If the area under the current-time curve is 20.6 mA min. Calculate the concentration of  $\text{Cu}^{2+}$  in the solution [At. wt of Cu = 63.5]



Total No. of Questions : 8]

SEAT No. :

PE-5283

[Total No. of Pages : 3

[6510]-304

S.Y. M.Sc.

PHYSICAL CHEMISTRY

CHP-313(A) : Photochemistry And Techniques in Polymer Chemistry

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answers to the two sections should be written in a separate answer books.
- 2) Question 1 and 5 Compulsory.
- 3) Answer any 2 questions out of Q2, Q3 and Q4 and any 2 questions out of Q6, Q7, and Q8.
- 4) Figures to right side indicate full marks.
- 5) Use of logarithmic table/calculator is allowed.
- 6) 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         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-16} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J s}$                                                                          |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.187 \times 10^7 \text{ erg}$<br>$= 4.187 \text{ J}$                                                                                                  |
| 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) Solve any four from the following: [8]
- i) What is photochemical pathway?
  - ii) Define effective light of photochemical changes.
  - iii) What is short term radiation?
  - iv) Give the important characteristics of Fluorescence.
  - v) What is Flash Photolysis?
- b) What are the types of electronic transition in organic molecule? [3]
- 
- Q2)** a) Explain in detail. [6]
- i) Discuss the working of linear accelerators.
  - ii) Explain the term delayed fluorescence.
- b) Answer the following:
- i) Explain photochemical kinetics of unimolecular process. [3]
  - ii) Discuss the Einsteins treatment on adsorption phenomenon. [3]
- 
- Q3)** a) Derive the Stern-volmer equation for the kinetics of collisional quenching. [6]
- b) Answer the following:
- i) What is meant by Quenching and state its importance. [3]
  - ii) Explain the term stimulated emission. [3]
- 
- Q4)** a) Explain the Jablonski diagram depicting photophysical process. [6]
- b) Answer the following:
- i) Explain the term Phosphorescence [3]
  - ii) State Grotthus-Draper's Law. [3]

## SECTION - II

- Q5) a)** Solve any four of the following: **[8]**
- i) Distinguish between molding and casting.
  - ii) What is glass transition temperature?
  - iii) Discuss the use of TGA technique in the analysis of polymer.
  - iv) Explain the term carbon blocks.
  - v) Define conducting polymer with example.
- b) Write a note on Step-polymerization. **[3]**
- 
- Q6) a)** Explain in detail: **[6]**
- i) Derive copolymer equation.
  - ii) How IR spectra useful in polymer analysis?
- b) Answer the following:
- i) Describe the crosslinking of the polymer. **[3]**
  - ii) What are the mechanical properties of crystalline polymer. **[3]**
- 
- Q7) a)** What is Rheology? Discuss the viscous flow phenomenon and its mechanism in polymer. **[6]**
- b) Answer the following:
- i) Describe the principle of membrane osmometry. **[3]**
  - ii) Define calendaring, dry spinning and wet-spinning. **[3]**
- 
- Q8) a)** Write a note on determination of molecular weight of a polymer by vapour phase osmometry technique. **[6]**
- b) Answer the following:
- i) Describe injection moulding with neat diagram. **[3]**
  - ii) Give an account of extrusion moulding. **[3]**



[6510]-305

S.Y. M.Sc.

**PHYSICAL CHEMISTRY****CHP-313(B) : Special Topics in Physical Chemistry  
(2019 Pattern) (Semester - III)***Time : 3 Hours]**[Max. Marks : 70**Instructions to the candidates:*

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *Question 1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of Q2, Q3 and Q4 and any 2 questions out of Q6, Q7 and Q8.*
- 4) *Figures to right side indicate full marks.*
- 5) *Use of logarithmic table/calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

**Physico - Chemical Constant**

|     |                     |           |   |                                                                                                                                                         |
|-----|---------------------|-----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Avogadro Number     | N         | = | $6.023 \times 10^{23} \text{ mol}^{-1}$                                                                                                                 |
| 2.  | Boltzmann Constant  | k         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3.  | Planck Constant     | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J s}$                                                                          |
| 4.  | Electronic Charge   | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5.  | 1 eV                |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6.  | Gas Constant        | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7.  | Faraday Constant    | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8.  | Speed of light      | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9.  | 1 cal               |           | = | $4.187 \times 10^7 \text{ erg}$<br>$= 4.187 \text{ J}$                                                                                                  |
| 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) What are the methods to reduce systematic errors?
  - ii) Explain Tyndall scattering phenomenon.
  - iii) What are gross errors?
  - iv) State the principle of spectrophotometry.
  - v) Define the term significant figure. Find significant figure of 0.023.
- b) Explain the difference between nephelometry and turbidimetry. [3]
- Q2) a)** Attempt the following: [6]
- i) What is proton condition for 0.1M  $\text{H}_3\text{PO}_4$ ?
  - ii) What is meant by regression analysis? State its types.
- b) Attempt the following: [6]
- i) Write mass balance and charge balance for 0.1M  $\text{H}_2\text{CO}_3$ .
  - ii) Explain the principle of nephelometry with suitable block diagram.
- Q3) a)** Attempt the following: [6]
- i) Determine the turbidity of a solution if the relative intensity of the incident radiation is 100 and relative intensity of the transmitted radiation is 43.2.
  - ii) Calculate the pH, the hydrogen and hydroxy ion concentration of a  $2.8 \times 10^{-4}\text{M}$  solution of magnesium hydroxide in water at  $25^\circ\text{C}$  [Given:  $K_w = 1.0 \times 10^{-14}$ ]
- b) Explain the methods of expressing accuracy and precision. [6]
- Q4) a)** The pH of a 0.1M solution of a salt of phosphoric acid is 12.56. Find the fraction of  $\text{H}_3\text{PO}_4$ ,  $\text{HPO}_4^{2-}$  and  $\text{PO}_4^{3-}$ . [6]  
[Given:  $K_{a1} = 5.83 \times 10^{-3}$ ,  $K_{a2} = 6.10 \times 10^{-8}$ ,  $K_{a3} = 4.78 \times 10^{-12}$ ]
- b) Attempt the following: [6]
- i) Explain the choice between nephelometry and turbidimetry for analysis.
  - ii) Write the formula of correlation coefficient ( $r$ ) and explain the terms involved in it.

## **SECTION - II**

- Q5) a)** Attempt any four of the following: [8]
- i) What do you mean by smart material?
  - ii) State and explain the factors affecting on physisorption.
  - iii) What is nano aerogel?
  - iv) Explain any two size dependent properties of nano-particles.
  - v) What are smart materials? Give its example.
- b) Give an account of electrochemical storage of Hydrogen in carbon materials. [3]
- 
- Q6) a)** Attempt the following: [6]
- i) What is chemisorption in hydrogen storage?
  - ii) Write a note on semiconductor nanoparticles.
- b) Attempt the following: [6]
- i) What is the influence of temperature and pressure on Hydrogen storage?
  - ii) Explain the functioning of smart windows and smart glasses.
- 
- Q7) a)** Attempt the following: [6]
- i) What are shape memory alloys? Explain with examples.
  - ii) Discuss the properties of nanoparticles.
- b) Give the applications of nanomaterials in various fields with suitable examples. [6]
- 
- Q8) a)** Attempt the following: [6]
- i) Write a note on smart polymers and its uses.
  - ii) Give electrical properties of metal nanoparticles.
- b) What are carbon nanotubes? How they are used in Hydrogen storage? [6]



Total No. of Questions : 6]

SEAT No. :

PE-5285

[Total No. of Pages : 3

[6510]-306

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-330 : Organometallic and Homogeneous Catalysis  
(2019 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 clean wherever necessary.

**SECTION - I**

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

- i) Explain the term  $\pi$  - acid ligand.
- ii) Find the value of 'n' in the following.  
 $K_2Fe(CO)_n$  ;  $CO_2(CO)_n$   
(Atomic no. of Fe = 26, Co=27)
- iii) What is mean by heteroleptic sigma complexes?
- iv) Which of the following complexes obey's 18 e<sup>-</sup> rule?
  - 1)  $[V(CO)_6]$
  - 2)  $[Cr(CO)_6]$[Atomic no. of V= 23, Cr = 24]

b) Write short note on fluxional behaviour of organometallic compounds. **[3]**

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

- i) Explain the bonding in metal alkene complexes.
- ii) Describe the properties of organometallic compounds as an electrophiles and nucleophiles.

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

- i) Give the synthesis and properties of cyclobutadiene metal complexes.
- ii) What are the significance of 18 e<sup>-</sup> rule and EAN rule in organometallic compounds?
- iii) Give difference between fischer and schrock carbene.

**P.T.O.**

- Q3) a)** Answer any one of the following. **[6]**
- i) Explain synthesis, bonding and applications of metal alkenes complexes.
  - ii) Give an account of organometallic compounds which acts as a activating and protecting agents.
- b)** Answer any two of the following. **[6]**
- i) Give classification of Sigma complexes.
  - ii) Draw the structures of ferrocene and osmocene and comment on their difference.
  - iii) List the different methods for the preparation of metal-carbonyl compounds. Explain any one of them.

## **SECTION - II**

### **[Homogeneous catalysis]**

- Q4) a)** Answer the following: **[8]**
- i) Define enantioselectivity with suitable example.
  - ii) List out the general characteristics of homogeneous catalysis.
  - iii) Give the name of the processes used for synthesis of acetic acid from methanol.
  - iv) What are the advantage and limitation of fenton reagents.
- b)** Phosphine is very good ligand in homogeneous catalysis. Justify this statement giving suitable example. **[3]**
- Q5) a)** Attempt any one of the following: **[6]**
- i) Give the names of various C-C coupling reaction. Explain any one of them with the help of catalytic cycle.
  - ii) What is biphasic catalysis? Explain aqueous biphasic catalysis with the help of schematic diagram.
- b)** Attempt any two of the following: **[6]**
- i) Differentiate between homogeneous and heterogeneous catalysis.
  - ii) What is polymerization reaction? Give the different type of polymers?
  - iii) What is asymmetric catalysis? Explain the role of chiral Ligand in asymmetric synthesis.

- Q6)** a) Attempt any one of the following: **[6]**
- i) Discuss the mechanism of epoxidation reaction with the help of catalytic cycles.
  - ii) Give an account of metathesis reaction along with the catalysts used in it.
- b) Attempt any two of the following: **[6]**
- i) Discuss CO insertion reaction with suitable example.
  - ii) Write a note on use of IR spectroscopy in homogeneous catalysis.
  - iii) How steric influence of attached ligand influence on catalyst activity and selectivity?



Total No. of Questions : 6]

SEAT No. :

PE-5286

[Total No. of Pages : 2

[6510]-307

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-331 : Inorganic Reaction Mechanism

(2019 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 indicate full marks.

**SECTION - I**

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

- i) Name the various techniques used for studying fast reactions.
- ii) Explain the mechanism of isomerization reaction with suitable example.
- iii) What is trans effect? Explain with suitable complex.
- iv) Thermodynamic stability of a complex is determined by which parameters.

**b)** Explain in detail HSAB principle. **[3]**

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

- i) Explain in detail classification of inorganic reactions.
- ii) Explain Intimate and Stoichiometric mechanism of ligand substitution.

**b)** Attempt the following (any Two): **[6]**

- i) Discuss  $SN^1$  mechanism in brief.
- ii) Beller-Twist mechanism for Racemisation.
- iii) Polymerisation theory of Trans-effect.

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

- i) What is  $SN^1CB$  mechanism with suitable example.
- ii) Explain steric effect on substitution isomerization in coordination compounds.

**P.T.O.**

- b) Write a short note on following (any Two): [6]
- i) Marcus equation.
  - ii) Factors affecting electron transfer reaction.
  - iii) Photochemical reactions of Co(III) complexes.

### SECTION - II

- Q4) a)** Attempt the following: [8]
- i) What is Fluorescence?
  - ii) What is role of d-d transition in photochemical reaction?
  - iii) Describe mechanism of alkylation of coordinating sulphur.
  - iv) What do you mean by quantum yield in photochemical reaction.
- b) Attempt the following: [3]
- i) Explain in detail photochemical reaction with suitable example.

- Q5) a)** Answer any one of the following: [6]
- i) Discuss in brief kinetic template effect involving chelate ring forming reaction.
  - ii) Explain in detail solvolysis of coordinated phosphorus atom.
- b) Answer any Two of the following: [6]
- i) Describe the photophysical processes of relaxation.
  - ii) Explain prompt and delayed reactions. Explain with suitable example.
  - iii) Discuss in brief quantum efficiency of photochemical reaction.

- Q6) a)** Answer any one of the following: [6]
- i) Explain in detail Electrophilic behaviour of liquid.
  - ii) Comment on substitution by reversible oxidative addition reaction.
- b) Write note on any Two of the following: [6]
- i) Alkylation of coordinated S and N atom
  - ii) Chelate modifying reaction
  - iii) Methyl migration & co-insertion



Total No. of Questions : 6]

SEAT No. :

PE-5287

[Total No. of Pages : 3

[6510]-308

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-332 : Bio-Inorganic and Medicinal Inorganic  
Chemistry

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

SECTION - I

[Bioinorganic Chemistry]

Q1) a) Attempt the following: [8]

- i) What is super oxide dismutase? Explain its role in biological system.
- ii) Enlist the functions of blue copper proteins.
- iii) Explain the structurally important components of Mo containing enzyme.
- iv) Which element is present at the active centre of carbonic anhydrase? Give the function of carbonic-anhydrase.

b) Write an account of copper containing enzymes. [3]

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

- i) Explain in detail model compounds of Non-blue proteins.
- ii) Why tyrosinase enzyme is called mixed-function catalyse? Explain with suitable example.

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

- i) Define p-cluster. Give it's role.
- ii) Draw the structure of Cu-PSTM and Cu-ASTM give it's role.
- iii) Explain the mutase activity of coenzyme B<sub>12</sub>.

P.T.O.

- Q3) a)** Attempt any one of the following: [6]
- i) How does nitrogen fixation take place by molybdenum?
  - ii) Explain the structure, function and active site of SOD in detail.
- b)** Write a note on any two: [6]
- i) Non-Heme iron protein.
  - ii) Galactose oxidase.
  - iii) Type-I, Type-II and Type-III Cu proteins.

### SECTION - II

- Q4) a)** Answer the following: [8]
- i) Explain the role of Gadolinium complexes as contrast agent in MRI.
  - ii) Draw the structure of
    - 1) Carboplatin
    - 2) Amavadin
  - iii) Explain the role of lithium isotopes.
  - iv) What is function of L-Dopa?
- b)** What do you mean by chemotherapy? Name the metals used in chemotherapy? [3]
- Q5) a)** Attempt any one of the following: [6]
- i) Explain MRI in detail. Name the important MRI contrast reagents and explain their functions.
  - ii) Why is Tc considered as best nucleus in radiopharmaceuticals?
- b)** Attempt any two of the following: [6]
- i) Explain with the help of suitable diagram the nuclease activity of  $[\text{Cu}(\text{phen})_2]^+$  complex.
  - ii) What is the oxidation state of vanadium in amavadin? Explain the structural feature of amavadin.
  - iii) Give an account of therapeutic and diagnostic applications of radiopharmaceuticals.

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

- i) Explain in detail leaching of metals by micro organism?
- ii) Give an account of fundamental interactions of metal complexes with nucleic acid.

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

- i) Antitumor Agents
- ii) Glucose Tolerance factor
- iii) Hypoxia imaging agents



Total No. of Questions : 6]

SEAT No. :

PE-5288

[Total No. of Pages : 2

[6510]-309

S.Y. M.Sc.

CHEMISTRY

**CHI-333(A) : Modern Instrumental Methods in Inorganic Chemistry**

**(2019 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

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

**SECTION - I**

**[Thermal and Spectroscopic Techniques]**

- Q1) a)** Answer the following: **[8]**
- i) What is XRD?
  - ii) What is hyperfine splitting?
  - iii) What is DSC?
  - iv) Why KBr is inactive in IR analysis?
- b)** Explain the ESR-spectra of methyl radicle. **[3]**
- 
- Q2) a)** Answer any one of the following. **[6]**
- i) What is principle of TPD? Explain the working and application of TPD.
  - ii) Write short notes on:
    - 1) Geiger Muller counter
    - 2) Scintillation counter
- b)** Attempt any two of the following: **[6]**
- i) Explain the heat flow and heating rate in TGA.
  - ii) Explain the typical D.T.A. curve showing water of hydration and water of crystallization.
  - iii) Explain the difference between Fluorescences and phosphorescences.

**P.T.O.**

- Q3) a)** Attempt any one of the following: [6]  
i) Describe the difference between  $^1\text{H}$ -NMR and  $^{19}\text{F}$ -NMR spectroscopy.  
ii) Explain the principle, construction and working of AES.
- b)** Answer any two of the following: [6]  
i) Derive the Bragg's equation.  
ii) Write the application of FTIR spectroscopy..  
iii) Explain the TGA curve for  $\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ .

### SECTION - II

- Q4) a)** Answer the following: [8]  
i) What is Hysteresis loop?  
ii) What is chromophore and auxochrome?  
iii) Write the advantages of UHV condition in XPS.  
iv) Give the uses of flame photometry.
- b)** Explain the cyclic voltammogram of  $\text{K}_3[\text{Fe}(\text{CN})_6]$  in 0.1 M KCl. [3]
- Q5) a)** Answer any one of the following: [6]  
i) What is photo degradation? Explain the factors affecting on photo degradation.  
ii) What is Magnetic susceptibility? Explain the anti-ferromagnetism and ferromagnetism.
- b)** Answer any two of the following: [6]  
i) Write the principle of flame photometry.  
ii) Explain the principle of UV-visible spectroscopy.  
iii) Write the advantages of STEM over TEM.
- Q6) a)** Answer any two of the following: [6]  
i) Explain the instrumentation and applications of TEM.  
ii) Explain the difference between soft magnets and hard magnet.
- b)** Write note on any two: [6]  
i) Give the application of XPS.  
ii) Explain the use of SEM in characterisation of nano materials.  
iii) Explain the cyclic voltammogram of thyroxine.



Total No. of Questions : 6]

SEAT No. :

PE-5289

[Total No. of Pages : 2

[6510]-310

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-333(B) : Inorganic Magneto & Polymer Chemistry  
(2019 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) Use of calculators is allowed.

**SECTION - I**

**[Inorganic Magneto-chemistry]**

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

- i) Define magnetic susceptibility. Give its unit.
- ii) Give the significance of magnetic materials.
- iii) Explain anti-ferromagnetic materials with one example.
- iv) Find out R-S term symbol for  $\text{Ti}^{3+}$  &  $\text{Cu}^{2+}$  ions.

**b)** Explain anomalous behaviour of magnetic moment. **[3]**

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

- i) Write a short note on quenching of orbital angular momentum and magnetism.
- ii) Explain magnetic properties of transition metal complexes in cubic and axially symmetric crystal field.

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

- i) Explain Curie law & Curie-Weiss law.
- ii) Enlist applications of magnetic materials.
- iii) Explain temperature independent paramagnetism.

**P.T.O.**

- Q3) a)** Attempt any one of the following: [6]  
i) Explain in brief Faraday's method.  
ii) Write Van-Vleck equation. Give the applications of it.
- b)** Answer any two of the following. [6]  
i) Define magnetic properties & types of magnetic substances.  
ii) Explain photo induced magnetism with suitable examples.  
iii) Discuss magnetic properties of lanthanides & actinides.

**SECTION - II**  
**[Inorganic Polymer]**

- Q4) a)** Attempt the following: [8]  
i) Explain structure of inorganic benzene.  
ii) What is homo polar inorganic polymers? Give their examples.  
iii) Write a short note on classification of polymers.  
iv) Mention four advantages of synthetic rubber over natural rubber.
- b)** Discuss in brief polymeric compounds of sulphur. [3]
- Q5) a)** Attempt any one of the following: [6]  
i) Explain preparation, properties and applications of aluminium nitrides.  
ii) What is degree of polymerization? Discuss relationship between average degree of polymerization & average molecular weight of polymer.
- b)** Answer any two of the following: [6]  
i) Give comparison between natural & synthetic polymer.  
ii) Write a note on polythiazoles.  
iii) Explain allotropes of carbon.
- Q6) a)** Attempt any one of the following: [6]  
i) Discuss synthesis and reactions of coordination polymers.  
ii) Explain applications of inorganic polymers with respect to its catalytic and medicinal properties.
- b)** Answer any two of the following: [6]  
i) Give the difference between addition and condensation polymers.  
ii) Draw structure of hexachlorophosphazenes. Give its chemical reaction with benzene in presence of  $\text{AlCl}_3$ .  
iii) Give a brief account of silicon rubber.



[6510]-311

S.Y. M.Sc.

## ORGANIC CHEMISTRY

CHO-350 : Organic Reaction Mechanism and Biogenesis  
(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

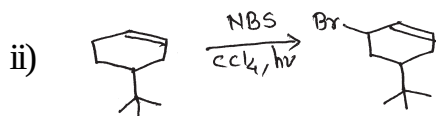
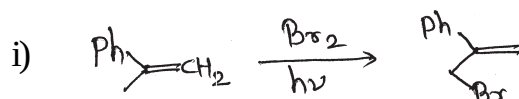
- 1) Question No.1 and Question No. 5 are compulsory and carry 11 marks each.
- 2) Attempt any two questions from Q. 2 to Q. 4 and two questions from Q.No. 6 to Q.No. 8.
- 3) Answer to the two sections should be written in separate answer books.
- 4) Figures to the right indicate full marks.

SECTION-I

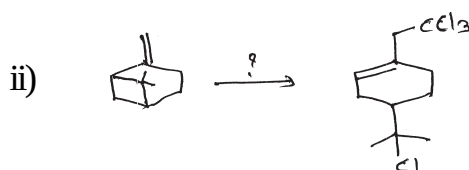
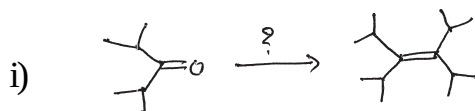
Q1) Attempt the following:

- a) Suggest the mechanism for the following reaction.

[5]



- b) Suggest the reagent for the following conversions and explain the mechanism. [6]



P.T.O.

**Q2)** Write a short notes on any three of the following: [12]

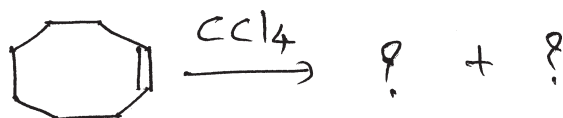
- a) Barton reaction
- b) Taft equation
- c) Methods for generation of free radical
- d) Trapping of intermediates

**Q3)** Attempt any four of the following: [12]

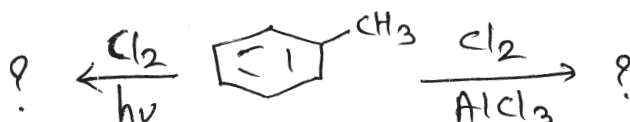
- a) Predict the sign of Hammett  $\sigma$  (sigma) constant for the following substituents:
  - i) M-OMe
  - ii) P-CH<sub>3</sub>
  - iii) P-NO<sub>2</sub>
- b) Explain the role of antioxidant in inhibition of autoxidation with example.
- c) Free radical chlorination of both n-propyl and isopropyl bromide gives the same product, 1-bromo-2-chloropropane. Explain.
- d) Discuss the use of isotopes in determination of reaction mechanism.
- e) Explain Hunsdiecker reaction with suitable example.

**Q4)** Attempt any four of the following: [12]

- a) Explain 'non-linear Hammett plot' with suitable example.
- b) Give applications of Bu<sub>3</sub>SnH (tributyltin hydride).
- c) Predict the product with mechanism



- d) Predict the product for the given reaction.



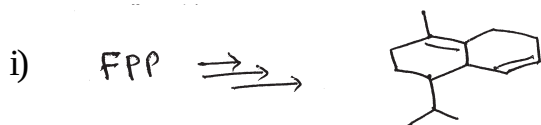
- e) Explain the experiment by which it can be prove that fries rearrangement is intramolecular or intermolecular rearrangement.

## SECTION-II

**Q5)** Attempt the following:

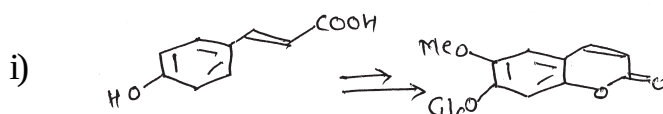
[5]

a) Suggest the biosynthesis scheme for following



b) Complete the following biogenetic conversion.

[6]



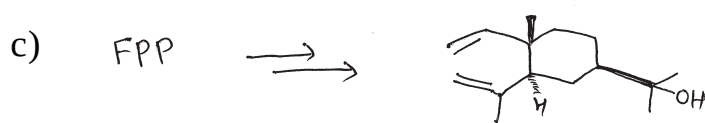
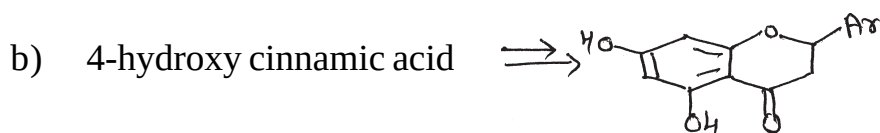
**Q6)** Write short notes on any three of the following:

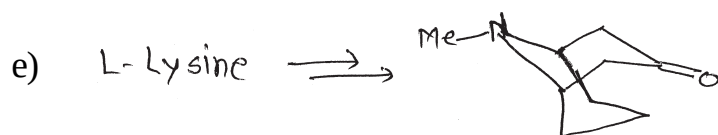
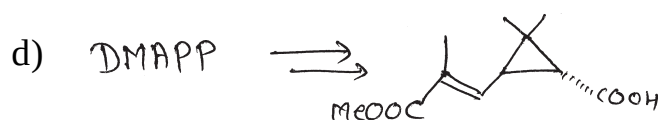
[12]

- Wagner-meerwein rearrangement
- Oxidative deamination
- Biogenesis of shikimic acid
- Use of FAD and FADH<sub>2</sub> in biotransformation.

**Q7)** Complete the following biogenesis (any four)

[12]

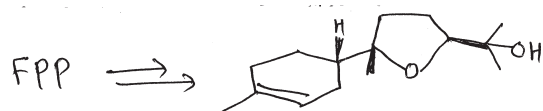




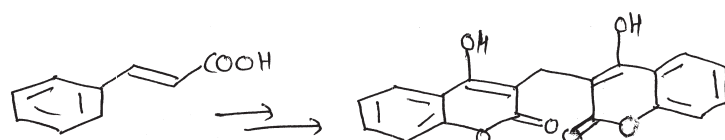
**Q8)** Attempt any four of the following:

[12]

a) Complete the given biogenesis

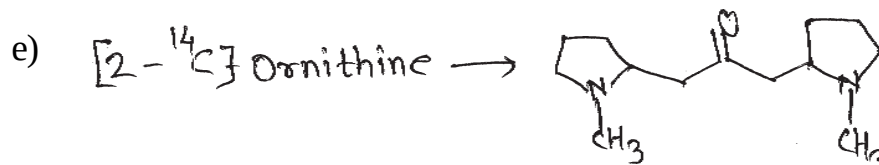
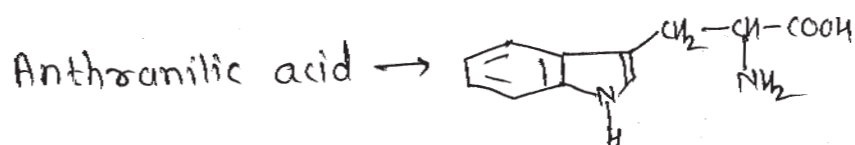


b) Complete the given biogenesis



c) Write short note on cycloaddition reaction of piperine.

d) Complete the following biosynthetic step



Indicate the position of label in each step of above biogenesis.



Total No. of Questions : 8]

SEAT No. :

PE-5291

[Total No. of Pages : 11

[6510]-312

S.Y. M.Sc.

**ORGANIC CHEMISTRY**

**CHO-351 : Structure Determination of Organic Compounds  
by Spectroscopic Methods  
(2019 Pattern) (Semester - III)**

*Time : 3 Hours]*

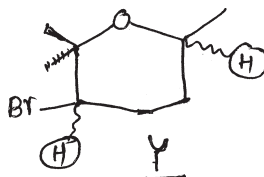
*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) Q. No. 1 and Q. No. 5 are compulsory and carry 11 marks each.
- 2) Attempt any two questions from Q. No. 2 to Q. No. 4 and any two questions from Q. No. 6 to Q. No. 8.
- 3) Answers to the two sections should be written in separate answer books.
- 4) Figures to the right indicate full marks.

**SECTION - I**

- Q1)** a) Discuss applications of shift reagents in NMR. [3]
- b) Draw the stereo structure of Y which showed following signals for circled protons. Explain each coupling constant, multiplicity and chemical shift of these protons. [4]



3.9 (ddQ) 12, 7 & 4Hz(1H)

4.3(dd) 11 & 3Hz(1H)

- c) A compound having molar mass 150 shows peak at  $1690\text{cm}^{-1}$  in its IR spectra. Deduce the structure from the given data. [4]

$^1\text{H}$ NMR: 2.5(s)3H, 3.8(s)3H

6.9(d)8Hz 2H, 7.8(d)8Hz2H

$^{13}\text{C}$ NMR: 197, 165, 130, 129, 114, 56, 26

- Q2)** Write a short note (any three): [12]
- a) AMX spin system
  - b) Spin decoupling experiment
  - c) Various factors affecting chemical shift in CMR.
  - d) NOE to study stereochemistry of molecules.

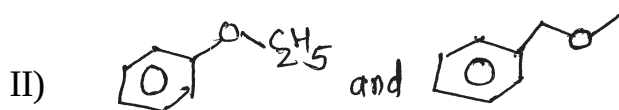
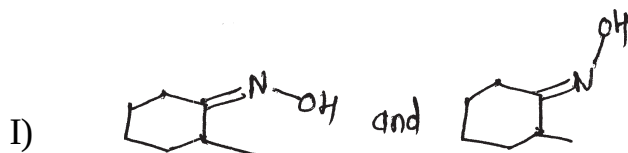
**P.T.O.**

**Q3)** Attempt any four of the following: Deduce the structure from data. [12]

- a) M.F.  $C_6H_{10}O$       b) M.F.  $C_5H_8O$   
 CMR: DEPT-90      IR:  $1700, 1630, 2720\text{ cm}^{-1}$   
 30 -ve      PMR: 1.1(t) 7Hz 3H  
 32 -ve      2.2(dQ) 4,7Hz 2H  
 48 -ve      5.9(dd) 6,13Hz 1H  
 52 +ve      6.78(dt) 4,13Hz 1H  
 115 -ve      9.35(d) 6Hz 1H  
 138 +ve
- c) M.F.  $C_7H_8N_2O_3$   
 PMR: 7.75(dd) 8.5, 2.5Hz 1H , 7.6(d) 2.5Hz 1H  
 6.7(d) 8.5 Hz 1H , 6.45(bs) Exch. 2H  
 3.9(s) 3H
- d) M.F.  $C_{15}H_{14}O$   
 IR:  $1680\text{ cm}^{-1}$   
 PMR: 2.4(s) 6H, 7.2(d) 8Hz 4H , 7.7(d) 8Hz 4H  
 CMR: 21, 129, 133, 136, 141, 190
- e) M.F.  $C_9H_9ClO_3$ , After  $D_2O$  exchange  
 PMR: 1.8(d) 7Hz 3H, 4.78(Q) 7Hz 1H, 6.78(dt) 8 & 2 Hz 1H  
 6.9(t) 2Hz 1H, 6.98(dt) 8 & 2Hz 1H  
 7.2(t) 8Hz 1H

**Q4)** Attempt any four of the following: [12]

- a) Distinguish between following pairs by using appropriate spectral method.



- b) Explain: Sensitivity of signal in  $^{13}\text{C}$ NMR is about 6000 times less intense than  $^1\text{H}$ NMR signals.
- c) Explain: DEPT is advantageous than APT.
- d) 2-nitrobutane shows a non-equivalence of methylene protons. Explain.
- e) Deduce the structure from given spectral data.

M.F.  $\text{C}_6\text{H}_{12}\text{O}_2$

IR:  $1700, 3400\text{ cm}^{-1}$

CMR: 29(Q), 31(Q), 53(t), 68(s), 210(s) ,

PMR: 1.2(s) 24mm, 2.2(s) 12mm

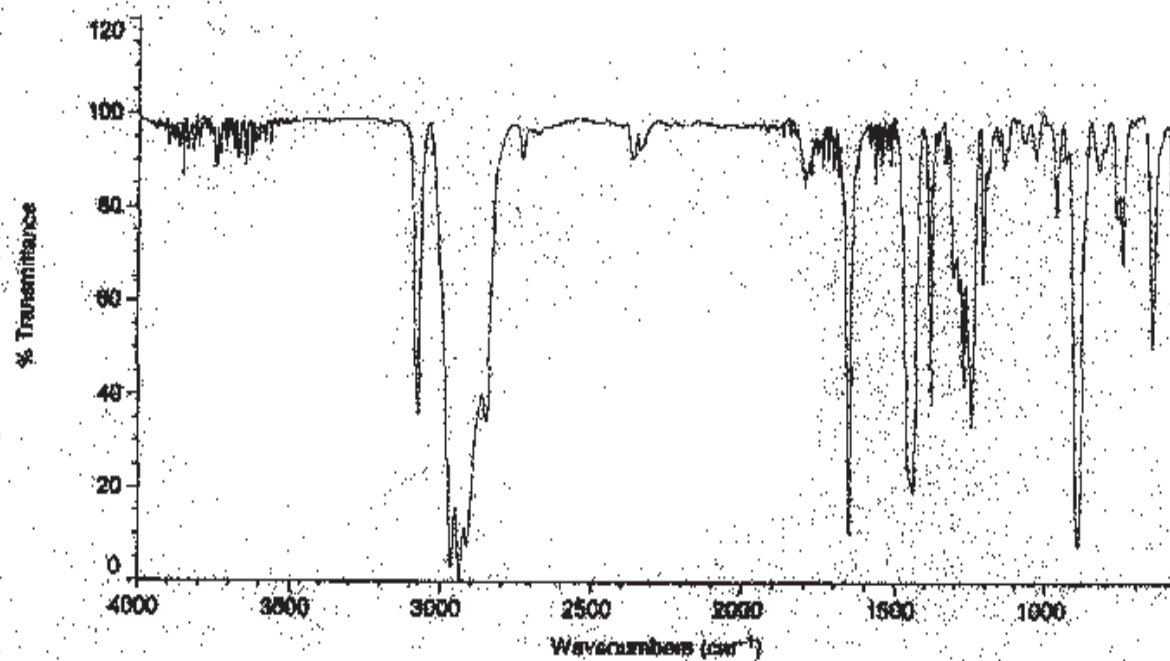
2.62(s) 8mm, 3.83(s) 4mm

### SECTION - II

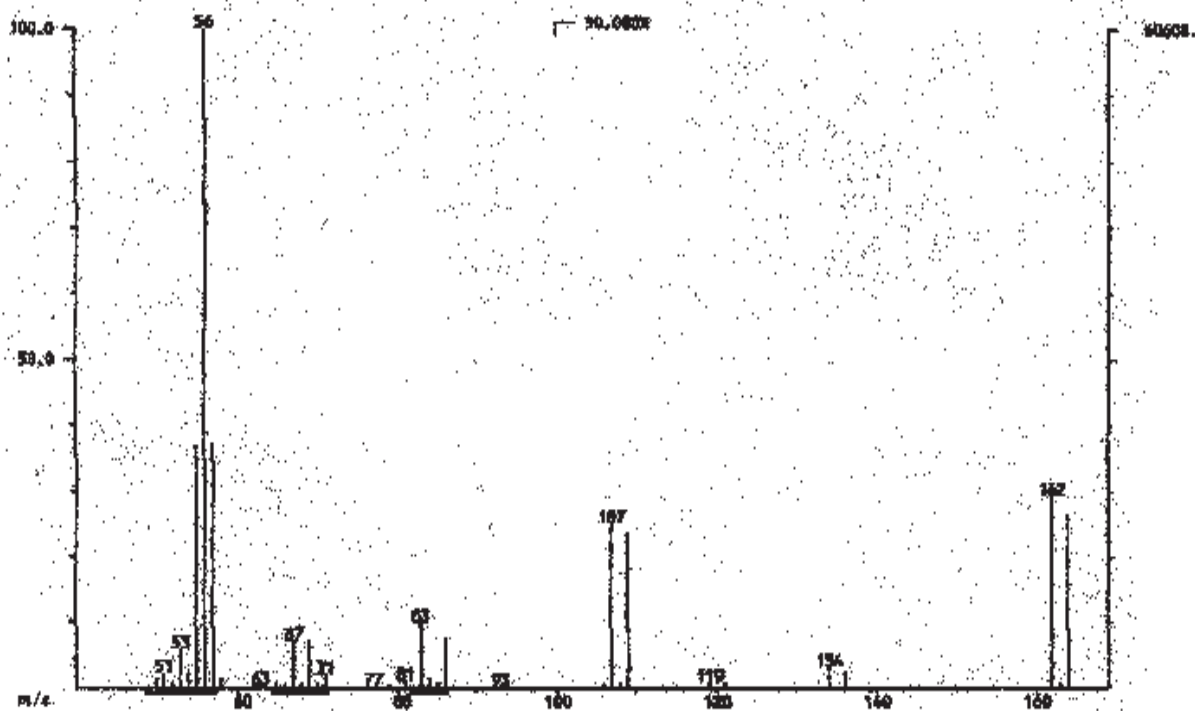
**Q5)** The spectra of unknown compound are given below. Analyse the spectra and use the data to arrive at a structure. **[11]**

**Note:** Students are instructed to interpret and attach extra copy of spectra to answer sheet as provided with question paper.

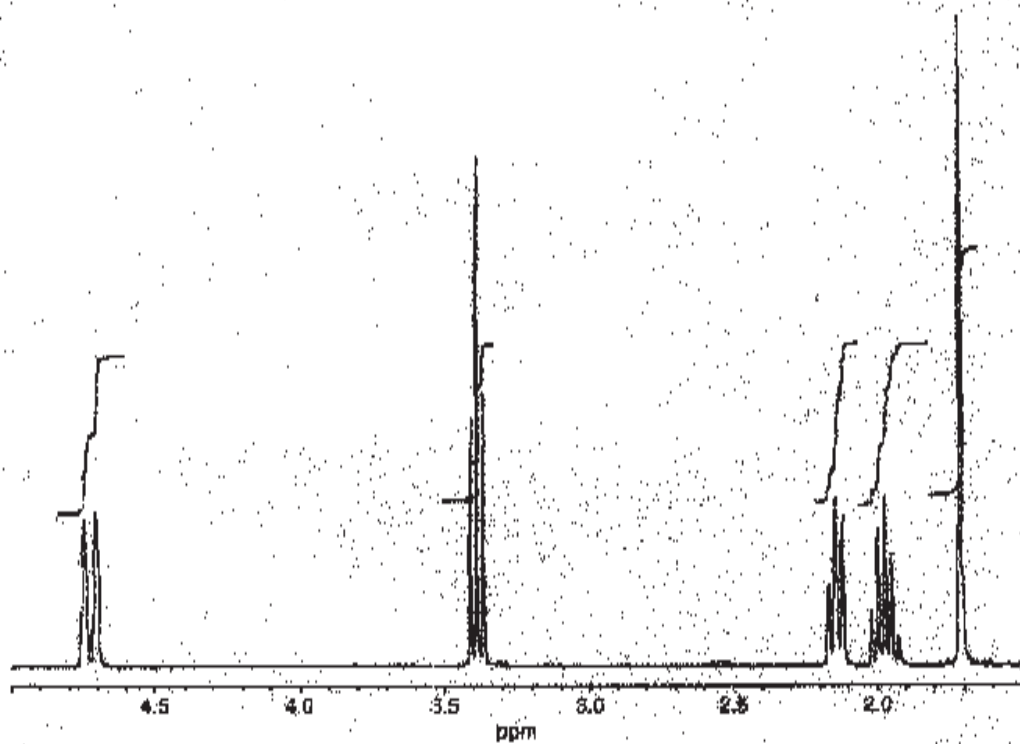
# INFRARED



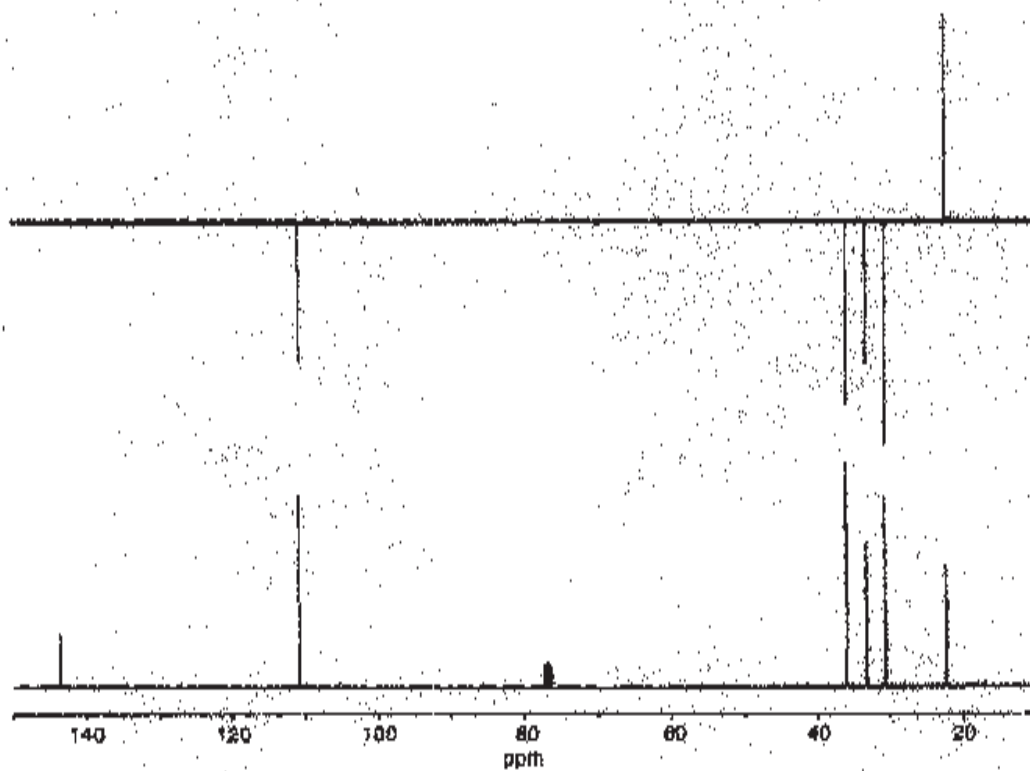
# MASS



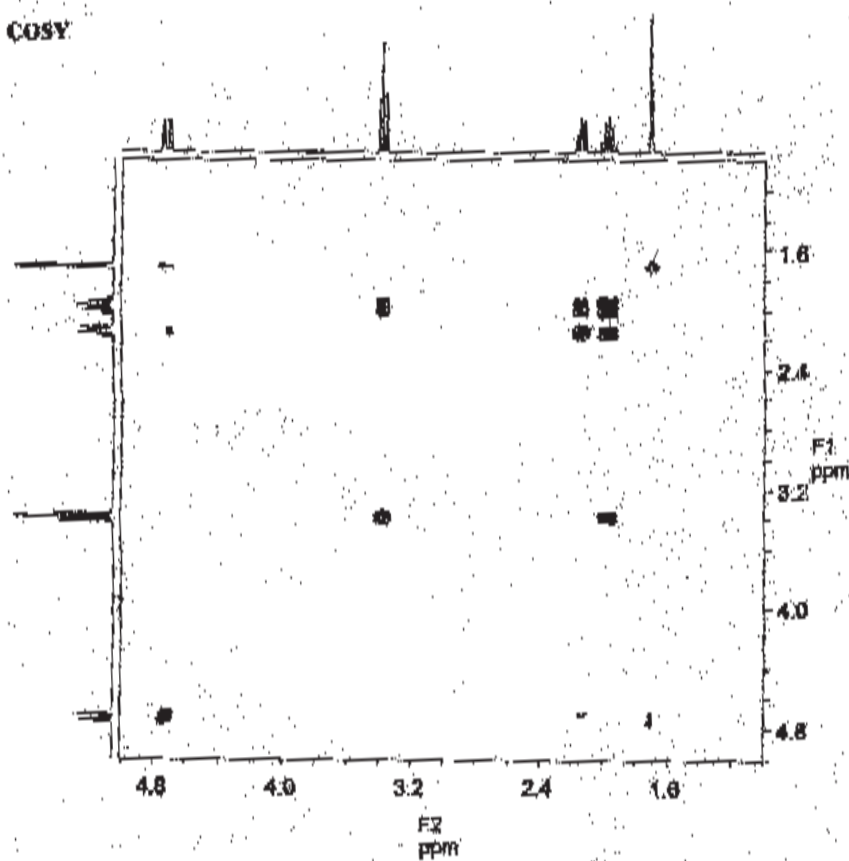
<sup>1</sup>H NMR



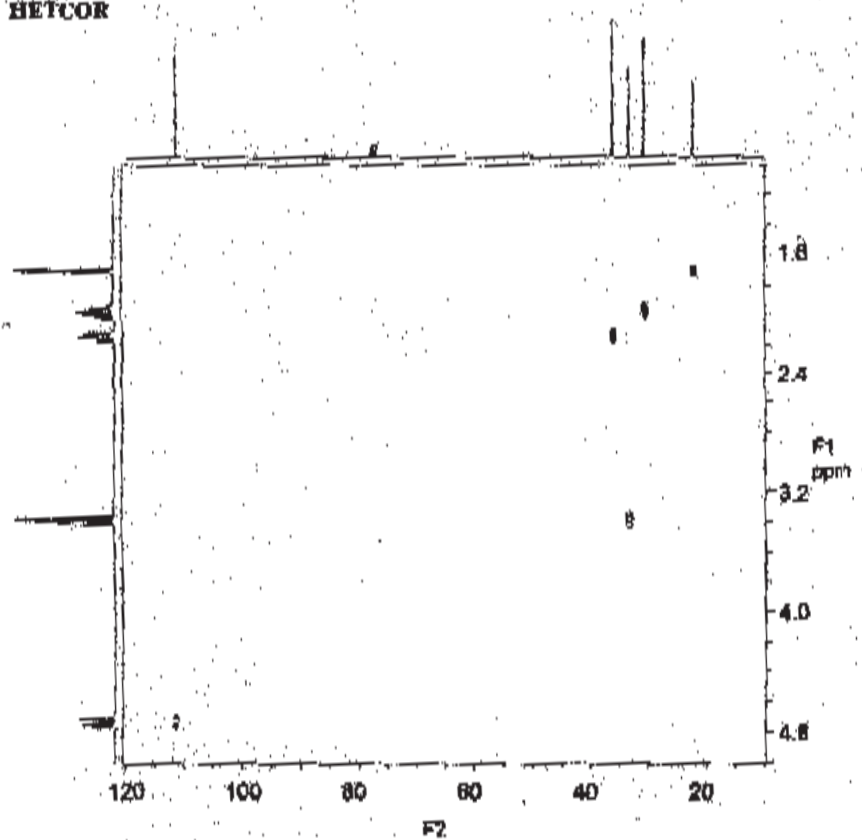
<sup>13</sup>C/DEPT



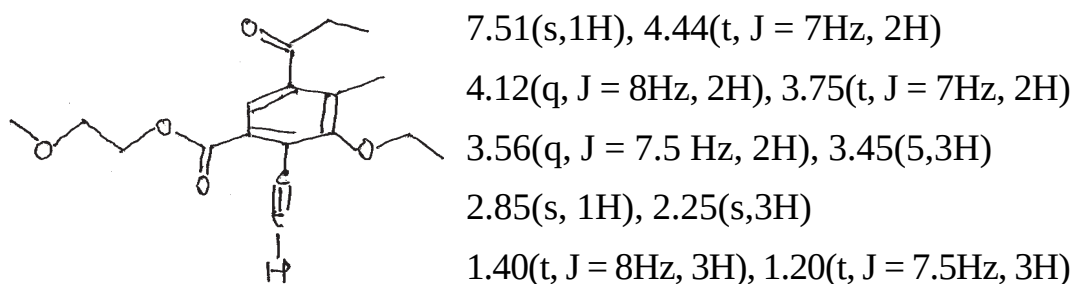
COSY



HETCOR



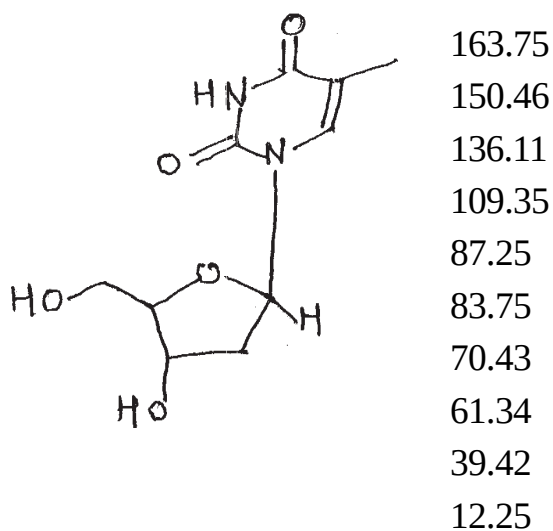
- Q6) a)** The PMR of compound A shows following signals. Assign signals to different protons using decoupling experiment. Justify your answer. [6]



Spin decoupling experiment

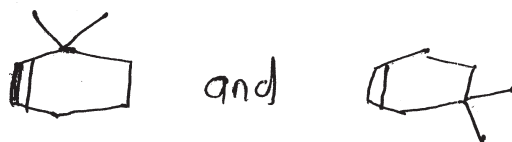
|    | Irradiation at | Change at |
|----|----------------|-----------|
| 1) | 4.44           | 3.75(s)   |
| 2) | 3.56           | 1.20(s)   |

- b)** Assign the chemical shift to various carbon of the following structure. [6]



- Q7)** Attempt any four of the following: [12]

- a) Differentiate the following by mass spectroscopy.



- b) Differentiate the following by mass spectroscopy.

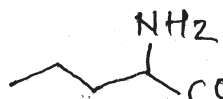


- c) Write genesis of the ions given below.



108, 107, 79, 77

- d) Write genesis of the ions given below.



131, 88, 72, 29

- e)  $\text{CH}_2\text{Br}_2$  shows molecular ion peak at  $M^+$ ,  $M+2$  and  $M+4$  with intensity 1:2:1. Explain.

**Q8)** Attempt any three of the following:

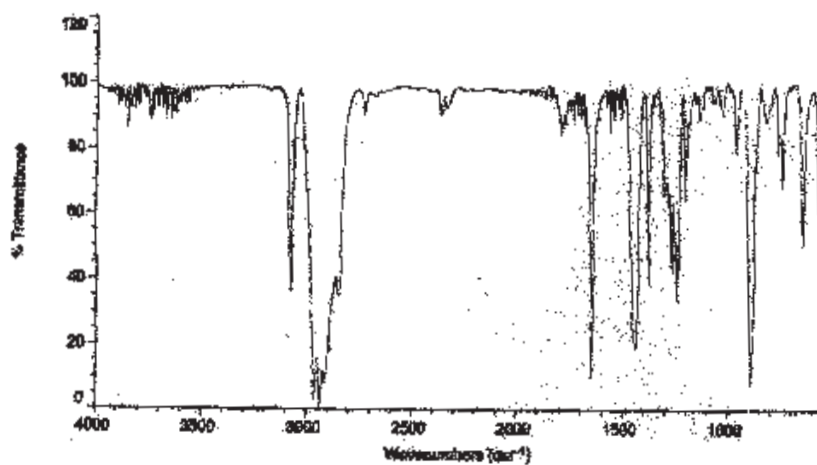
**[12]**

- Explain how McLafferty helps to distinguish between isomeric carbonyl compounds?
- Explain EI process in mass.
- State and explain nitrogen rule with an example.
- Compound 'X' methyl ether with molecular formula  $\text{C}_5\text{H}_{12}\text{O}$  shows following mass spectra. Identify structure of 'X'

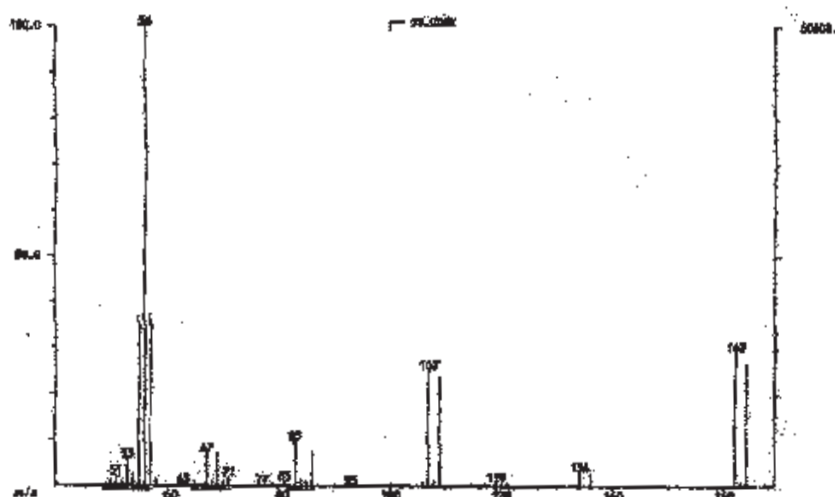
X = 88, 56, 45 (100%), 41, 29, 27

student should interpret the spectra and attach with answer sheet

# INFRARED

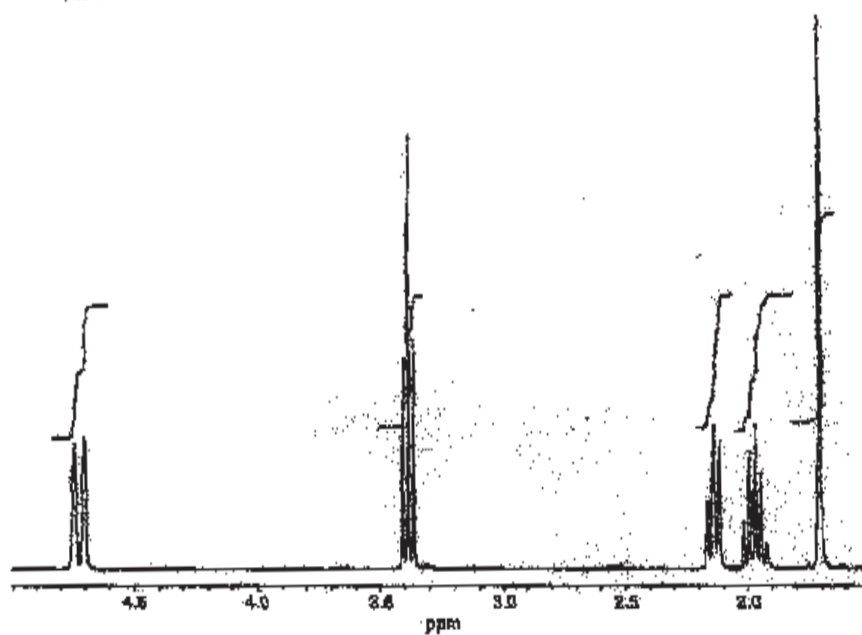


# MASS

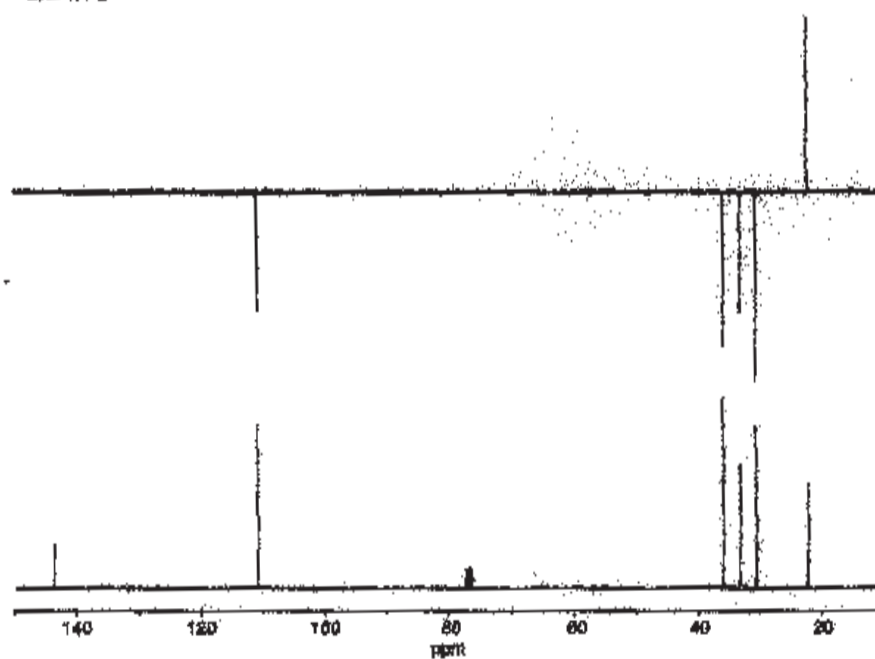


To be attached with answer sheet.

<sup>1</sup>H NMR

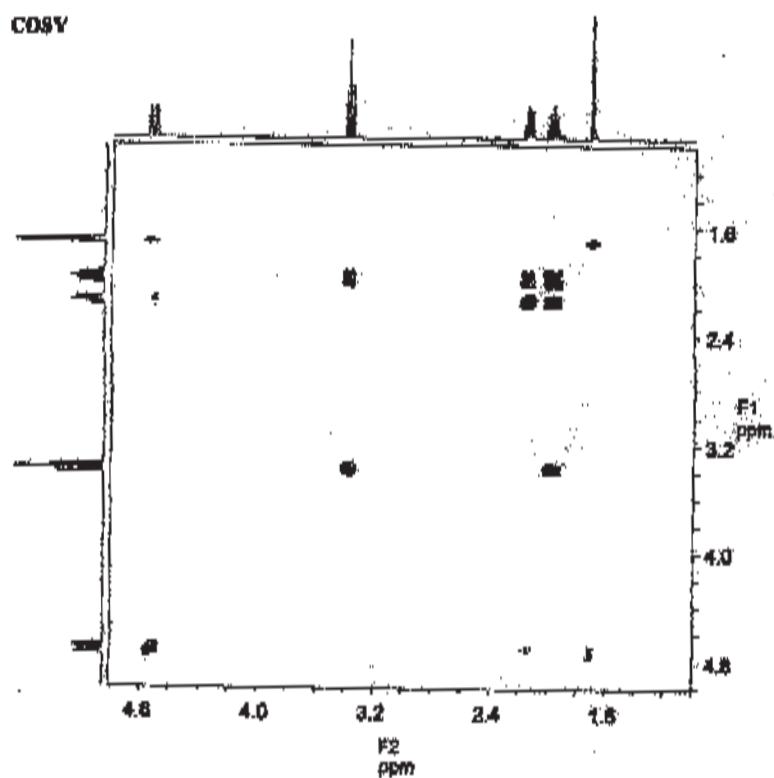


<sup>13</sup>C/DEPT

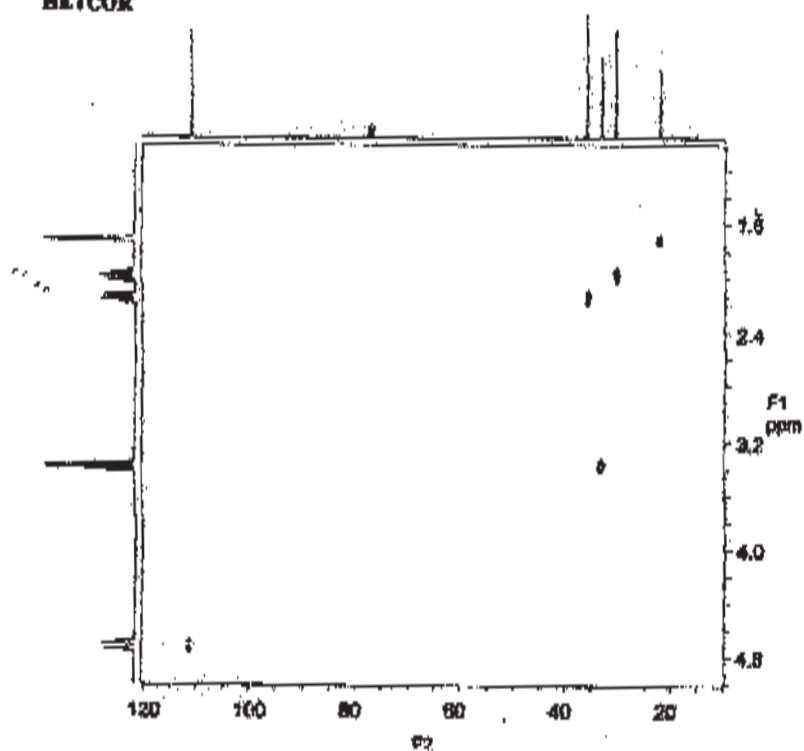


To be attached with answer sheet.

COZY



HETCOR



~~~~~

Total No. of Questions : 8]

SEAT No. :

PE-5292

[Total No. of Pages : 5

[6510]-313

S.Y. M.Sc.

ORGANIC CHEMISTRY

CHO-352 : Stereochemistry and Asymmetric Synthesis of
Organic Compounds

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No.1 and 5 are compulsory.
- 2) Attempt any two questions from Q.No.2 to Q.No.4.
- 3) Attempt any two questions from Q.No.6 to Q.No.8.
- 4) Answers to the two sections should be written in separate answer book.
- 5) Figures to the right indicate full marks.

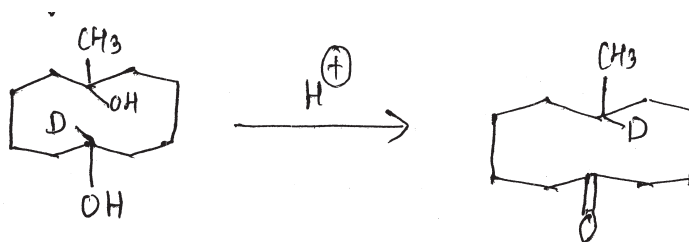
SECTION - I

Q1) a) Answer the following: [5]

- i) Explain the concept of I-strain with suitable examples.
- ii) Write a short notes on Tacticity.
- b) Explain any two methods of racemic resolution. [3]
- c) Draw the stable conformation of Cis and Trans 1, 3 di-t-butyl cyclohexanes. Justify your answer. [3]

Q2) Attempt any three of the following. [12]

- a) What is pyramidal inversion? Explain with suitable examples.
- b) Write a note on 'Cram's chelation model'.
- c) Explain Bredt's rule with suitable examples.
- d) Suggest the mechanism for the following.



P.T.O.

Q3) Give reasons (any four)

[12]

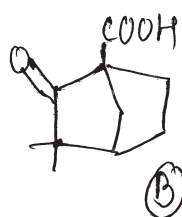
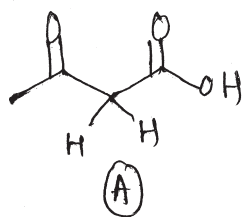
- In 3 and 4 membered rings reactions involving change in hybridization from $sp^2 \rightarrow sp^3$ are favoured while in 5 and 7 membered rings $sp^3 \rightarrow sp^2$ are favoured.
- Cis-Syn-Cis perhydrophenanthrene is less stable than Cis-anti-Cis perhydrophenanthrene.
- The observed outcomes of the following reaction is as follows.



LiBH₄: 9 91

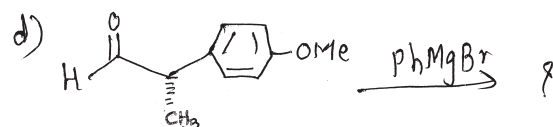
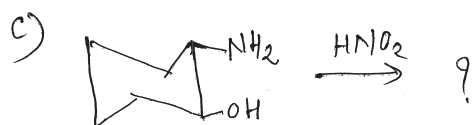
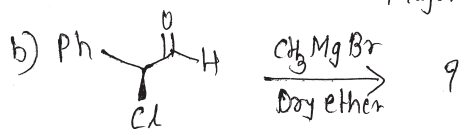
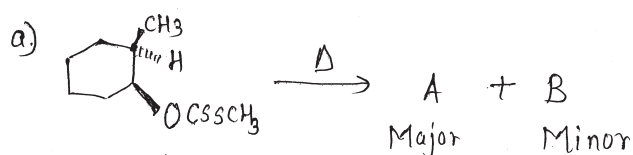
LiB(iBu₃)H: 86 14

- Neomenthyl chloride undergoes base catalysed elimination about 200 times faster than menthyl chloride.
- β -keto acid (A) can undergo decarboxylation on heating while (B) can not.



Q4) Predict the product/s. Justify your answer by giving mechanism and stereochemical principles involved in it. (any four)

[12]

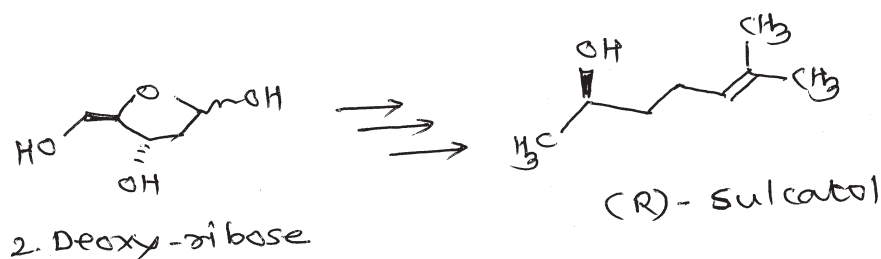


SECTION - II

Q5) a) Answer the following. **[8]**

- i) With the help of suitable examples, explain the term-regioselectivity.
- ii) Explain the characteristics of good chiral auxiliary.
- iii) Why 'Z' enolate gives mainly 'syn' product? Explain.
- iv) Explain the applications of BINAP Ruthenium (II) in asymmetric reduction reactions.

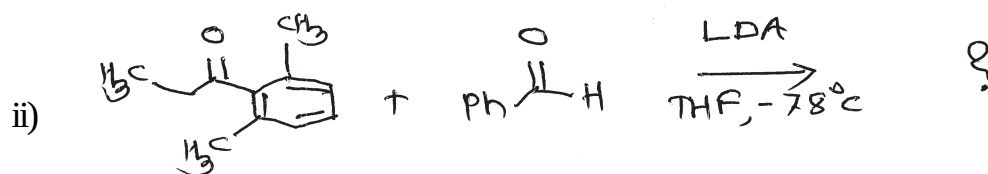
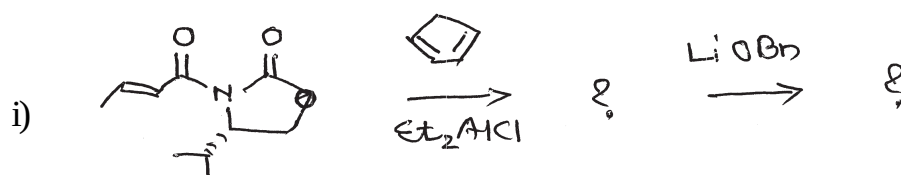
b) Complete the following conversion. **[3]**



Q6) a) Answer the following. (any two) **[6]**

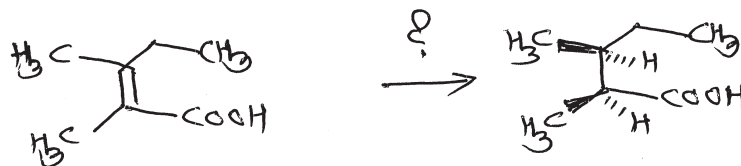
- i) Explain the mechanism involved in the Shi epoxidation reaction.
- ii) Explain the conditions and selectivity for Sharpless asymmetric dihydroxylation.
- iii) Discuss the role of (S)-Proline in asymmetric synthesis. Give one example.

b) Predict the product/s and justify the mechanism. **[6]**

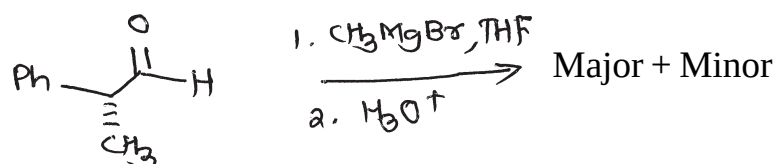


Q7) a) Answer the following. (any two) **[6]**

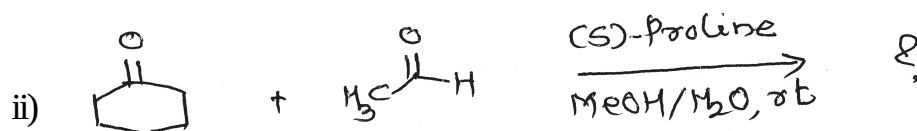
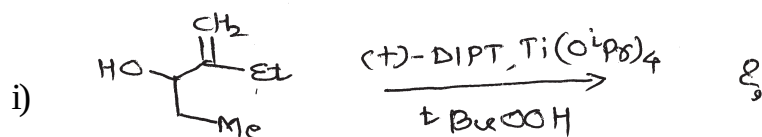
- i) Write a note on 'Chiral pool approach in asymmetric synthesis'.
- ii) Name the suitable reagent for the following transformation and justify your answer.



- iii) With the help of Felkin-Anh model predict the major and minor products in following reaction.

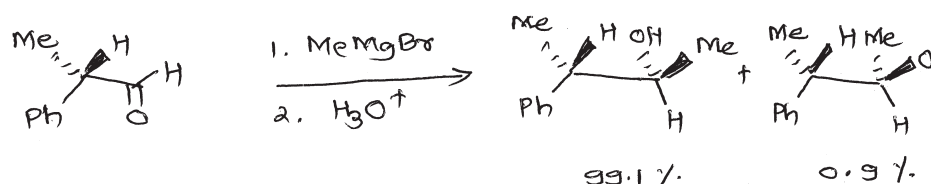


b) Predict the product/s and justify the mechanism. **[6]**

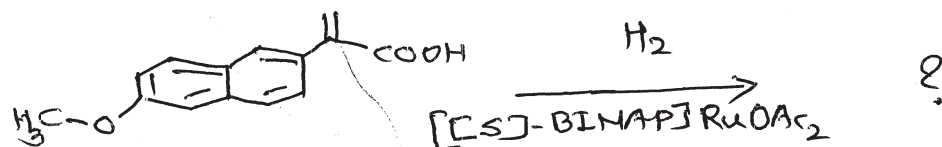


Q8) a) Answer the following. (any two) **[6]**

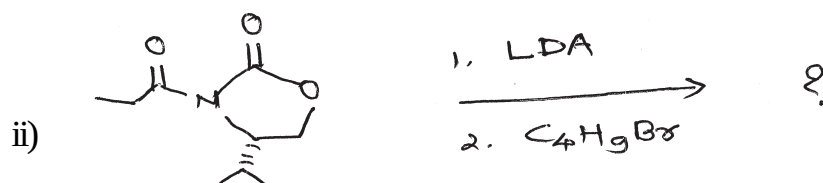
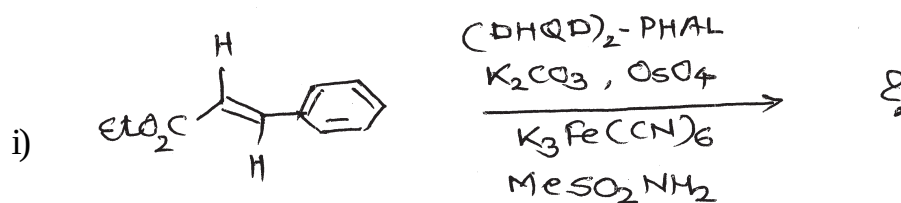
- i) Explain diastereomeric excess. Calculate the diastereomeric excess of following reaction.



- ii) Explain the Zimmerman Traxler transition state structures for Aldol reaction of Cis(z)-enolate with a chiral aldehyde.
- iii) Predict the product/s in the following conversions and explain the stereochemistry.



- b) Predict the product/s and justify the mechanism. [6]



~~~~~

[6510]-314

S.Y. M.Sc.

## ORGANIC CHEMISTRY

**CHO-353(A) : Protection-Deprotection Chiron Approach  
and Carbohydrate Chemistry  
(2019 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

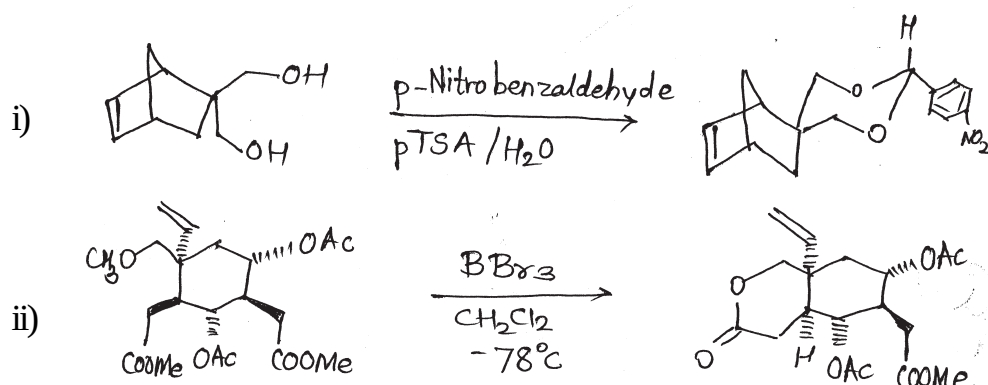
*Instructions to the candidates:*

- 1) Question 1 and 5 Compulsory and carry 11 marks.
- 2) Answer any 2 questions out of Q2 to Q4 and any 2 questions out of Q6 to Q8.
- 3) Answers to two sections should be written on a separate answer books.
- 4) Figures to right indicate full marks.

SECTION - I

Q1) a) Suggest the mechanism.

[6]



- b) Explain in details the synthesis of (–) multistriatin by using chiron approach strategy. [5]

Q2) Attempt any three of the following.

[12]

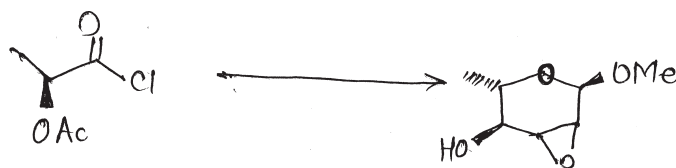
- a) Explain protection of ketones and aldehydes with suitable examples.
- b) What is Chiral templates? Explain role of chiral templates in organic synthesis.
- c) Explain the stabilities of different protecting groups in acidic conditions and in basic conditions.
- d) Why sugars are used as chiral template as well as chiral processor for synthesis of chiral drugs. Explain with examples.

P.T.O.

Q3) Attempt the following.

[12]

- a) Arrange the reagents in sequentially with intermediate in following conversions.

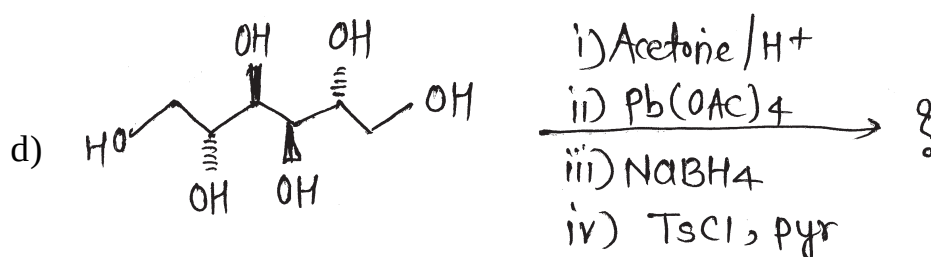
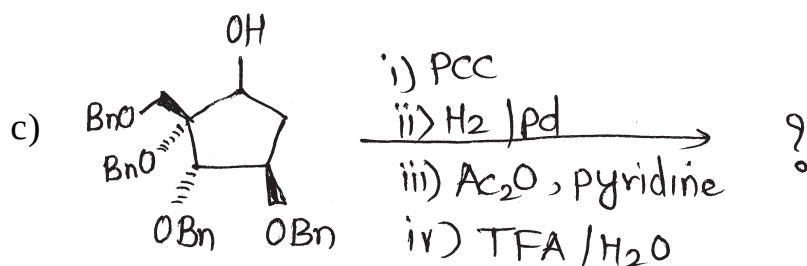
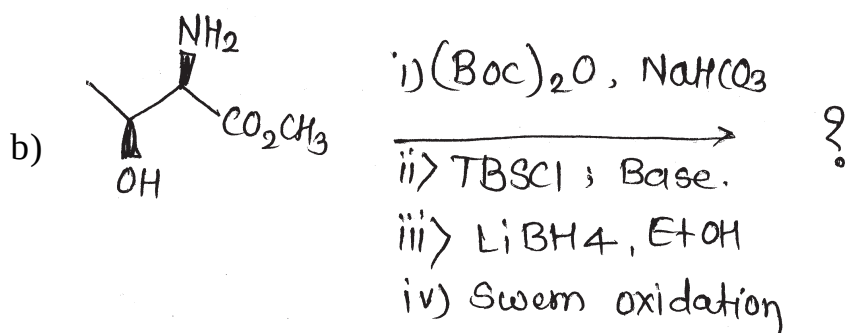
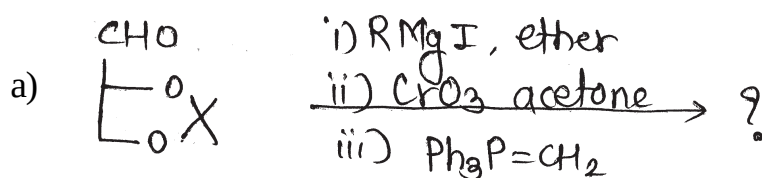


mcPBA ;  $\text{H}_2, \text{Pd}/\text{BaSO}_4$  ;  $\text{LiAlH}_4, \text{Et}_2\text{O}$  ;  $\text{NaOH}$  ;  $\text{H}_3\text{PO}_4, \text{CCl}_4$  ;  
 $\text{BrMgC}\equiv\text{C-CH(OMe)}_2$

- b) Write retrosynthetic analysis of shikimic acid.  
 c) Outline the following synthesis with all intermediate and reagents.  
 D - mannitol  $\rightarrow$  (R) & (S) epichlorohydrin

Q4) Predict the product/s with mechanism.

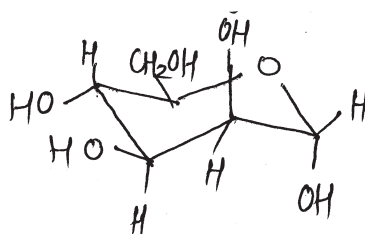
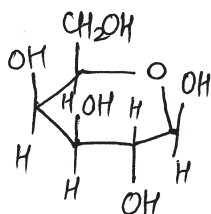
[12]



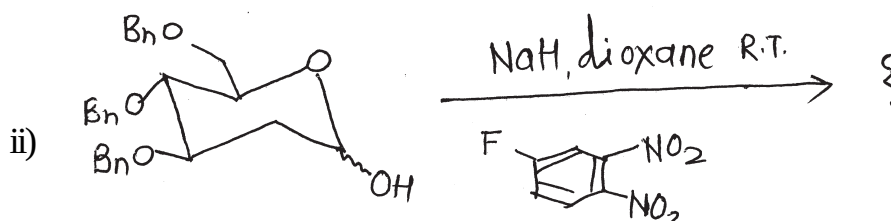
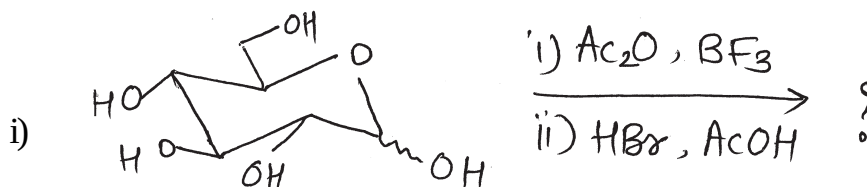
## SECTION - II

**Q5) a)** Attempt the following: **[6]**

- i) Write the zigzag form of D-Allose. Label the chiral centers with R/S configurations.
- ii) Identify the following sugar.



**b)** Predict the products. **[5]**

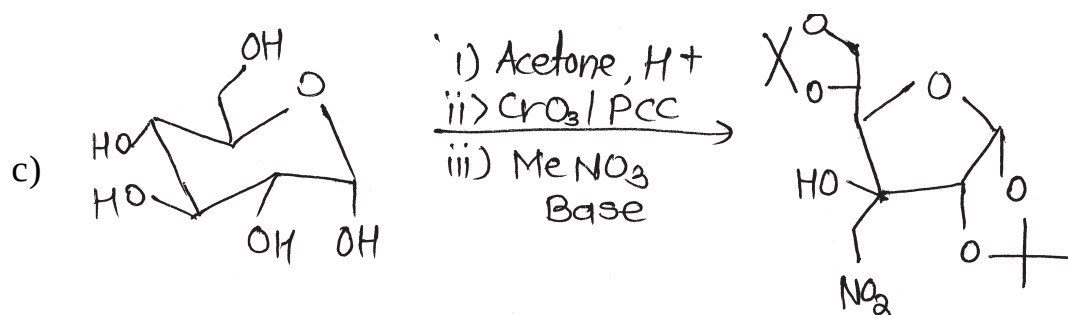
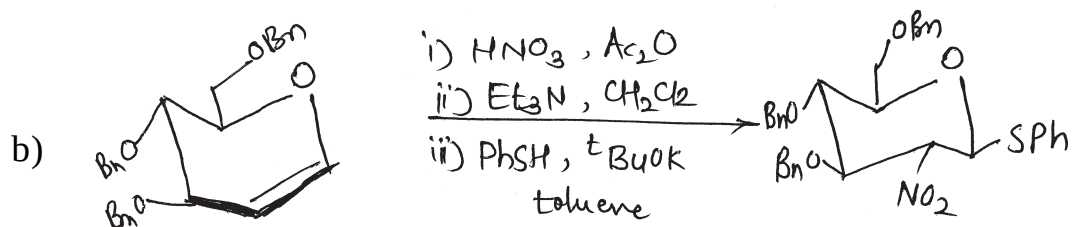
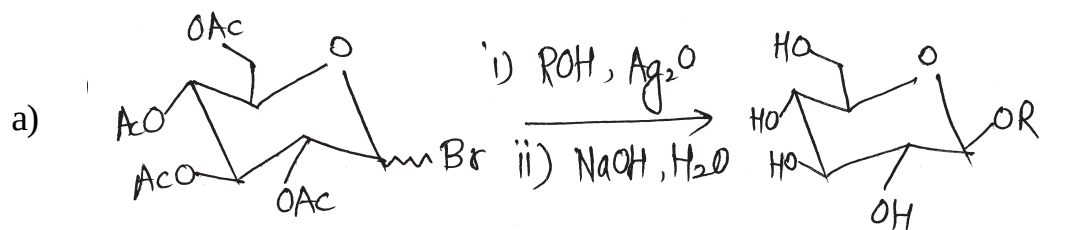


**Q6)** Write a short note on any three. **[12]**

- a) Glycosyl acceptor and glycosyl donor
- b) Regioselective protections in D-glucose
- c) Orthogonal strategy in oligosaccharide synthesis
- d) Alditols and cyclitols

**Q7)** Attempt the following: **[12]**

- a) Explain the factor affecting for anomeric effect.
- b) What are thioglycosyl donors? Write any two examples of the promoters which activates thioglycosyl donor.
- c) Explain the preparations of Trichloroacetimidate glycosides.
- d) Explain Killiani Fischer synthesis for conversion of aldotriose to aldotetrose.



~~~~~

[6510]-315

S.Y. M.Sc.

ORGANIC CHEMISTRY

CHO-353(B) : Designing Organic Synthesis and
Heterocyclic Chemistry

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 1 and 5 Compulsory and carry 11 marks.
- 2) Answer any 2 questions out of Q2 to Q4 and any 2 questions out of Q6 to Q8.
- 3) Answers to two sections should be written on a separate answer books.
- 4) Figures to right indicate full marks.

SECTION - I

Q1) a) Answer the following (any Two): [6]

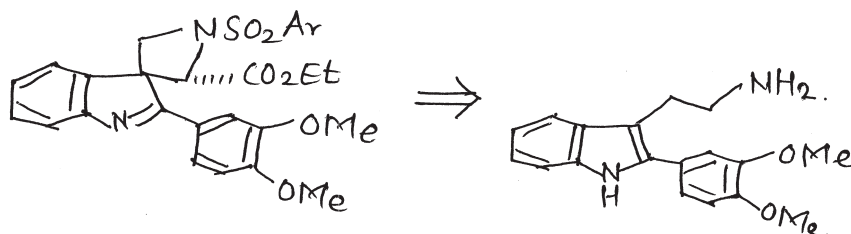
- i) Write the synthetic equivalent for following synthons with suitable examples.



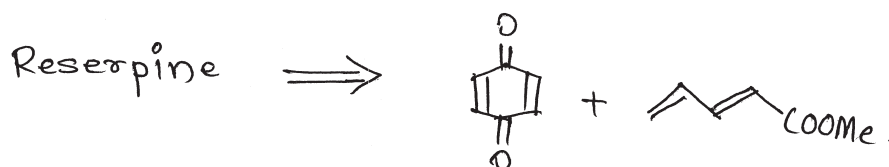
- ii) Explain umpolung of reactivity can be achieved by using nitroalkanes.
- iii) Explain illogical breaking in 1, 2-dioxygenated systems.

b) Attempt the following. [5]

- i) Write retrosynthetic steps for following.

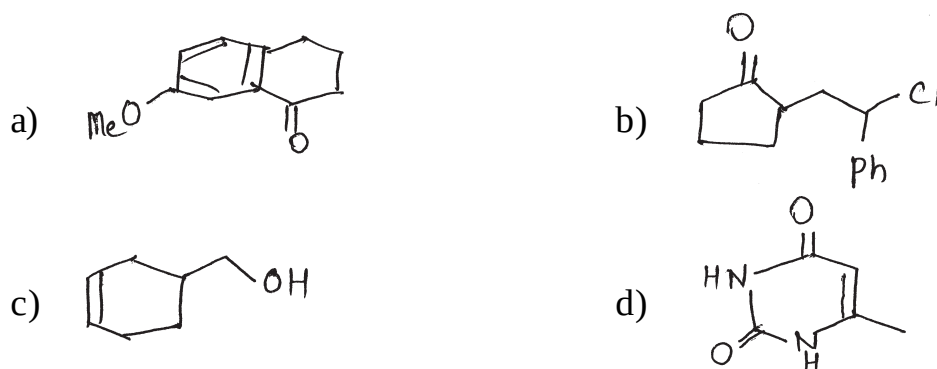


- ii) Suggest retrosynthesis for following.



P.T.O.

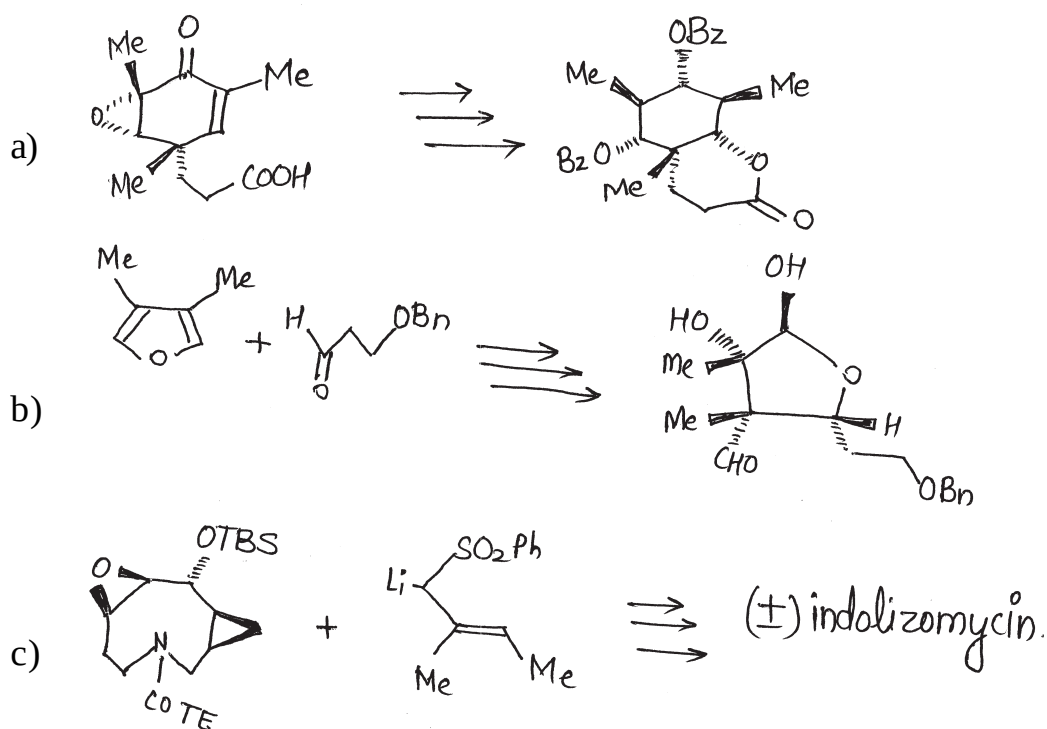
Q2) Using retrosynthetic analysis, suggest suitable method for the synthesis of following compounds (any three) [12]



Q3) Answer the following. [12]

- Explain disconnection in 1, 5-dicarbonyl compounds with suitable examples.
- If the yield of five step convergent synthesis is 90% for each step. What is the overall yield of this five step convergent synthesis?
- Explain use of azo-Robinson annulation reaction in total synthesis of indolizomycin.
- Explain the role of [3, 3] sigmatropic rearrangement reaction in the synthesis of strychnine molecule.

Q4) How will you effect the following conversions. [12]



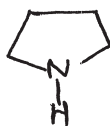
SECTION - II

Q5) a) Answer the following: **[6]**

i) Name the following heterocycles using.

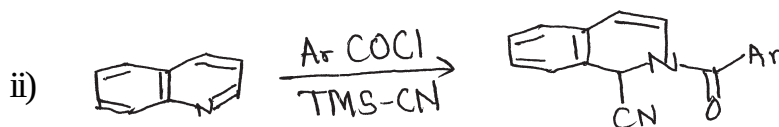
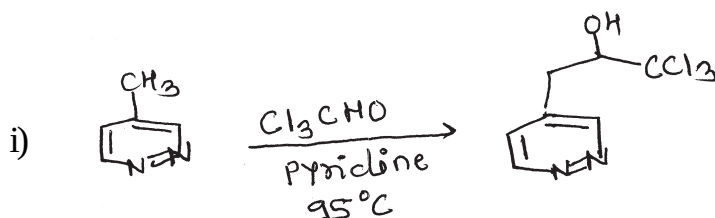
1) Recognized trivial names

2) By systematic Hantzsch-Widman nomenclature

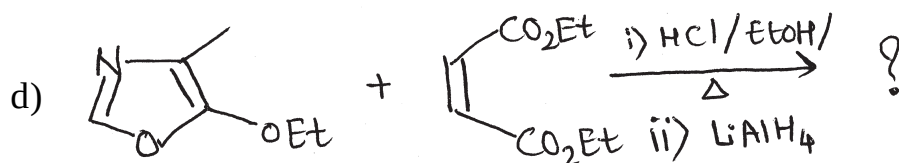
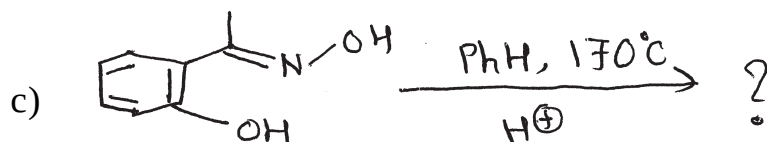
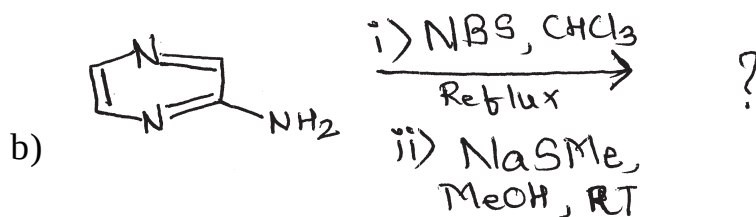
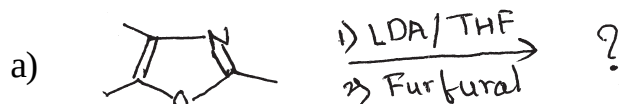


ii) Imidazole is much stronger base than pyrazole. Explain.

b) Suggest a suitable mechanism for the following. **[5]**



Q6) Predict the product with a mechanism. **[12]**

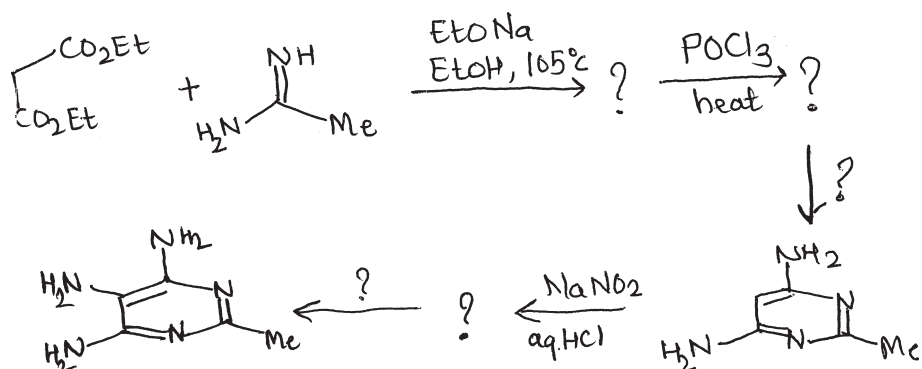


Q7) Answer the following: **[12]**

- a) Explain Epoxidation reaction for synthesis of heterocyclic compounds.
- b) Give any one method for preparation of oxazole and pyrazine.
- c) Explain any two reactions in benzimidazole.

Q8) a) Answer the following: **[6]**

- i) Write a note on Neurotransmitters heterocyclic compounds.
 - ii) Explain the role of heterocyclic compounds in biological system.
- b) Complete the following reactions sequence and write the structure & reagents. **[6]**



~~~~~

Total No. of Questions : 8]

SEAT No. :

PE-5295

[Total No. of Pages : 3

[6510]-316

S.Y. M.Sc.

**ANALYTICAL CHEMISTRY**

**CHA-390 : Electrochemical and Thermogravimetric  
Methods of Chemical Analysis  
(2019 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q. No. 1 and Q. No. 5 are compulsory.*
- 2) *Q. No. 2 to Q. No. 4 and Q. No. 6 to Q. No. 8 carry equal marks.*
- 3) *Solve any two questions from Q. No. 2 to Q. No. 4 and two questions from Q. No. 6 to Q. No. 8.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of log table and calculator is allowed.*
- 6) *Answer to two sections should be written on separate answers sheet.*

**SECTION - I**

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

- i) State and explain Faradays first law of electrolysis.
- ii) What is supporting electrolyte in polarography?
- iii) When and how dissolved oxygen interferes in polarographic analysis?
- iv) Discuss the different steps involved in stripping voltammetry.
- v) What type of excitation signal is applied to cyclic voltammetric experiment?

b) Calculate the diffusion current that would be expected from the reduction of  $2.0 \times 10^{-3}$  M.  $Zn^{2+}$ . The diffusion coefficient for  $Zn^{2+}$  is  $1.0 \times 10^{-6}$  cm<sup>2</sup>/sec. and the mercury drop characteristics are  $m = 1.80$  mgls and  $t = 3.45$  sec.

**[3]**

**Q2) a)** Attempt the following. **[6]**

- i) Draw the ideal cyclic voltammogram and explain analytical importance of cathodic peak current and anodic peak current.
- ii) Explain the different analytical applications of cyclic voltammetry.

**P.T.O.**

- b) Attempt the following : [6]
- What is Coulometry? Explain the advantages of coulometry over electrogravimetry.
  - How many gram of nickel will be deposited by passage of constant current 2.0 A for four hours through the solution of nickel salt?  
(Given : At. wt. of Ni = 58.75 and  $1F = 96500$  coulomb)
- Q3) a)** Attempt the following : [6]
- What is hydrodynamic voltammetry? Explain construction of rotating ring micro electrode.
  - What is diffusion current? Explain the factors affecting the diffusion current on polarogram.
- b) Attempt the following : [6]
- Compare the normal pulse polarography with differential pulse polarography.
  - Explain the principle and applications of controlled potential coulometry.
- Q4) a)** Attempt the following : [6]
- What are the analytical principles of anodic stripping and cathodic stripping voltammetry?
  - Draw the schematic diagram of dropping mercury electrode and explain its advantages and disadvantages.
- b) Attempt the following: [6]
- With schematic diagram explain the application of hydrodynamic voltammetry as a detector for liquid chromatography.
  - A 10.0 ml unknown amount of Cu(II) ions produces  $24.6 \mu A$  diffusion current on DC polarogram. By adding 5.0 ml of  $2.0 \times 10^{-3} M$  Cu(II) ions in above solution, the new diffusion current is  $56.4 \mu A$ . Calculate the unknown amount of Cu(II) ions.

## SECTION - II

- Q5) a)** Solve any four of the following: [8]
- Define thermomechanical analysis.
  - Explain term polymer blends.
  - What is evolved gas analysis.
  - Mention any two applications of DTA.
  - Explain crystalline phase transition.

- b) The curve was obtained for 10.80 mg of sample contain  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  when the monohydrate formation was completed at  $210^\circ\text{C}$ . The loss in mass is 1.99 mg. Find the percentage of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  in sample. [Given : At. wt. Ca = 63.54, S = 32.0, O = 16.0, H = 1.0] [3]
- Q6)** a) Attempt the following [6]  
 i) Write a note on TA Infrared.  
 ii) Write in detail application of TGA.  
 b) Draw and explain the curve of calcium oxalate monohydrate  $[\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}]$  in detail. [6]
- Q7)** a) What is DTA? Draw and explain components of DTA apparatus. [6]  
 b) Attempt the following: [6]  
 i) Explain simultaneous TG-analysis. TG-MS.  
 ii) Write note on factors affecting thermometric titration.
- Q8)** a) Attempt the following : [6]  
 i) Give a comparative account of TGA and DTA.  
 ii) Write a note on dielectric thermal analysis.  
 b) Answer the following : [6]  
 i) Write a note on heat flux DSC.  
 ii) Give any two applications of thermomicroscopy.



Total No. of Questions : 8]

SEAT No. :

PE-5296

[Total No. of Pages : 3

[6510]-317

S.Y. M.Sc.

**ANALYTICAL CHEMISTRY**

**CHA-391 : Analytical Method Development and Extraction  
Techniques**

**(2019 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) Questions 1 and 5 are compulsory.
- 2) Questions 2 to 4 carry equal marks.
- 3) Solve any 2 questions from 2 to 4 and solve 2 questions from 6 to 8.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic tables and scientific calculator is allowed.

**SECTION - I**

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

- i) Define specificity.
  - ii) What is a personal error?
  - iii) Enlist topics selected for initial harmonization.
  - iv) What is multiple point calibration?
  - v) Give factors affecting dissolution test.
- b) With a suitable diagram describe the USP Type - II dissolution apparatus. **[3]**

**Q2) a)** Explain in detail. **[6]**

- i) Limit of detection and limit of quantitation.
  - ii) Cosponsors of ICH.
- b) Solve the following: **[6]**
- i) Discuss one point calibration.
  - ii) Analysis of blood sample for its lead content gave 0.320, 0.324, 0.332, 0.338 and 0.342 ppm of lead. Calculate mean, mean deviation, standard deviation and relative standard deviation.

**P.T.O.**

- Q3)** a) Give essential principles of method transfer process. [6]  
 b) What is revalidation? Why is it necessary? [6]
- Q4)** a) Describe European community guidelines. [6]  
 b) i) The mean  $\bar{x}$  of four determinations of copper content of a sample of alloy was 8.02% with standard deviation  $S = 0.20\%$ . Calculate 95% confidence limit for true value [Given  $t = 3.18$ ] [3]  
 ii) Differentiate between accuracy and precision. [3]

### **SECTION - II**

- Q5)** a) Attempt the following any four: [8]  
 i) What are the advantages and disadvantages of using MAE for recovery of organic compounds from sample matrices?  
 ii) What is single drop SPME?  
 iii) How long might the fibre be exposed in the sampling and desorb mode in SPME techniques?  
 iv) Enlist the post extraction technique.  
 v) Write five stages of SPE.  
 b) A metal 'X' was found to be extracted to the extent of 95% into methylene chloride with dithiazone at  $\text{pH} = 5$ ; when equal volumes of aqueous and organic solvents were used. Another Y was 5% extracted under the same conditions. What is the separation efficiency for these two metals at  $\text{pH} = 5$ . [3]
- Q6)** a) Attempt the following: [6]  
 i) Describe headspace SPME for volatile organic compounds in water.  
 ii) Describe trace analysis of chlorophenols using MIPs with LC-MS/MS detection.  
 b) Attempt the following: [6]  
 i) Describe application of reverse phase SPE in the extraction of chloroforms in drinking water.  
 ii) Describe SPE formats and apparatus.

- Q7) a)** Attempt the following: **[6]**
- i) Explain different types of SPE sorbent.
  - ii) Describe different sample pre concentration methods for organic compounds in the sample extract.
- b)** Attempt the following: **[6]**
- i) Describe determination of lead by the dithiazone method.
  - ii) In solvent extraction of Uranium with 8-hydroxyaminoline in chloroform; the volume of aqueous and organic phase was 25ml each. When the percentage extracted was 99.8%, calculate the distribution ratio.
- Q8) a)** Attempt the following: **[6]**
- i) Describe parameter optimization in the applications of PFE.
  - ii) Explain in detail microwave heating and conventional heating with a diagram.
- b)** Attempt the following: **[6]**
- i) Describe automated soxhlet extraction process.
  - ii) Explain any one SPME-GC applications.



Total No. of Questions : 8]

SEAT No. :

PE-5297

[Total No. of Pages : 3

[6510]-318

S.Y. M.Sc.

ANALYTICAL CHEMISTRY

CHA-392 : Advanced Chromatographic Methods of  
Chemical Analysis

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Write answers of two sections on two answer books.
- 2) Q.1 and 5 are compulsory.
- 3) From Q. 2 to 4 and 6 to 8 solve any two-two questions.
- 4) Figures to right indicate full marks.
- 5) Use of log table and calculator is allowed.

**SECTION - I**

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

- i) Give classification of GC on the basis of stationary phases.
- ii) Give principle of electron impact ionization.
- iii) What is peak capacity?
- iv) Give equation to calculate METP and meaning of terms in it.
- v) What is partition coefficient? Give equation for its.

b) A mixture of acetone, methanol and ethanol was analysed by GC. The peaks are observed at 4.25, 5.92 and 6.86 min. respectively having peak areas 1856, 2390 and 1345 mV-sec. Calculate percentage of each component in the mixture. **[3]**

**Q2) a)** Write note on the following: **[6]**

- i) Chemical ionization method.
- ii) Classical theory of chromatography.

b) Answer the following: **[6]**

- i) Analysis of organochlorine pesticides by LLC-GC method.
- ii) Explain construction working of TCD.

P.T.O.

- Q3) a)** What is mass analyser? Explain construction and working of [6]  
 i) Quadrupole  
 ii) Time flight mass analyser
- b)** Explain the following: [6]  
 i) Selected ion monitoring in GCMS.  
 ii) Determination of phenols in LLC-GC.
- Q4) a)** Explain/discuss qualitative and quantitative analysis of substances by CTC method. [6]
- b)** Answer the following: [6]  
 i) What is resolution in chromatography? If two peaks are observed at 2.75 and 3.15 min having base width 1.8 min. each then calculate resolution.  
 ii) Give difference between GC and HPLC.

### **SECTION - II**

- Q5) a)** Solve any four of the following: [8]  
 i) What is the principle of ion exchange chromatography?  
 ii) What is the role of scavenger column in HPLC?  
 iii) Differentiate between normal phase and reverse phase in HPLC.  
 iv) Draw neat diagram of electrospray interface.  
 v) Describe linear dynamic range and detection limit of detector.
- b)** A standard solution of aspartame of  $8\text{g/l}^{-1}$  is prepared. It gives a peak area of 7200. The sample containing aspartame gives a peak of 4800. Calculate calibration factor and amount of aspartame in given sample. [3]
- Q6) a)** Answer the following:  
 i) What is super critical fluid? Give properties of supercritical fluid carbondioxide. [3]  
 ii) Describe internal standard method with suitable example. [3]
- b)** Write notes on the following:  
 i) Eluotropic series [3]  
 ii) Pumps in HPLC [3]

- Q7)** a) Describe working of PDA detector with suitable diagram. Explain advantages of PDA over UV detector. [6]
- b) Answer the following:
- i) Explain precolumns in HPLC. [3]
- ii) Discuss any one application of LC-MS in detail. [3]
- Q8)** a) Explain principle of size exclusion chromatography. Describe how it is useful in determination of molecular weight. [6]
- b) Write short note on following:
- i) Preparative HPLC [3]
- ii) Gradient elution in HPLC. [3]



Total No. of Questions : 8]

SEAT No. :

PE-5298

[Total No. of Pages : 3

[6510]-319

S.Y. M.Sc.

ANALYTICAL CHEMISTRY

CHA-393(A) : Bioanalytical Chemistry

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

*Instructions to the candidates:*

- 1) *Answers to two sections should be written on a separate answer books.*
- 2) *Figures to right indicate full marks.*
- 3) *Use of logarithmic table/calculator is allowed.*

**SECTION - I**

*Instructions to the candidates:*

- 1) *Question 1 is compulsory.*
- 2) *From Question 2 to 4 solve any two.*

**Q1) a)** Solve any four from the following: **[8]**

- i) What is the role of support media in electrophoresis?
  - ii) What is the effect of pore size on electrophoretic mobility?
  - iii) Define electroosmosis.
  - iv) Write the principle of MALDI techniques.
  - v) State Kubelka-Munk equation.
- b) What is derivatization? Explain pre and post column derivatization method. **[3]**

**Q2) a)** Attempt the following: **[6]**

- i) Discuss sensitivity, detection limit and linear range for detector in capillary electrophoresis.
  - ii) What is the difference between TLC and HPTLC?
- b) What are the different types of electro phoretic system? Discuss moving boundary electrophoretic in detail. What are its drawbacks? **[6]**

**P.T.O.**

- Q3) a)** Answer the following: [6]
- Explain in detail transmittance measurement in TLC.
  - Write a note on optical method for detection of separated components in electrophoresis.
- b)** Explain in detail amperometric detection. [6]
- Q4) a)** Answer the following: [6]
- Write a note on electrokinetic injection in capillary electrophoresis.
  - What is zone electrophoresis? Explain principle of capillary zone electrophoresis.
- b)** What is atmospheric pressure mass spectrometry? Explain in detail with applications. [6]

## SECTION - II

### ***Instructions to the candidates:***

- Question 5 is compulsory.***
- From Question 6 to 8 solve any two.***

- Q5) a)** Attempt any four of the following: [8]
- What are deficiency symptoms of vitamin B2?
  - How collected blood sample is preserved?
  - Write a principle of RIA.
  - Draw the structure of Vitamin C.
  - Give the mechanism by which  $\text{Na}_2\text{EDTA}$  and oxalate avoid coagulation of blood.
- b)** Unknown blood sample of patient were analyzed for creatinine content by picric acid method. The absorbance of sample is 0.010 and standard is 0.055. Calculate the concentration of creatinine in 100 ml of sample. (Conc. of creatinine standard = 2 mg/dl). [3]
- Q6) a)** Discuss the following: [6]
- Estimation of Vitamin A by spectrometry.
  - Explain in detail the affinity and avidity.
- b)** Answer the following: [6]
- Explain the estimation of Na, K and Ca by flame photometry.
  - Explain diagnostic usefulness of antigen and antibodies in infectious diseases.

- Q7)** a) Discuss the following: [6]
- i) Determination of blood haemoglobin.
  - ii) Vitamin B<sub>6</sub> (pyridoxine) with respect to functions, deficiency, diseases, daily requirement and analytical method.
- b) Answer the following: [6]
- i) Explain the methods of collection of faces sample.
  - ii) State the principle & explain the procedure for estimation of serum cholesterol.
- Q8)** a) What is sandwich ELISA? Explain direct and indirect sandwich ELISA in detail. [6]
- b) Answer the following: [6]
- i) Explain the colorimetric method for determination of leucocyte ascorbate.
  - ii) Unknown blood sample of patient were analyzed for urea content by DAM method. The absorbance of sample is 0.180 and that of standard is 0.215. Calculate the concentration of urea in sample. [Given: conc. of standard urea is 30 µg/ml]



Total No. of Questions : 8]

SEAT No. :

PE-5299

[Total No. of Pages : 3

[6510]-320

S.Y. M.Sc.

ANALYTICAL CHEMISTRY

CHA-393 B : Analytical Methods of Food and Controlled  
Substances

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.1 and Q.5 are compulsory.
- 2) Attempt any two questions from Q.2 to Q.4 and any two questions from Q.6 to Q.8.
- 3) Figures to the right indicate full marks.
- 4) Answers to both sections should be written on separate answer books.

**SECTION - I**

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

- i) What is Muffle Furnace?
- ii) What are Polysaccharides?
- iii) What do you mean by optical properties of food?
- iv) What is the tertiary structure of protein?
- v) Write the principal of Tanner's method.

**b)** Analysis of FAME by GC gave following areas for identified peaks. **[3]**

| FAME | Peak area (Arbitrary Unit) |
|------|----------------------------|
| A    | 2853369                    |
| B    | 1182738                    |
| C    | 14344172                   |

Calculate the % composition of each fatty acid.

**P.T.O.**

- Q2) a)** Explain the terms: [6]
- Protein E.R.
  - Essential Amino acid index
- It nitrogen retained, nitrogen absorbed and nitrogen intake from protein by rat was 2.74 mg, 2.18mg and 8.24 mg respectively. Calculate the net protein utilization, digestibility and biological value.
- b)**
- Explain the terms: [3]
    - Official samples
    - Process control samples
  - Write a note on dietary fibres. [3]
- Q3) a)** Outline an analytical method for the determination of peroxide value of oil. A 5gm cheese sample was dissolved in  $\text{CHCl}_3$  and treated with KI solution and titrated against 0.01N  $\text{Na}_2\text{S}_2\text{O}_3$ . It required 9.4ml of the titrant ("corrected titre value). Calculate the peroxide value of the cheese sample. [6]
- b)**
- Distinguish between dry ashing and wet ashing. [3]
  - Discuss the determination of total starch from food sample. [3]
- Q4) a)** What are food additives? Describe the different types of food additives. 2.10 gm of saccharin tablet sample was subjected to saccharin estimation and required 1.8 ml of 0.1N NaOH. Calculate the percentage of saccharin in the sample. (MW of saccharin = 183.2) [6]
- b)**
- Write a note on Karl Fischer titration. [3]
  - What are proteins? Write the principal of the Bradford protein assay. [3]

### SECTION - II

- Q5) a)** Attempt any four of the following: [8]
- What are trichomes?
  - Write the name and structure of the active compound present in *Lophophora Williamsii*.
  - Explain the extraction of LSD for quantitative analysis.
  - What are chemical colour tests?
  - Define:
    - Narcotic drugs
    - Psychopharmaceuticals

- b) A mixture of 3 compounds (A, B and C) was analysed using TLC. The distance travelled by solvent was 6.5 cm and the distances travelled by the compounds A, B and C were 2.5cm, 3.9 cm and 1.5 cm respectively. Calculate  $R_f$  value of each compound in sample. [3]
- Q6) a)** Discuss the identification of amphetamine by GCMS. [6]  
 Sample containing amphetamines shows a peak height of 26 mAUmin where as the peak height for reference solution with concentration of 50mg/ml 27 is mAUmin. Calculate the concentration of amphetamine present in the sample.
- b) i) Explain types of trichomes in cannabis plant. [3]  
 ii) Explain the analysis of barbiturates by TLC. [3]
- Q7) a)** Discuss the identification of diacetylmorphine by GCMS. A sample containing heroin was analysed by liquid chromatography. It gave following observations: [6]  
 $C_s = 7.4$  mAUmin,  $P_x = 6.9$  mAUmin,  $A_x = 6.7$  mAUmin,  
 $P_s = 3.4$  mAUmin,  $A_s = 6.7$  mAUmin.  
 Calculate the concentration ( $C_x$ ) of heroin in the sample.
- b) i) What are microcrystal tests? Give the advantages and disadvantages of microcrystal technique. [3]  
 ii) Explain the Zimmerman test. [3]
- Q8) a)** Discuss any two presumptive tests for cocaine. [6]  
 b) i) Explain the analysis of mescaline by TLC. [3]  
 ii) A drug containing LSD was extracted in  $CHCl_3$ . The  $CHCl_3$  extract of drug was analysed using GCMS. It gave following observations [3]

| LSD Std. (mg/ml) | Peak area ratio (AU) |
|------------------|----------------------|
| 0.1              | 110                  |
| 0.2              | 221                  |
| 0.3              | 336                  |
| 0.4              | 445                  |
| 0.5              | 562                  |
| sample           | 155                  |

Calculate the amount of LSD present in the sample.



[6510]-401

M.Sc. (Part - II)

PHYSICAL CHEMISTRY

CHP-410 : Molecular Structure &amp; Spectroscopy

(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

*Instructions to the candidates:*

- 1) *Answers to two sections should be written on a separate answer books.*
- 2) *Question No.1 and Q.No.5 are compulsory.*
- 3) *Answer any 2 questions out of Q2, Q3 and Q.4 and any 2 questions out of Q6, Q7 and Q8.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of logarithmic table, calculator is allowed.*
- 6) *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         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{23} \text{ J K}^{-1} \text{ molecule}^{-1}$                       |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{16} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ Js}$                                                                            |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.187 \times 10^7 \text{ erg}$<br>$= 4.187 \text{ J}$                                                                                                  |
| 10. 1 amu               |           | = | $1.673 \times 10^{-24} \text{ kg}$                                                                                                                      |
| 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 | $m_e$     | = | $9.11 \times 10^{-31} \text{ kg}$                                                                                                                       |

## SECTION - I

- Q1)** a) Attempt any four of the following: [8]
- i) State application of  $^{19}\text{F}$  NMR.
  - ii) Give the principle of NMR.
  - iii) What is quadrupole moment?
  - iv) Write the application of nqr.
  - v) Why derivative mode is preferred in ESR spectra?
- b) Predict the intensity distribution in the hyperfine lines of the esr spectrum of the radicals  $\cdot\text{CH}_3$  and  $\cdot\text{CD}_3$ . [3]
- 
- Q2)** a) Attempt the following: [6]
- i) Explain the factors affecting g-value.
  - ii) What is Larmor precession and Larmor frequency?
- b) Attempt the following: [6]
- i) Explain the principle of esr.
  - ii) Write the theory of spin-spin interaction for  $A_2$  type case.
- 
- Q3)** a) Describe the instrumentation involved in high resolution NMR spectroscopy. [6]
- b) Attempt the following: [6]
- i) What is the importance of Mc Connell equation.
  - ii) Write a note on  $^{31}\text{P}$  nmr spectroscopy.
- 
- Q4)** a) Describe the instrumentation used in ESR spectroscopy with suitable diagram. [6]
- b) Attempt the following: [6]
- i) Explain the term spin density with respect to ESR spectroscopy.
  - ii) Calculate NMR frequency of  $^{35}\text{Cl}$  in a magnetic field of intensity 1.8 T.  
(Given :  $I = 3/2$ ).

## SECTION - II

- Q5) a)** Attempt any four of the following: **[8]**
- i) Define and explain the term curie temperature.
  - ii) State Van Vlecks equation and explain the terms involved in it.
  - iii) Explain the term nuclear and magnetic scattering.
  - iv) Define the terms pole strength and magnetic field.
  - v) What is scattering intensity in electron diffraction.
- b) A powder diffraction photograph from tungsten shows lines that index are (110) (200) (211) (220) (310) (222) (321) and (400). Identify the (Bravais) lattice type of unit cell. **[3]**
- 
- Q6) a)** Attempt the following: **[6]**
- i) State Langevin equation and explain its theory of paramagnetism.
  - ii) How electron diffraction method is used for structure elucidation of gas phase molecule?
- b) Attempt the following: **[6]**
- i) What is structure factor of simple cubic and face centre cubic lattice.
  - ii) Give the applications of neutron diffraction technique.
- 
- Q7) a)** Attempt the following: **[6]**
- i) How scattering intensity is related to scattering angle.
  - ii) Discuss electron diffraction technique for the structure of surfaces.
- b) Attempt the following: **[6]**
- i) Explain how X-ray diffraction can be used to determine the absolute configuration of molecule.
  - ii) The Gouy balance results showed that a sample of complex ion in a tube of  $1.75 \times 10^{-5} \text{ m}^2$  cross section was partly in a magnetic flux density of 0.4T was pushed into the field by a force equal to  $2.50 \times 10^{-4} \text{ N}$ . Calculate magnetic susceptibility.  
(Given :  $\mu_0 = 4 \pi \times 10^{-7} \text{ J C}^{-2} \text{ M}^{-1} \text{ S}^2$ )

- Q8) a)** Attempt the following: **[6]**
- i) Explain constructive and destructive interferences observed in X-ray diffraction pattern.
  - ii) Explain paramagnetism and diamagnetism.
- b)** Attempt the following: **[6]**
- i) Write a note on elastic scattering of neutron.
  - ii) Calculate the molar susceptibility of benzene, given that its volume susceptibility is  $-7.2 \times 10^{-7}$  and its density is  $0.879 \text{ g cm}^{-3}$  at  $25^\circ\text{C}$ .



PE-5301

[Total No. of Pages : 3]

[6510]-402

S.Y. M.Sc.

**PHYSICAL CHEMISTRY****CHP-411 : Surface Chemistry and Electrochemistry  
(2019 Pattern) (Semester - IV)***Time : 3 Hours]**[Max. Marks : 70**Instructions to the candidates:*

- 1) *Answers to two sections should be written on a separate answer books.*
- 2) *Questions 1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of logarithmic table, calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

**Physico - Chemical Constant**

|                         |           |   |                                                                                                                                                         |
|-------------------------|-----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Avogadro Number      | N         | = | $6.023 \times 10^{23} \text{ mol}^{-1}$                                                                                                                 |
| 2. Boltzmann Constant   | k         | = | $1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                      |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-16} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J s}$                                                                          |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.187 \times 10^7 \text{ erg}$<br>$= 4.187 \text{ J}$                                                                                                  |
| 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) Write Gibbs Adsorption equation and define the terms involved in it.
  - ii) Define the terms:
    - 1) Adsorbate
    - 2) Adsorbent
  - iii) What is differential heat of adsorption?
  - iv) What is hysteresis of Adsorption?
  - v) Write the relationship between surface tension and adsorption. Define the terms in it.
- b) Explain Langmuir adsorption isotherm. **[3]**
- 
- Q2) a)** Answer the following: **[6]**
- i) Write the assumptions of potential theory of multilayer adsorption.
  - ii) How Harkins-Jura equation used to determine the surface area of solid?
- b) Answer the following: **[6]**
- i) Describe the microtome method for verification of Gibb's equation.
  - ii) Explain the isothermal method for measurement of heat of adsorption.
- 
- Q3) a)** Derive and explain Gibb's Adsorption equation. **[6]**
- b) Answer the following: **[6]**
- i) Explain the mechanism of chemisorption on semiconductor
  - ii) Discuss the mechanism of detergency
- 
- Q4) a)** Derive the equation for enthalpy of adsorption. **[6]**
- b) Answer the following: **[6]**
- i) Explain Gravimetric method for measurement of adsorption.
  - ii) Write the assumptions of potential theory for multilayer adsorption.

## SECTION - II

- Q5) a)** Attempt any four of the following: [8]
- i) Define the terms fuel cell and primary batteries.
  - ii) Write the equation for thickness of ionic atmosphere and explain the terms involved in it.
  - iii) What is liquid junction potential?
  - iv) What is diffusion? Explain with suitable example.
  - v) What is electro kinetic phenomenon?
- b)** Deduce Debye-Huckel limiting law. [3]
- Q6) a)** Answer the following: [6]
- i) Derive expression for mean activity coefficient for finite size ions.
  - ii) Write a note on tafel plot.
- b)** Answer the following: [6]
- i) Find the ionic strength of following solution. Assuming complete dissociation 400 ml of 0.2m  $\text{Na}_3\text{PO}_4$  + 100ml of 0.4 m  $\text{ZnCl}_2$ .
  - ii) What are the ways of transport of ions?
- Q7) a)** Answer the following: [6]
- i) Ionic strength of KCl is 0.04. Calculate the mean activity coefficient of an electrolyte using Debye-Huckel limiting law.
  - ii) Discuss the variation of emf with temperature.
- b)** Answer the following: [6]
- i) Write Butler-Volmer equation and explain the terms involved in it.
  - ii) Write the equation for Fick's first law and explain the terms involve in it.
- Q8) a)** Answer the following: [6]
- i) Explain lead acid storage battery.
  - ii) Give the assumptions of Debye-Huckel theory.
- b)** Answer the following: [6]
- i) Explain the Stern adsorption theory of double layer.
  - ii) Derive an equation showing the relationship between emf of cell and enthalpy.



Total No. of Questions : 8]

SEAT No. :

PE-5302

[Total No. of Pages : 2

[6510]-403

S.Y. M.Sc.

**PHYSICAL CHEMISTRY**

**CHP-412 (A) : Material Chemistry and Catalysis  
(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Answer to the Two sections should be written in separate answer books.*
- 2) *Questions 1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of logarithmic table, calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

**Physico - Chemical Constant**

|                         |           |   |                                                                                                                                                         |
|-------------------------|-----------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Avogadro Number      | N         | = | $6.023 \times 10^{23} \text{ mol}^{-1}$                                                                                                                 |
| 2. Boltzmann Constant   | k         | = | $1.38 \times 10^{-16} \text{ erg K}^4 \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$                         |
| 3. Planck Constant      | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ Js}$                                                                           |
| 4. Electronic Charge    | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{-19} \text{ C}$                                                                              |
| 5. 1 eV                 |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6. Gas Constant         | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7. Faraday Constant     | F         | = | $96487 \text{ C equivalent}^{-1}$                                                                                                                       |
| 8. Speed of light       | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9. 1 cal                |           | = | $4.184 \times 10^7 \text{ erg}$<br>$= 4.184 \text{ J}$                                                                                                  |
| 10. 1 amu               |           | = | $1.673 \times 10^{-24} \text{ kg}$                                                                                                                      |
| 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) Draw the unit cell diagram of 2-1-4 superconductor cuprate crystal.
  - ii) Define the term coherent length.
  - iii) State the optical properties of solid devices.
  - iv) Give two applications of hi-tech materials.
  - v) Write the applications of capacitors.
- b)** What are transistors? Explain the three modes of its operation. **[3]**
- Q2) a)** Attempt the following. **[6]**
- i) State and explain different types of elastic constant.
  - ii) Discuss the chemical vapor deposition with suitable examples.
- b)** Attempt the following **[6]**
- i) Explain construction and working of full wave rectifier.
  - ii) Describe the properties of perovskites.
- Q3) a)** Explain the term photolithography with suitable diagram **[6]**
- b)** Attempt the following : **[6]**
- i) Write note on optical photon modes in hitech materials.
  - ii) Explain the types of Langmuir-Blodgett film.
- Q4) a)** Explain the preparation and normal state properties of 1-2-3 materials **[6]**
- b)** Attempt the following: **[6]**
- i) Explain the term MOCVD.
  - ii) 92% light passes through a 16 cm solid. Evaluate the absorption coefficient of the solid.

### **SECTION - II**

- Q5) a)** Attempt any four of the following: **[8]**
- i) Define 'site' and 'support'
  - ii) What is catalyst deactivation?
  - iii) Which catalyst is used in diesel oxidation reaction?
  - iv) Differentiate between homogeneous and heterogeneous catalysis.
  - v) State any four factors which affects the activity of catalyst.
- b)** Discuss impregnation method of preparation of catalyst. **[3]**

- Q6)** a) Attempt the following [6]  
i) Explain the mechanism of chemisorption on metal oxide.  
ii) Describe the Mercury porosimeter method for pore size determination.
- b) Attempt the following: [6]  
i) Discuss the photocatalysis in semiconductors  
ii) Explain FTIR method to determine solid particle size.
- Q7)** a) How is ozone produced in the environment? How its attenuation take place by a catalyst? [6]  
b) Attempt the following: [6]  
i) Explain the hydrothermal method of preparation of a catalyst.  
ii) What are VOCs? How are various catalysts used to remove them?
- Q8)** a) Explain the sol-gel method used for preparation of catalyst. [6]  
b) Attempt the following: [6]  
i) How is the surface area of a powdered solid measured?  
ii) Explain principle of calcination method in catalyst activation.



Total No. of Questions : 8]

SEAT No. :

[Total No. of Pages : 2

PE-5303

[6510]-404

S.Y. M.Sc.

**PHYSICAL CHEMISTRY**

**CHP- 412(B) : Biophysical Chemistry and Special  
Topics in Nuclear & Radiation Chemistry  
(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Answer to the Two sections should be written in separate answer books.*
- 2) *Question No.1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Use of logarithmic table calculator is allowed.*
- 6) *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         | = | $1.38 \times 10^{-16} \text{ erg K}^4 \text{ molecule}^{-1}$<br>$= 1.38 \times 10^{23} \text{ J K}^{-1} \text{ molecule}^{-1}$                          |
| 3.  | Planck Constant     | h         | = | $6.626 \times 10^{-27} \text{ erg s}$<br>$= 6.626 \times 10^{-34} \text{ J/s}$                                                                          |
| 4.  | Electronic Charge   | e         | = | $4.803 \times 10^{-10} \text{ esu}$<br>$= 1.602 \times 10^{19} \text{ C}$                                                                               |
| 5.  | 1 eV                |           | = | $23.06 \text{ k cal mol}^{-1}$<br>$= 1.602 \times 10^{-12} \text{ erg}$<br>$= 1.602 \times 10^{-19} \text{ J}$<br>$= 8065.5 \text{ cm}^{-1}$            |
| 6.  | Gas Constant        | R         | = | $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$<br>$= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$<br>$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
| 7.  | Faraday Constant    | F         | = | $96487 \text{ C equiv}^{-1}$                                                                                                                            |
| 8.  | Speed of light      | c         | = | $2.997 \times 10^{10} \text{ cm s}^{-1}$<br>$= 2.997 \times 10^8 \text{ m s}^{-1}$                                                                      |
| 9.  | 1 cal               |           | = | $4.184 \times 10^7 \text{ erg}$<br>$= 4.184 \text{ J}$                                                                                                  |
| 10. | 1 amu               |           | = | $1.673 \times 10^{-24} \text{ kg}$                                                                                                                      |
| 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) Give the two function of proteins.
  - ii) Write the classification of RNA.
  - iii) Distinguish active and passive transport.
  - iv) What is Bragg's law.
  - v) Enlist the applications of Biopolymers.
- b) Write a note on competitive inhibition. [3]
- Q2) a)** Attempt the following: [6]
- i) Derive the Michaelis-Menten equation.
  - ii) Explain problems of protein folding.
- b) Attempt the following: [6]
- i) What are biopolymers? State and explain their characteristics and applications.
  - ii) Explain denaturation of proteins.
- Q3) a)** Discuss the applications of circular dichroism spectroscopy. [6]
- b) Attempt the following: [6]
- i) Discuss the role of ATP in biological systems.
  - ii) Explain primary and secondary structure of proteins.
- Q4) a)** Discuss the factors affecting enzyme activity. [6]
- b) Attempt the following: [6]
- i) Distinguish between RNA and DNA.
  - ii) Calculate  $R_{rms}$  and  $R_s$  for a linear polymeric chain containing ISO monomeric unit each 45 Å long.

## **SECTION - II**

- Q5) a)** Attempt any four of the following: **[8]**
- i) Define the term radiopharmaceutical and nuclear pharmacy.
  - ii) Enlist various natural and man made sources of radiation.
  - iii) What are the after effects of chernobyl accident?
  - iv) Which precautions are to be taken while handling the radioactivity?
  - v) Explain the term primordial nucleosynthesis.
- b) Describe how external radiation hazards can be controlled? **[3]**
- 
- Q6) a)** Attempt the following: **[6]**
- i) Write a note on solar neutrino problems.
  - ii) Explain somatic and genetic effects.
- b) Attempt the following: **[6]**
- i) Enlist personal dosimeters. Explain the details of any one of them.
  - ii) Give the classification of radioactive waste.
- 
- Q7) a)** Explain the general aspects of use of radio-pharmaceuticals. **[6]**
- b) Attempt the following: **[6]**
- i) Give the AERB guidelines for classification of liquid waste.
  - ii) Write a note on stellar nucleosynthesis.
- 
- Q8) a)** Describe the use of radiation for food preservation and sterilization. **[6]**
- b) Attempt the following: **[6]**
- i) Discuss maximum permissible dose-ICRP recommendation.
  - ii) Write a short note on stellar evolution.



Total No. of Questions : 6]

SEAT No.:

PE-5304

[Total No. of Pages : 3

[6510]-405

S.Y. M.Sc.

INORGANIC CHEMISTRY

**CHI-430 : Heterogeneous Catalysis and its Applications  
(2019 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) *Write each section in separate answer book.*
- 4) *Draw neat diagrams wherever necessary.*

**SECTION - I**

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

- a) Define the principle of Heterogeneous catalysis.
  - b) What is the significance of adsorption isotherms in surface chemistry.
  - c) What is the role of BET surface area analysis in characterizing catalysts?
  - d) What is turn-over frequency? Give its significance.
- B) Give the classification of heterogeneous catalyst. [3]**

**Q2) A) Attempt any One of the following: [6]**

- a) Give an account of factors influencing on zeolite synthesis.
  - b) Describe the preparation of solid catalysts by precipitation method. Give its advantages and disadvantages.
- B) Attempt any two of the following: [6]**
- a) Discuss in brief about nomenclature of zeolites.
  - b) Discuss the role of support in supported metal catalyst with suitable example.
  - c) Describe the method for the preparation of Raney-Ni catalyst.

**P.T.O.**

- Q3) A) Attempt any One of the following: [6]**
- a) Give an account of various processes of deactivation of heterogeneous catalyst.
  - b) What is chemical reactor? Explain construction, working, merits and demerits of fixed bed reactor.
- B) Attempt any Two of the following: [6]**
- a) Discuss the characterization of zeolite using powder XRD.
  - b) Discuss the impregnation method for the synthesis of solid catalysts in brief.
  - c) Write a note on phase transfer catalyst.

### **SECTION - II**

- Q4) A) Answer the following: [8]**
- a) What is Water Gas Shift reaction? Which catalyst used in it.
  - b) What is shape selective catalysis? Give its example.
  - c) Why  $\text{TiO}_2$  is considered as a good photo catalyst?
  - d) What is Friedel-Craft alkylation? Give its example.
- B) Explain the use of Clays and interrelated clays as a catalyst with suitable examples. [3]**
- Q5) A) Answer any One of the following: [6]**
- a) Draw the scheelite structure on  $\text{BiMoO}_4$ . Discuss its use as oxidation and ammoxidation catalyst.
  - b) Describe the role of HPA as a green catalyst for biomass conversion to useful products.
- B) Answer any Two of the following: [6]**
- a) Discuss in brief the use of MCM-41 as a catalyst.
  - b) Explain the significance of zeolites as a solid catalysts.
  - c) Write a note on promoters and poisons in catalysis.

**Q6) A) Answer any One of the following: [6]**

- a) Describe catalytic reforming with respect to feedstock, catalyst and products.
- b) Describe the process and advantages of Fischer-Tropsch Synthesis.

**B) Answer any Two of the following: [6]**

- a) What is hydrocracking? Give it's advantages.
- b) Write a note on industrial electrocatalysis.
- c) Discuss methanol, synthesis using heterogeneous catalysis.



Total No. of Questions : 6]

SEAT No. :

PE-5305

[Total No. of Pages : 3

[6510]-406

S.Y. M.Sc.

**INORGANIC CHEMISTRY**

**CHI-431 : Inorganic Nanomaterials : Properties,  
Applications & Toxicity**

**(2019 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 indicate full marks.*
- 4) *Use of logarithmic table, calculator is allowed.*
- 5) *Answers to the two sections should be written in separate answer books.*

**SECTION - I**

**[Nano-structural Materials & Applications]**

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

- i) Explain the term nanocomposites.
  - ii) Discuss in brief term nanophotonics.
  - iii) Explain the concept of 3D nanostructures.
  - iv) What are quantum dots 2? Explain with examples.
- b) Explain the effect of size of nanomaterials on surface area and quantum effect. **[3]**

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

- i) Discuss in brief about optical properties of nanomaterials & magnetic properties.
  - ii) Discuss about 0D, 1D, 2D and 3D nanostructures with suitable examples.
- b) Answer any two of the following: **[6]**
- i) Give a difference between natural and artificial nanoparticles with suitable example.
  - ii) Explain the term nanotechnology. Discuss applications of nanotechnology in organic electronics.
  - iii) Explain in brief about SWCNT & MWCNT.

**P.T.O.**

- Q3) a)** Answer any one of the following. **[6]**
- i) Discuss about Bottom up process and top down process for nanoparticle fabrication.
  - ii) Explain in brief about nanobiotechnology and polymer nanotechnology.
- b)** Answer any two of the following. **[6]**
- i) Write a short note on computational nanotechnology.
  - ii) Discuss Moore's Law.
  - iii) Discuss in brief about thermal and chemical properties.

## **SECTION - II**

### **[Nano Toxicology & Biosafety]**

- Q4) a)** Answer the following: **[8]**
- i) Explain the term nanotoxicology.
  - ii) What do you mean by Nano etymology?
  - iii) What is significance of Biosensors.
  - iv) Explain the term cyto toxicity.
- b)** Discuss in brief toxic effects of Bismuth and Antimony nanostructures. **[3]**
- Q5) a)** Attempt any one of the following: **[6]**
- i) What do you mean by nanotoxicity? Explain the general mechanism of nanotoxicity.
  - ii) Explain in detail about in vitro toxicity assessment cell viability and vivo toxicity assessment.
- b)** Attempt any two of the following: **[6]**
- i) Explain the major toxicological effects due nanostructure deposition on human body.
  - ii) What are common desalination methods used for toxic heavy metals (nanostructures) in waste water.
  - iii) How zeta potential analysis is useful for determination of vitro toxicity.

- Q6)** a) Attempt any one of the following: **[6]**
- i) Discuss the common methods of diagnosis of nanotoxicity.
  - ii) Explain the various physico-chemical characteristics based on toxicology.
- b) Attempt any two of the following: **[6]**
- i) Write a short note on apoptosis assay.
  - ii) Discuss any two methods to detect the nanotoxicity.
  - iii) Write a short note on chemical method used for identification of nanotoxicity.



Total No. of Questions : 6]

SEAT No. :

PE-5306

[Total No. of Pages : 3

[6510]-407

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-432A : Material Science

(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

**SECTION - I**

**[crystal defect, magnetic & super conducting materials]**

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

- i) What is Point defect?
- ii) What is Anti-ferromagnetism? Explain with suitable example.
- iii) What is permanent magnet?
- iv) Define
  - 1) Imperfection
  - 2) Domain

**b) Draw the FCC structure. Calculate number of atoms per unit cell. [3]**

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

- i) What is Meissner effect? Explain in detail Type-I and Type-II super conductors.
- ii) What is Kirkendall effect? Explain with the help of brass alloy.

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

- i) What is Hysteresis loop? Explain the hysteresis loop for hard and soft materials.
- ii) Write a short note on ferromagnetic material.
- iii) Explain applications of super conductors in electronic and magnetic devices.

**P.T.O.**

- Q3) a)** Answer any one of the following. [6]
- i) What are Perovskite materials? Explain applications of Perovskite materials.
  - ii) What are spinels and Inverse spinel compounds? Explain the concept with suitable example.
- b)** Answer any two of the following. [6]
- i) Explain role of metallic materials in super conductors.
  - ii) What is Curie-Weiss law?
  - iii) What are ferrite materials? Discuss the applications of Ferrite materials in catalysis of sensing fields.

## **SECTION - II**

### **[Ceramic, Composite, cementitious and Biomaterials]**

- Q4) a)** Answer the following: [8]
- i) Explain Piezoelectric effect. Give one example.
  - ii) Write in short about Bioceramics.
  - iii) Define:
    - 1) Hydration process
    - 2) Set retarder
  - iv) What are Ceramics? Give its applications.
- b)** What is high alumina cement? Explain its properties and uses. [3]
- Q5) a)** Attempt any one of the following: [6]
- i) What is Asphalt? Explain Asphalt mixes.
  - ii) Write a note on dielectric properties of ceramic materials.
- b)** Attempt any two of the following: [6]
- i) Explain different characteristics of biomaterials.
  - ii) Give applications of ceramic materials.
  - iii) Write a note on special concretes.
- Q6) a)** Attempt any one of the following: [6]
- i) What is wood? What are different parts of wood? Explain with function of each part.
  - ii) What is Portland cement? Explain its type.

b) Attempt any two of the following:

[6]

i) Define:

- 1) Oil Well cement
- 2) Slip casting

ii) Give full form:

- 1) LLDPE
- 2)  $C_4AF$
- 3)  $C_3S$

iii) Write a note on Macro defect free cement.



Total No. of Questions : 6]

SEAT No. :

PE-5307

[Total No. of Pages : 3

[6510]-408

S.Y. M.Sc.

INORGANIC CHEMISTRY

CHI-432B : Inorganic Chemistry applications in Industry  
(2019 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) Figure to the right indicate full marks.
- 4) Use of logarithm table and calculator is allowed.
- 5) Answers to the two sections should be written in two separate answer books.

**SECTION - I**

**[Inorganic Chemistry Applications in Industry]**

- Q1) a)** Attempt the following: **[8]**
- i) What do you mean by Corrosion inhibitors?
  - ii) What is Electro deposition?
  - iii) What is Air Quality Index (AQI)?
  - iv) What do you mean by Green Chemistry?
- b)** Explain Hazards of CO<sub>2</sub> as environmental pollutant. **[3]**
- Q2) a)** Answer any one of the following: **[6]**
- i) Explain the role of Green chemistry in day to day life.
  - ii) What do you mean by chemical safety? Discuss common methods used for chemical safety.
- b)** Answer any two of the following: **[6]**
- i) Explain role of semiconductors in electro deposition.
  - ii) Discuss role of anionic inhibitors in neutral electrolytes.
  - iii) What are military explosives? Explain in brief.
- Q3) a)** Answer any one of the following. **[6]**
- i) Discuss in detail the disadvantages associated with solid propellants compared to the liquid propellants.

P.T.O.

- ii) Discuss the common hazards and control of hazards in petroleum refineries.
- b) Answer any two of the following. [6]
  - i) Green synthesis methods.
  - ii) Sustainable development
  - iii) SO<sub>2</sub> and NO<sub>2</sub> pollutants: Effects on health.

## **SECTION - II**

- Q4) a)** Answer the following: [8]
- i) Define Tidal power.
  - ii) What do you mean by sewage treatment?
  - iii) What is Biomass?
  - iv) What do you mean by Fuel cells?
- b) What is solid phase extraction? Explain. [3]
- Q5) a)** Attempt any one of the following: [6]
- i) What do you mean by solar cells? Explain the role of solar cells in industry and household applications.
  - ii) Discuss in detail about techniques used to treat waste water/sewage/ industrial waste water treatment.
- b) Attempt any two of the following: [6]
- i) What do you mean by water power plant? Explain.
  - ii) What is reversible (regenerative) fuel cell?
  - iii) Explain role adsorbent catalyst useful to treat common water pollutants.
- Q6) a)** Attempt any one of the following: [6]
- i) Discuss chemical principles involved in:
    - 1) Coagulation
    - 2) Filtration
    - 3) Water softening
  - ii) What do you mean by clean cars? Explain future scope of clean cars.
- b) Attempt any two of the following: [6]

- i) What do you mean by Water Quality Index (WQI)? Explain the role of WQI.
- ii) Role of biotechnology for high strength waste. Explain.
- iii) Write a short note on photovoltaic cells.



Total No. of Questions : 8]

SEAT No. :

PE-5308

[Total No. of Pages : 5

[6510]-409

S.Y. M.Sc.

**ORGANIC CHEMISTRY**

**CHO-450 : Chemistry of Natural Products**

**(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

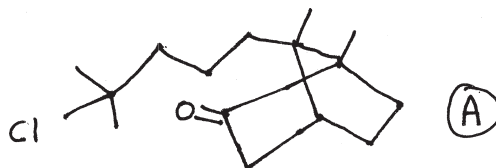
*Instructions to the candidates:*

- 1) Question No.1 and 5 are compulsory and carry 11 marks each.
- 2) Attempt any two questions from 2 to 4 and two from 6 to 8
- 3) Answers to the two sections should be written in separate answer books.
- 4) Figures to the right indicates full marks.

**SECTION - I**

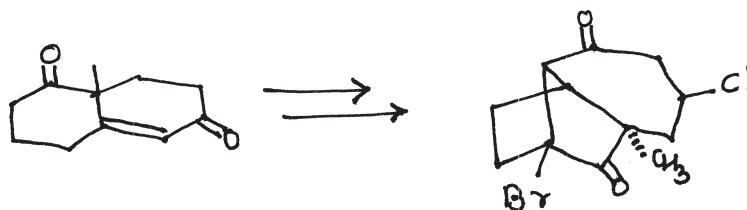
**Q1) a)** Solve any four of the following: **[8]**

- i) Write protecting and deprotecting reagent for carbonyl group with suitable example.
- ii) Write a note on Diels-Alder reaction in Hirsutellone B.
- iii) Write the role of following reagents in synthesis.  
A)  $\text{CaCO}_3$ ,  $\text{LiClO}_4$   
B)  $\text{CHBr}_3$ ,  $\text{KO C(CH}_3)_3$
- iv) Write the structure of (–) - Ribisin A with correct stereochemistry.
- v) Why the attempts of synthesis of longifolene by Kuo, Money method from precursor (A) was failed.



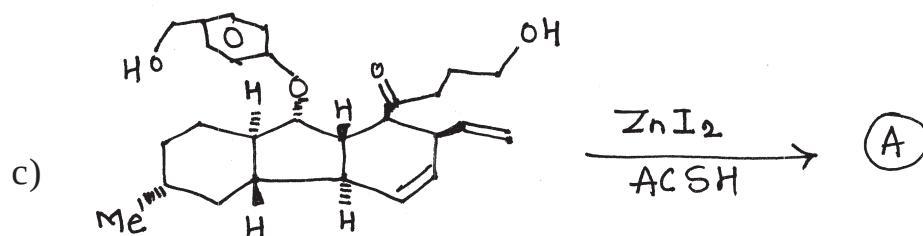
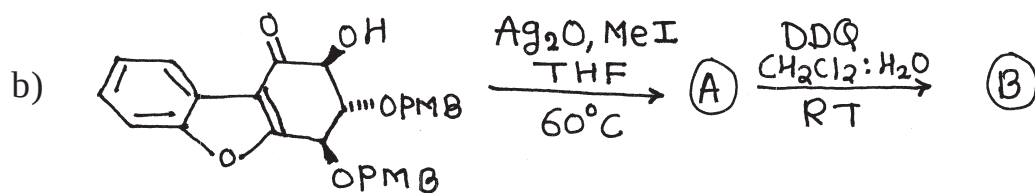
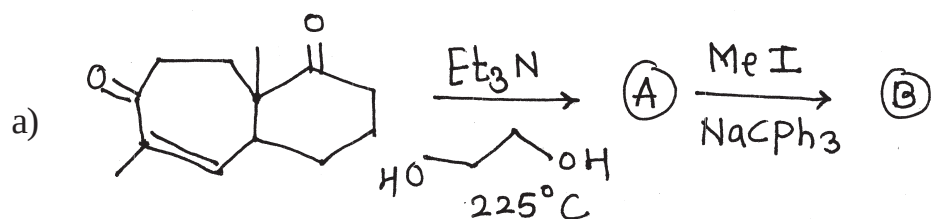
**P.T.O.**

b) Write the correct sequence of reagents for following conversion. [3]

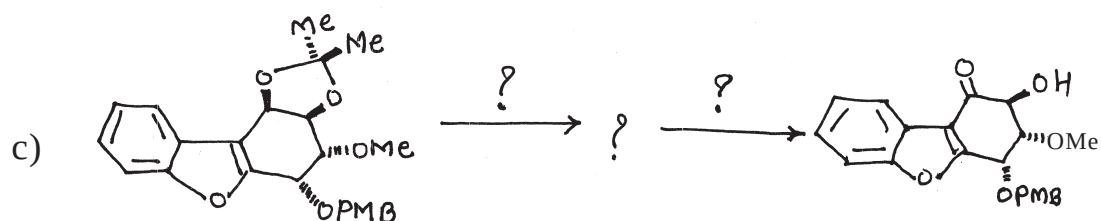
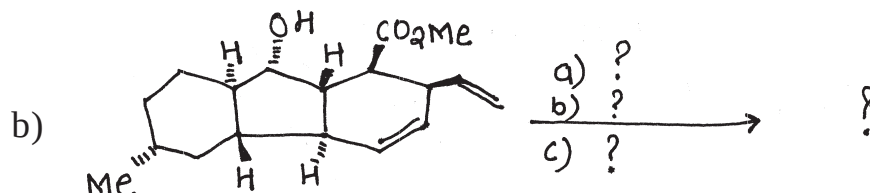
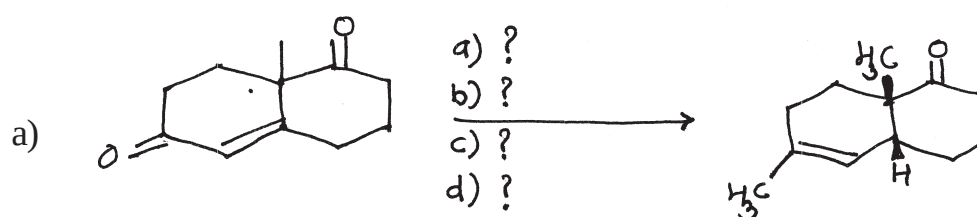


- i) DBU
- ii)  $H_2$ , Pd/C
- iii) LDA, TM 5-Cl
- iv) NBS
- v)  $CH_2I_2$ ,  $Et_2Zn$  &  $FeCl_3$
- vi) TMS-Cl, NaI,  $Et_3N$

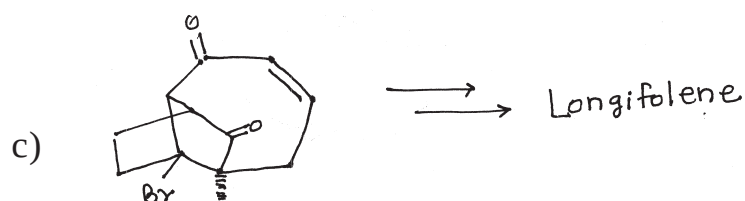
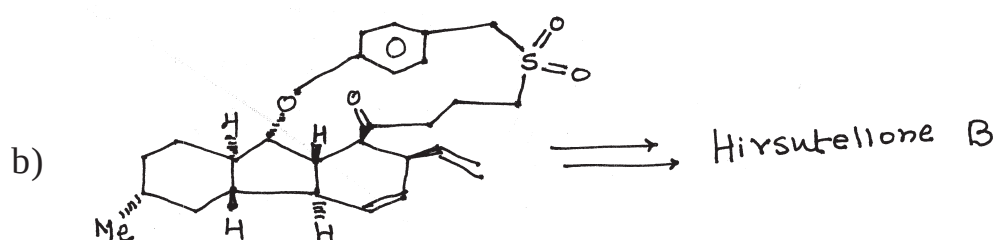
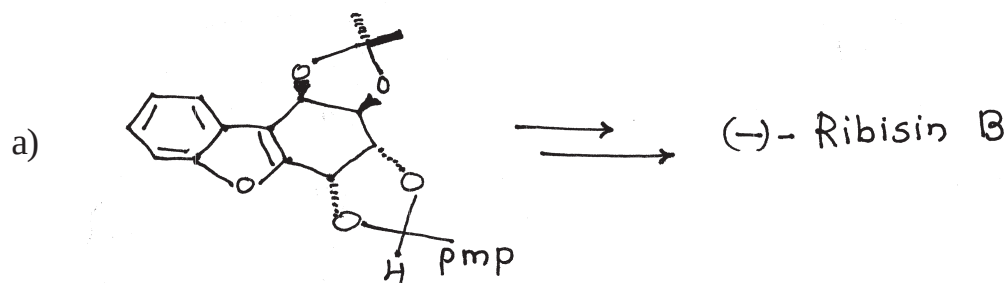
Q2) Predict the products with mechanism. [12]



**Q3)** Write the missing reagents and intermediates for the following conversions. [12]



**Q4)** Outline the steps involved in the following synthesis sequence. [12]



## SECTION - II

**Q5) a)** Solve any four of the following: **[8]**

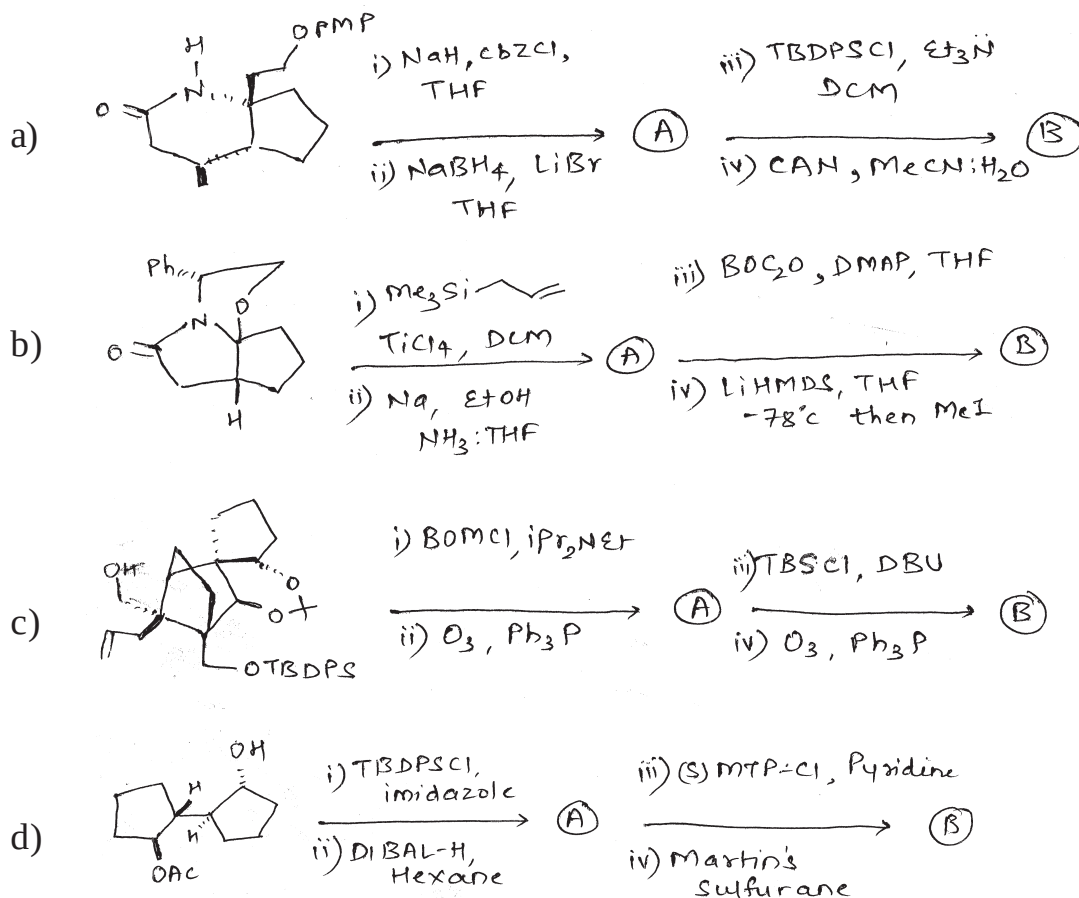
- i) Which key cyclization step was involved in the asymmetric synthesis of pinnaic acid?
- ii) Draw the structure of originally assigned vannusal B with correct stereochemistry.
- iii) Write the role of following reagent.
  - a)  $\mu\text{F}$ , pyridine
  - b)  $\text{POCl}_3$ , pyridine
- iv) Which  $^1\text{H}$  NMR coupling constants were exhibited by both originally assigned structure and natural vannusal-B?
- v) Explain the reason for the use of tri-SEM protection in the total synthesis of  $\text{C}_{21}$  empimer of originally assigned vannusal B.

**b)** Write correct full form and use of the following: **[3]**

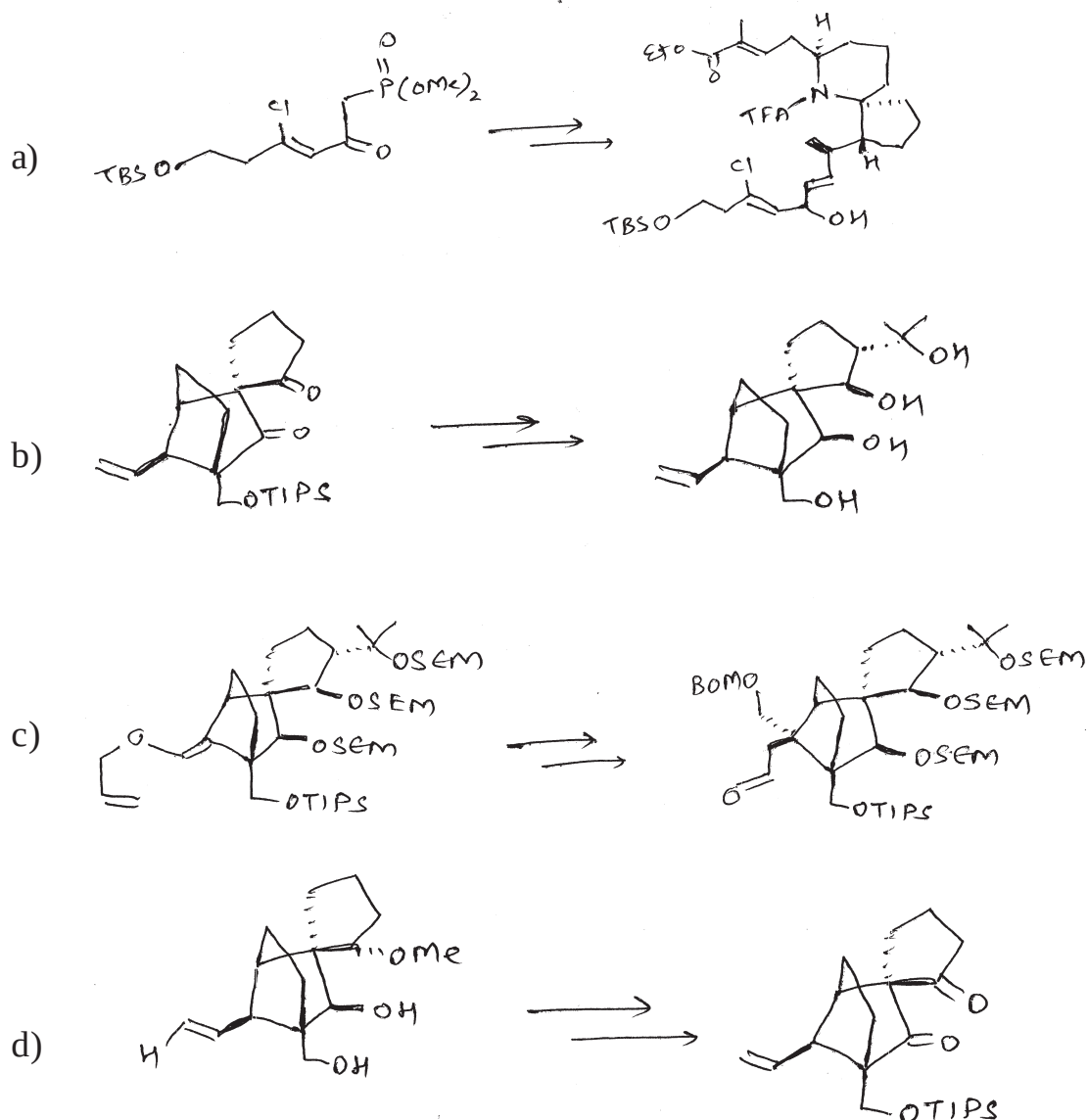
- i) LiHMDS
- ii) TPAP

**Q6)** Predict the products (any three):

**[12]**



**Q7)** Write correct reagents and steps involved in the following conversions. [12]



**Q8)** Answer the following:

[12]

- Explain the synthetic plan for pinnaic acid asymmetric synthesis.
- Explain with mechanism the concept of Cross Olefin Metathesis with respect to pinnaic acid.
- Which two hypothesis were proposed initially for vannusal A and B biosynthesis. Explain.

~~~~~

[6510]-410

S.Y. M.Sc.

ORGANIC CHEMISTRY**CHO-451 : Organometallic Reagents in Organic Synthesis
(2019 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 70

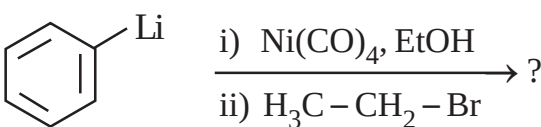
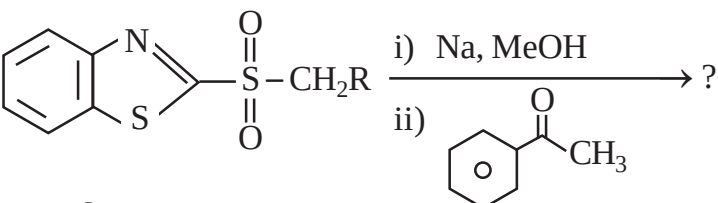
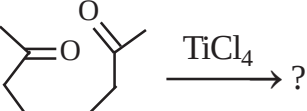
Instructions to the candidates:

- 1) Answers to the two sections should be written in separate books.
- 2) Question No. 1 and 5 are compulsory and carry 11 marks each.
- 3) Write any 2 questions from Q. 2 to Q. 4 from section I and 2 questions from Q. 6 to Q. 8 from Section - II.
- 4) Figures to the right side indicate full marks.

SECTION - I**Q1) a)** Explain the following (any four). **[8]**

- i) Wittig-Horner reaction is preferred over Wittig reaction.
- ii) Tertiary amines resist to undergo Buchwald-hartwig amination reaction.
- iii) Applications of Iridium complexes in organic synthesis.
- iv) Copper catalyzed aerobic oxidation of benzyl alcohol to benzoic acid.
- v) Grignard reagent is used for coupling reaction.

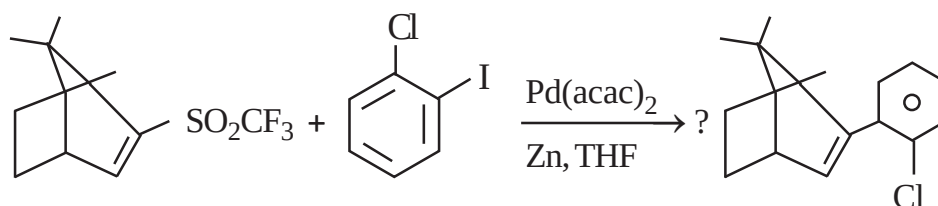
b) Discuss stille coupling with mechanism. **[3]****Q2) a)** Predict the product for following reactions. **[6]**

- i)  $\xrightarrow[\text{ii) } \text{H}_3\text{C}-\text{CH}_2-\text{Br}]{\text{i) } \text{Ni}(\text{CO})_4, \text{EtOH}}$?
- ii)  $\xrightarrow[\text{ii) } \text{Cyclohexanone}]{\text{i) } \text{Na, MeOH}}$?
- iii)  $\xrightarrow{\text{TiCl}_4}$?

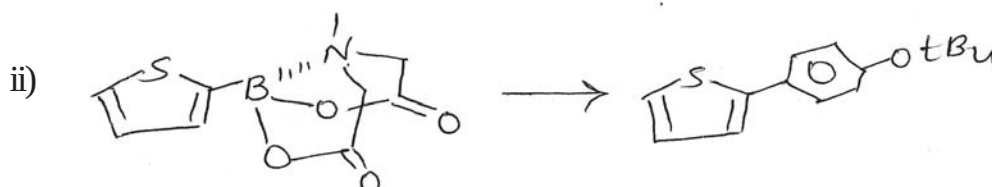
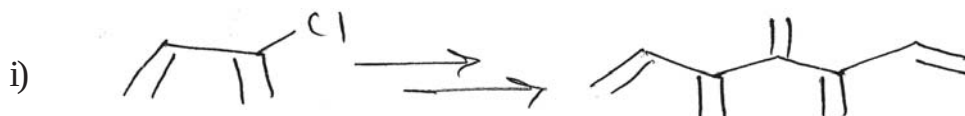
b) Answer the following: [6]

i) Write Peterson Olefination reaction with two examples in detail.

ii) Suggest the mechanism for the following transformation.

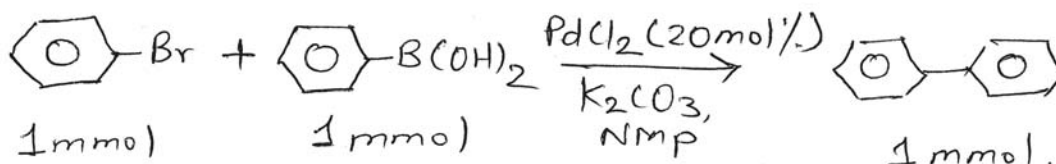


Q3) a) Suggest the suitable reagents and mechanism for the following conversion. [8]



b) Calculate the amount of catalyst PdCl_2 required for the following reaction. [4]

Given M.W. of $\text{PdCl}_2 = 177.33 \text{ g/mole}$.



Q4) a) Write a note on: [6]

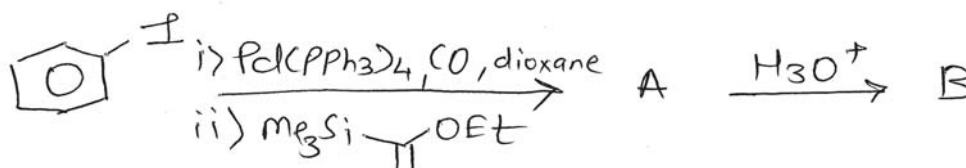
i) Sonogashira coupling

ii) Bamford stevens olefination

b) Answer the following: [6]

i) Discuss Reppe's process in detail.

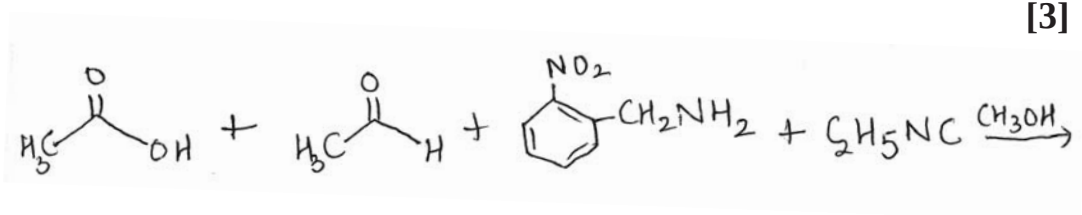
ii) Predict the products A and B with mechanism for the following reaction sequence.



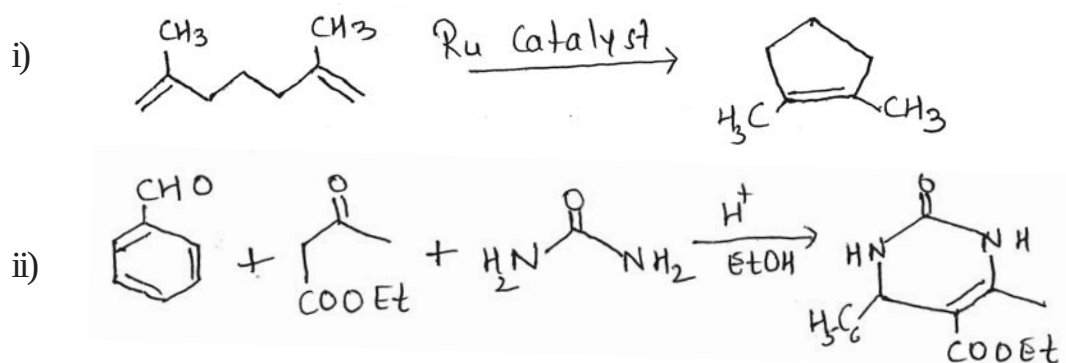
SECTION - II

Q5) a) Answer any four of the following: **[8]**

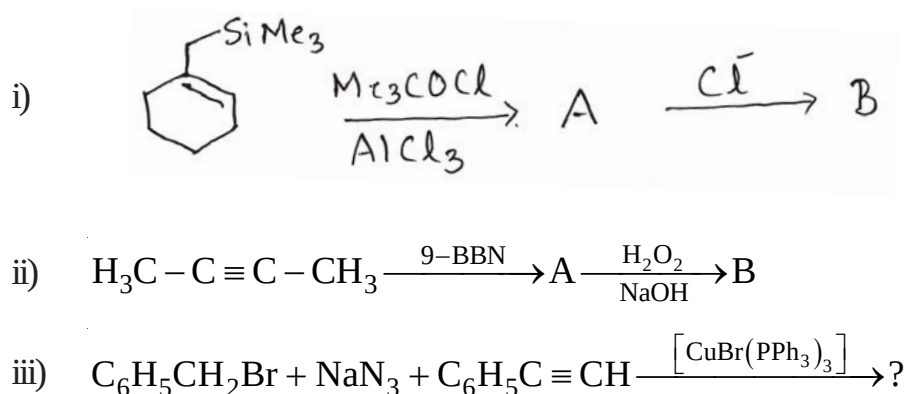
- i) How the nucleophilic substitution reaction of trimethyl silyl chloride is different from the nucleophilic substitution reaction of tert-butyl chloride. Write the reaction involved.
 - ii) Compare thermal and copper catalyzed Huisgen 1, 3 dipolar cycloaddition of alkynes to azides.
 - iii) How 3-methyl-2-butanbol can be prepared using hydroboration approach?
 - iv) What is ROM? What is the driving force involved in it?
 - v) What are the important features of multicomponent reactions?
- b) Predict the product and suggest the mechanism for the following reaction. **[3]**



Q6) a) Suggest the mechanism for the following reactions. **[6]**



b) Predict the product/s of the following reactions. **[6]**

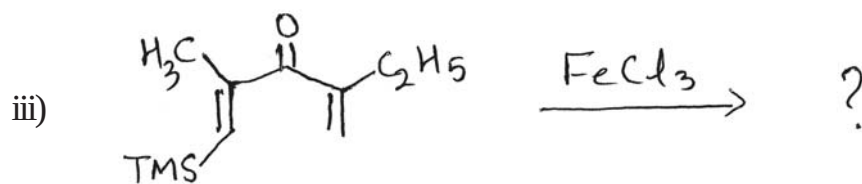
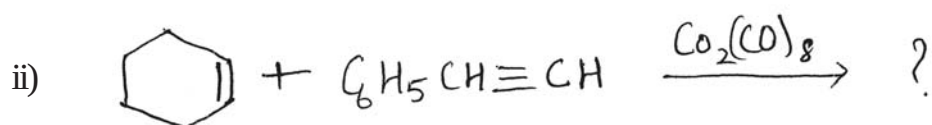
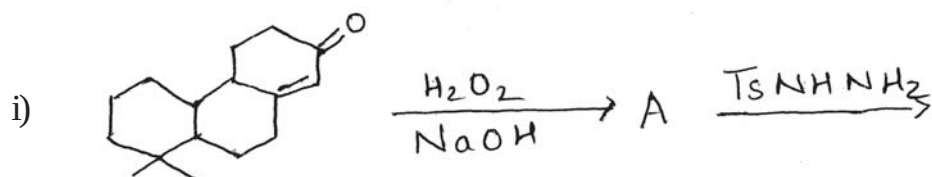


Q7) a) Write short notes on: [6]

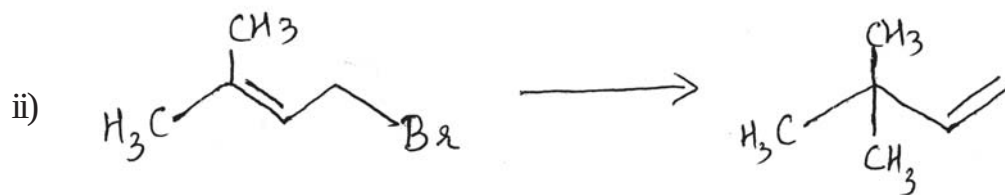
i) Mitsunobu reaction

ii) Biginelli reaction

b) Predict the product/s for the following reactions. [6]



Q8) a) Carry out the following conversion employing Boron/Silicon reagents. [6]



b) Write short notes on: [6]

i) Grubb's first generation catalyst

ii) Use of hexyl borane in organic synthesis

iii) Use of Silicon in the protection of alkyne.

~~~~~

Total No. of Questions : 8]

SEAT No. :

PE-5538

[Total No. of Pages : 3

[6510]-411

M.Sc. - (Part - II) (Organic Chemistry)

CHEMISTRY

CBOP-4 CHO-452(A) : Concepts and Application of  
Medicinal Chemistry  
(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q1 & Q5 are compulsory, carry 11 marks.
- 2) Attempt any two questions from Q2 to Q4 & Q6 to Q8.
- 3) Answers to the two sections should be written in separate answer books.
- 4) Figures to the right indicate full marks.

**SECTION - I**

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

- i) Write biological importance of folic acid
- ii) Write biological functions of TPP
- iii) What is drug
- iv) What is drug receptor

b) Write note on sources of drugs. [3]

**Q2)** Answer the following (Any three) : [12]

- a) Explain merits and Demerits of Solution Phase Peptide Synthesis.
- b) Write a note on proton pump inhibitor.
- c) Explain drug receptor interactions.
- d) Explain journey of orally active drugs.

P.T.O.

**Q3)** Explain any three of the following : **[12]**

- a) Pharmacodynamics of drugs
- b) Modern technique of disease diagnosis.
- c) Therapeutic role of Peptides.
- d) Drug optimization strategies

**Q4)** Explain any three of the following : **[12]**

- a) Phase I and II drug metabolism.
- b) Functions of Proteins in living organism
- c) Solution Phase peptide synthesis
- d) Historical development of Medicinal chemistry

### **SECTION - II**

**Q5)** a) Answer the following : **[8]**

- i) What is Partition coefficient?
- ii) Define : Pharmacodynamics.
- iii) What is Prodrug?
- iv) What are azoles?

b) Explain : SAR and mode of action of penicillins. **[3]**

**Q6)** Discuss any three of the following : **[12]**

- a) Type - I statins.
- b) Polyenes as antifungal agents.
- c) SAR and mode of action of Macrolides.
- d) Physico-chemical parameters in drug design.

**Q7)** Answer any three of the following :

**[12]**

- a) Explain mode of action of Refamycin and Amantadine
- b) Discuss : Sulphonamides.
- c) What is QSAR? Explain its importance in drug design.
- d) Explain : Steps involved in Pharmacokinetics.

**Q8)** Write note on any three of the following :

**[12]**

- a) Stereochemistry of drug and its action.
- b) Effect of pH on drug solubility.
- c) Problems associated with Penicillin - G.
- d) SAR and mode of action of Tetracyclins.



Total No. of Questions : 8]

SEAT No. :

PE-5310

[Total No. of Pages : 2

[6510]-412

S.Y. M.Sc.

ORGANIC CHEMISTRY

CHO-452B : Applied Organic Chemistry

(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.No.1 and Q.No. 5 are compulsory and carry 11 marks each.
- 2) Attempt any two questions from Q.No. 2 to Q.No.4 and two questions from Q.No.6 to Q.No.8.
- 3) Answers to the two sections should be written in separate answer books.
- 4) Figure to the right indicate full marks.

**SECTION - I**

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

- i) Explain double layer Organic Light Emitting Device (OLED) with energy level diagram of a two-layer OLED.
- ii) Write a note on Postsynthetic Intercalation and complexation in COFs.

b) What is COFs? Explain types with examples. [3]

**Q2)** Answer of the following: [12]

- a) Explain hole injection materials.
- b) With the help of suitable diagram explain ambipolar semi conducting COF.
- c) Explain different types of OLEDs.

**Q3)** Answer the following. [12]

- a) Explain Imine-linked COFs synthesis with suitable example.
- b) Write a note on P-type semiconducting covalent organic frame works.
- c) Explain solvothermal synthesis of COFs.

P.T.O.

**Q4)** Answer the following: [12]

- a) With the help of schematic representation explain the azine-linked COFs with Fluorinated linkers.
- b) Write any two examples of photo catalyst COF.
- c) Explain phosphorescent OLEDs.

## **SECTION - II**

**Q5)** a) Answer the following: [8]

- i) Discuss non-covalent synthesis of supermolecules.
- ii) Write a note on light induced switching.
- b) Explain electrochemical molecular rotor based on the redox activity of p-phenylenediamine (PDA). [3]

**Q6)** Answer the following: [12]

- a) Draw the structure of  $\alpha$ -cyclodextrin.
- b) Explain tunnelling electron induced switching.
- c) Describe the non-ionic and dipolar supramolecular interactions.

**Q7)** Answer the following: [12]

- a) Describe the synthesis and redox properties of pentiptycene-derived DBB analogues.
- b) Explain thought machine exploring Brownian motion.
- c) Explain artificial molecular machines.

**Q8)** Answer the following: [12]

- a) Explain applications of cavit and Host-guest complex.
- b) Write any two synthesis of super molecules with examples.
- c) Explain spin switching in molecule switch.



Total No. of Questions : 8]

SEAT No.:

PE-5311

[Total No. of Pages : 3

[6510]-413

S.Y. M.Sc.

**ANALYTICAL CHEMISTRY**

**CHA-490 : Advanced Analytical Spectroscopic  
Techniques**

**(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Answers to two sections must be written on a separate answer books.*
- 2) *Figures to right indicate full marks.*
- 3) *Use of logtable and calculator is allowed.*
- 4) *Q.No.1 & Q.No.5 are compulsory.*
- 5) *Solve any two questions from Q.No.2 to Q.No.4 and solve any two questions from Q.No.6 to Q.No.8.*

**SECTION - I**

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

- i) What is atomization? Enlist the different types of atomizers used in AAS.
  - ii) Explain the interferences in AFS.
  - iii) Enlist the different mass analyzers used in ICP-MS.
  - iv) Explain the decomposition technique for sample preparation.
  - v) Draw labelled diagram of inductively coupled plasma.
- b) The amount of magnesium in the sample was analysed by AAS. A 10.0 gram of sample after treatment was diluted to 100 ML. The sample solution shows absorbance of 0.18. The 5.0 ml stands magnesium of 8 ppm plus 5.0 ml. sample shows absorbance 0.58. Calculate the amount of magnesium in the sample. **[3]**

**Q2) a)** Attempt the following: **[6]**

- i) Explain the difference between IPC & DCP.
- ii) Enlist the different sources used in AFS. Explain any one of them.

**P.T.O.**

- b) Draw the schematic diagram of atomic absorption spectrophotometer. Explain the different components of AAS in detail. [6]
- Q3) a)** Attempt the following: [6]
- What are the different analysis methods for AFS?
  - What is inorganic mass spectroscopy? Explain its any one application.
- b) Attempt the following: [6]
- Explain the different interferences in AAS.
  - The sodium in water sample was analysed by FES. A 25 ppm standard solution of sodium shows flame intensity 70 units. A 10 ml water sample diluted to 20 ml showed flame intensity 33 units. Calculate level of sodium in the water sample.
- Q4) a)** Attempt the following: [6]
- Explain total nitrogen analyzer for elemental analysis.
  - How to prepare aqueous sample for ICP-MS, using liquid-liquid extraction? Explain the factors affecting on it.
- b) How to analyse metals from waste water sample by ICP-MS method?[6]

## **SECTION - II**

- Q5) a)** Attempt any four of the following: [8]
- What is fluorescence?
  - Give the principle of XPS.
  - What is triplet state?
  - What is Larmor precision?
  - Draw the hyperfine splitted ESR spectrum of  $\cdot\text{CH}_3$  radical.
- b) 1.8 PPM 5 ml Cd(II) solution was extracted three times with 5 ml  $\text{CCl}_4$  containing 8-hydroxy quinoline and the combined extract was diluted to 50 ml. Similar treatment is given to sample containing Cd (II). Fluorescence intensity for standard is 30 while sample is 12. Calculate Mg of Cd(II) in 500 ml sample solution. [3]

- Q6) a)** Attempt the following: [6]
- Which of the following nuclei are ESR active? Why?  
 $^{14}\text{N}$ ,  $^{16}\text{O}$ ,  $^1\text{H}$
  - Explain with suitable example, the ESR spectrum of free radical containing multiple set of equivalent protons.
- b)** With schematic diagram, explain instrumentation of photoelectron spectroscopy. [6]
- 
- Q7) a)** Attempt the following: [6]
- Draw and explain the ESR spectrum of 1, 1 diphenyl, 2-picryl hydroxyl radical.
  - The 1 'S' electron of sodium ion has binding energy 1073 eV. Estimate the work function of electron spectrometer if incident radiation is the  $K_{\alpha}$  line of magnesium and kinetic energy of measured electron is 165.0 eV.  
(Given  $h = 6.626 \times 10^{-34}$  Js,  $\lambda = 1.89 \text{ \AA}$ ,  $C = 3.0 \times 10^8$  m/s.)
- b)** Draw the energy level diagram for photo luminescent molecule. Explain in detail the deactivation process of molecule. [6]
- 
- Q8) A)** Attempt the following: [6]
- Give construction and working of ion gun in electron spectrometer.
  - Discuss the applications of photo luminescence.
- B)** Attempt the following: [6]
- Write a note on g-factor.
  - Calculate ESR frequency of an unpaired electron in magnetic field of 3000 G(0.3 T).  
Given  $h = 6.626 \times 10^{-34}$  Js  
g -factor : 2.0023



Total No. of Questions : 8]

SEAT No. :

PE-5312

[Total No. of Pages : 4

[6510]-414

S.Y. M.Sc.

ANALYTICAL CHEMISTRY

**CHA-491 : Chemical Methods of Pharmaceutical Analysis  
(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Answer to the two sections must be written in separate answer books.*
- 2) *Use of logtable and calculator is allowed.*
- 3) *Figures to the right indicate full marks.*

**SECTION - I**

- Note:** i) Question No. 1 is compulsory.  
ii) Solve any two questions from 2 to 4.

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

- i) What are parental preparations? Give the types of parental preparations.
  - ii) What are inhalation preparations?
  - iii) What are Pyrogens? Write an advantage of Pyrogen test.
  - iv) Write the factors affecting disintegration test.
  - v) What is potency? Write models of calculations for potency estimation.
- b) Find the acid value of a vegetable oil whose 5 ml required 2 ml of N/100 KOH during titration. **[3]**
- Given : Density of oil : 0.92

**Q2) a)** Attempt the following: **[6]**

- i) Explain the determination of ester value of a substance.
  - ii) Explain in detail the stationary phase and the decline phase.
- b) Define zone of inhibition. Discuss the theory of zone formation in detail. **[6]**

**P.T.O.**

- Q3) a)** Attempt the following. [6]
- i) Write a note on turbidimetric assay.
  - ii) What are oral liquids? Discuss the types of oral liquids in detail.
- b) What is Dissolution test? Explain dissolution test by apparatus Type-1 and Type-2 in detail. [6]

- Q4) a)** Attempt the following: [6]
- i) Discuss the principle, reaction and procedure for the limit test of iron.
  - ii) A sample of oil weighing 0.35 gm was treated with KI solution after 30 min. the iodine liberated. The liberated Iodine titrated with 0.095 M  $\text{Na}_2\text{S}_2\text{O}_3$  and it required 8.58 ml of titrant if blank titre value was 25 ml. Calculate the iodine value of oil.
- b) Attempt the following: [6]
- i) Explain the critical factors affecting the assay of growth promoting substances.
  - ii) Write a note on powder fineness.

## SECTION - II

- Note:**
- i) Question No. 5 is compulsory.
  - ii) Solve any two questions from Q.6 to Q.8.
  - iii) Q.6 to Q.8 carries equal marks.

- Q5) a)** Attempt any four : [8]
- i) What are aqueous acid-base titrations?
  - ii) What are pharmaceutical preparations?
  - iii) What is a shelf life of pharmaceutical preparation?
  - iv) What are residual solvents?
  - v) Write the structures at:
    - i) Droperidol
    - ii) Hydrocortisone
- b) 1.066 gm of pharmaceutical ingredient was transferred to a crucible of weight 23.5664 gm. After the ashing procedure, the mass of the crucible was 23.5671 gm. Calculate the amount of residue obtained on ignition. [3]

- Q6) a)** What are pharmacopoeia monographs? Describe the monograph of paracetamol in detail as per phar.Eur. [6]
- b) i) Explain the assay of Fentanyl by LC. [3]
- ii) 20 tablets were weighted and the total weight was found to be 11713.5 mg. Then the tablets were weighed individually and the weights at first five tablets were 588.8, 592.8, 591.0, 598.7 and 587.0 respectively. Calculate the average weight for tablet and percentage of deviation of its weight from the average weight for the first five tablets. [3]
- Q7) a)** What are non-aqueous acid-base titrations? Describe the assay of Lidocaine by non-aqueous acid-base titration according to Phar.Eur. A 0.2008 gm of drug sample containing Lidocaine was dissolved in 50 ml of anhydrous acetic acid and titrated potentiometrically with 0.0968M perchloric acid. The equivalence point was obtained at 8.81 ml. Calculate the percentage of Lidocaine present in the sample. (MW = 234.3) [6]
- b) i) Explain the assay of  $\text{Fe}^{2+}$  in Ferrous fumarate tablet by redox titration. [3]
- ii) A 0.2099 gm of ephedrine sample was dissolved in a mixture of 5ml ethanol and 20ml 0.1024m HCl. This solution is titrated with 0.0998m NaOH and the burette reading was 7.75ml. Calculate the concentration of ephedrine present in the sample. (MW = 165.2) [3]
- Q8) a)** Explain the identification of Diazepam in Diazepam tablet by Uv-spectrophotometry. 20 tablets of Diazepam were weighed and the total mass of these 20 tablets was 2.6656 gm. A quantity of powder containing 0.26 gm of Diazepam was dissolved in sufficient quantity of 0.5%  $\text{H}_2\text{SO}_4$  in methanol. and diluted to 100ml with methanol. 10ml of this solution is further diluted to 100ml with the same solvent. The absorbance of the resulting solution was measured at 284 nm. The absorbance of the solution was 0.539 with a 1 cm light path. Calculate the content of Diazepam in the sample if the specific absorbance of Diazepam is 450 (1%, 1cm). [6]

- b) i) Write a note on appearance of solution test. [3]
- ii) 0.127 gm of previously dried pharmaceutical ingredient was weighed accurately, dissolved in minimum volume of acetonitrile and diluted to 25ml with the same solvent. The angle of rotation was  $+2.9^\circ$  at  $20^\circ\text{C}$  in a polarimeter tube of 20 cm. Calculate the specific optical rotation of a sample. [3]



Total No. of Questions : 8]

SEAT No. :

PE-5313

[Total No. of Pages : 3

[6510]-415

S.Y. M.Sc.

**ANALYTICAL CHEMISTRY**

**CHA-492A : Laboratory Automation & Environmental  
Analytical Chemistry**

**(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q.No.1 and Q.No. 5 are compulsory.*
- 2) *Attempt any two questions from Q.No. 2 to Q.No.4 for Section-I and from Q.No.6 to Q.No.8 for section II.*
- 3) *Answers to the two sections should be written on separate answer books.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log table and calculator is allowed.*

**SECTION - I**

**Q1) a)** Solve any Four: **[8]**

- i) Enlist any Four advantages of automation.
- ii) What is the continuous flow analysis?
- iii) Define automated and automatic device.
- iv) List the different types of mass sensor.
- v) What is lab automation?

b) Explain continuous sample analyser. **[3]**

**Q2) a)** Explain the following. **[6]**

- i) How would you design an optical biosensor to measure the glucose?
- ii) What are the objectives of automation in analytical chemistry?

b) Define micro fabrication. Explain silicon and glass micro-matching. **[6]**

**Q3) a)** Explain the following. **[6]**

- i) Explain surface acoustic wave sensor.
- ii) Explain batch and continuous flow analysis.

**P.T.O.**

- b) Discuss the following: [6]
- What is Biosensor? Explain the role of biosensor in analysis.
  - Write a note on optical sensor.
- Q4) a)** Explain the following. [6]
- Write a short note on catalytic gas sensor.
  - Explain serial integration and parallel integration.
- b) What is Chemical Sensor? Give its classification according to transducers. [6]

### **SECTION - II**

- Q5) a)** Solve any four of the following: [8]
- What are the sources and health hazard's of cadmium (II) in water?
  - How methylated mercury is formed?
  - What are persistent organic pollutants?
  - Define the term chemical oxygen demand.
  - Give the principle for analysis of oxidants in polluted air.
- b) A waste water sample (25 ml) was analysed for COD. The 25 ml water sample treated with 10 ml 0.1 N  $K_2Cr_2O_7$  as per standard procedure and excess dichromate was estimated by titrating with 0.1 N Fe(II) solution. It required 5.2 ml Fe(II) solution. The blank titration was performed with 0.1 N Fe(II) solution and it required 9.8 ml Fe(II) solution. Calculate COD of water sample in ppm. [3]
- Q6) a)** Explain the following. [6]
- Determination of  $SO_2$  from polluted air sample.
  - Determination sulfide in polluted water by ion selective electrode.
- b) Answer the following. [6]
- Explain determination of colour of polluted water sample by spectrophotometric method by multi-wavelength method.
  - Explain titrimetric method for determination of acidity of polluted water.
- Q7) a)** What is oxidant demand? Give the importance of determination of oxidant demand. Explain method for chlorine demand determination in detail. [6]

- b) Solve the following. [6]
- What is microwave digestion? Explain microwave digestion for metal ion estimation from polluted water.
  - Dissolved  $O_2$  is determined from water sample. 50 ml water sample was treated with Mn(II)- NaOH reagent and then with KI- $H_2SO_4$ . Liberated  $I_2$  is determined with 0.02 M  $Na_2S_2O_3$  and end point was observed at 5.8 ml. Calculate dissolved  $O_2$  in ppm.

- Q8) a) Answer the following. [6]
- Discuss the method for determination of Fluoride from polluted water.
  - Write note on the estimation of non-metal ions by ion chromatography.

- b) Answer the following. [6]
- What is the principle co-analysis by GC? Give details and advantage of GC method for determination of CO from air.
  - Fluoride ion from polluted water sample was analysed by colorimetric method. 2 ml, 0.01 mg/ml standard showed absorbance 0.581. 2 ml water sample was treated same as standard and it showed absorbance 0.082. Calculate ppm of fluoride in water sample.



Total No. of Questions : 8]

SEAT No. :

PE-5314

[Total No. of Pages : 3

[6510]-416

S.Y. M.Sc.

**ANALYTICAL CHEMISTRY**

**CHA-492B : Analytical Chemistry of Agriculture, Polymer & Detergents**

**(2019 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Q.No.1 and Q.No. 5 are compulsory.*
- 2) *Attempt any two questions from Q.No. 2 to Q.No.4 and any two questions from Q.No.6 to Q.No.8.*
- 3) *Figure to the right indicate full marks.*
- 4) *Answers to the two sections should be written on separate answer books.*
- 5) *Use of log table and calculator is allowed.*

**SECTION - I**

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

- i) What is meant by sub-sampling?
- ii) Give effects of excessive use of pesticides on environment.
- iii) Enlist and explain weighing errors.
- iv) What is ECEC?
- v) How is moisture determined from lining material?

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

0.415g of soil was analyzed for nitrogen content by Kjeldahl's method. The evolved ammonia was absorbed in 55 ml of 0.15 N HCl, the remaining acid when back titrated with 0.15 N NaOH gave burette reading of 17.1 ml. Then calculate % of Nitrogen (Given At wt. N =14)

**Q2) a)** Attempt the following. **[6]**

- i) Give analytical method for determination of organochlorine pesticide by Gas chromatography.
- ii) Give a method for determination of extractable phosphorus in soil.

**b)** Attempt the following. **[6]**

- i) Give a general scheme for analysis of Pesticide.
- ii) Write a note on weighing and dispensing errors.

**P.T.O.**

- Q3) a)** Attempt the following. [6]
- Explain in detail auto-analysis method for determination of total nitrogen in fertilizer.
  - Explain in detail method for analysis of Aldicarb by gas chromatography.
- b)** Solve the following: [6]
- Explain analytical procedure for extractable boron.
  - 0.23 g soil sample was analyzed by complexometric titration method for determination of Magnesium. Solution containing magnesium ions was diluted to 100 ml. An aliquot of 10 ml required 15 ml of 0.011 N EDTA solution for complete reaction. Calculate percentage of Mg in the given sample. (Given At.wt Mg = 24.30 g)
- Q4) a)** Attempt the following. [6]
- Discuss the process of sampling of soil.
  - Outline procedure for determination of ammonium oxalate soluble potassium in fertilizer.
- b)** Solve the following. [6]
- Give an account of exchangeable bases and base saturation.
  - Enlist and explain various methods used for acid digestion of soils.

## **SECTION - II**

- Q5) a)** Solve any four of the following: [8]
- Differentiate between thermoplastics and thermosets polymers.
  - Define non-ionic surfactant.
  - State basic types of stress measurements.
  - Explain Flexural testing.
  - Define saponification value.
- b)** Solve the following. [3]
- A sample of a glass filled nylon 6,6 composite is found to have a density of  $1515 \text{ kg m}^{-3}$ . The densities of nylon 6,6 and glass are 1135 and  $2500 \text{ kg m}^{-3}$  respectively. What is the volume fraction of glass fibre in the nylon?
- Q6) a)** Attempt the following. [6]
- Explain the Raman Spectroscopy technique for identification of polymers.
  - Discuss end-group analysis method for to determine the molecular weights of polymers.

b) Attempt the following. [6]

- i) The data shown below in table were obtained for the molecular weight distribution of a sample of PVA. Determine the weight-average molecular weight of this material.

Molecular weight distribution of a sample of PVA

| Mean $M_i$ (g mol <sup>-1</sup> ) | $W_i$ |
|-----------------------------------|-------|
| 7500                              | 0.02  |
| 12500                             | 0.10  |
| 17500                             | 0.18  |
| 22500                             | 0.29  |
| 27500                             | 0.26  |
| 32500                             | 0.13  |
| 37500                             | 0.03  |

- ii) Discuss common types of non-ionic and amphoteric surfactants.

**Q7)** a) Attempt the following. [6]

- i) Define hydroxyl value. Describe method for determination of hydroxyl value.
- ii) Describe isolation of surfactant using liquid-solid extraction technique.

b) Attempt the following. [6]

- i) Write short note on impact & hardness testing of polymer.
- ii) Explain optical microscopy to study the morphology of polymers.

**Q8)** a) Attempt the following. [6]

- i) Describe stress-strain behaviour of polymers.
- ii) Describe nuclear magnetic resonance spectroscopy for characterize polymer structure.

b) Attempt the following. [6]

- i) Describe the determination of elemental nitrogen from surfactant.
- ii) Discuss injection moulding and extrusion processing method for thermoplastics.

