**[5909]-11**

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 110 : Fundamentals of Physical Chemistry - I**

**(2019 Pattern) (Semester - I) (CCTP - I)**

*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 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 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 $\quad$ N = $6.023 \times 10^{23}$ $mol^{-1}$

2) Boltzmann Constant $\quad$ k = $1.38 \times 10^{-16}$ erg $K^{-1}$ $molecule^{-1}$
$\qquad\qquad\qquad\qquad$ = $1.38 \times 10^{-23}$ J $K^{-1}$ $molecule^{-1}$

3) Planck Constant $\quad$ h = $6.626 \times 10^{-16}$ erg s
$\qquad\qquad\qquad\qquad$ = $6.626 \times 10^{-34}$ J s

4) Electronic Charge $\quad$ e = $4.803 \times 10^{-10}$ esu
$\qquad\qquad\qquad\qquad$ = $1.602 \times 10^{-19}$ C

5) 1 eV $\qquad\qquad\qquad$ = 23.06 k cal $mol^{-1}$
$\qquad\qquad\qquad\qquad$ = $1.602 \times 10^{-12}$ erg
$\qquad\qquad\qquad\qquad$ = $1.602 \times 10^{-19}$ J
$\qquad\qquad\qquad\qquad$ = 8065.5 $cm^{-1}$

6) Gas Constant $\quad$ R = $8.314 \times 10^{7}$ erg $K^{-1}$ $mol^{-1}$
$\qquad\qquad\qquad\qquad$ = $8.314$ J $K^{-1}$ $mol^{-1}$
$\qquad\qquad\qquad\qquad$ = $1.987$ cal $K^{-1}$ $mol^{-1}$

7) Faraday Constant $\quad$ F = 96487 C $equivalent^{-1}$

8) Speed of light $\quad$ c = $2.997 \times 10^{10}$ cm $s^{-1}$
$\qquad\qquad\qquad\qquad$ = $2.997 \times 10^{8}$ m $s^{-1}$

9) 1 cal $\qquad\qquad\qquad$ = $4.187 \times 10^{7}$ erg
$\qquad\qquad\qquad\qquad$ = $4.187$ J

10) 1 amu $\qquad\qquad\qquad$ = $1.673 \times 10^{-27}$ kg

11) Bohr Magneton $\quad$ $\beta_e$ = $- 9.274 \times 10^{-24}$ J $T^{-1}$

12) Nuclear Magneton $\quad$ $\beta_n$ = $5.051 \times 10^{-27}$ J $T^{-1}$

13) Mass of an electron $\quad$ $m_e$ = $9.11 \times 10^{-31}$ Kg

*P.T.O.*

## SECTION-I

*Q1)* a) Attempt Any Four of the following: [8]

    i) What are normalised and orthogonal wave functions?

    ii) Differentiate between ideal and non-ideal solutions.

    iii) What is depression in freezing point?

    iv) Write schrödinger equation for Hydrogen atom and explain the terms in it.

    v) What is internal energy? Explain its variation with temperature.

  b) Show that PV = constant in an adiabatic process. [3]

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

    i) Explain Molecular Orbital diagram of NO Molecule. Calculate its bond order.

    ii) What is photoelectric effect?

  b) Solve the following: [6]

    i) Explain the graph showing the deviation of Raoult's law and Henry's law from the ideal behaviour.

    ii) Calculate the de-Broglie wavelength of an electron having velocity $3 \times 10^5$ m/s.

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

    i) Explain particle in a box concept.

    ii) What are operators? Explain its types with suitable example.

  b) Solve the following: [6]

    i) Explain UV catastrophe with the help of graph.

    ii) The vapour pressure of pure solvent at 25°C is 25.756 mm. Calculate the mole fraction of solute if the vapour pressure of the solutionat 25°C is 24.800 mm.

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

   i)   Explain the geometry, hybridisation and bonding in $NH_3$ molecule.

   ii)   Explain Clausius inequality.

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

   i)   Find the well behaved functions among the following:

   $\sin\theta, \cos\theta, \tan\theta$

   ii)   Calculate the momentum of an electron having de-Broglie wavelength 3.1A°.

### SECTION-II

*Q5)* a)   Attempt Any four of the following:                                       **[8]**

   i)   Distinguish between order and molecularity of reaction.

   ii)   Discuss the steady state principle with suitable example.

   iii)   State and explain the principle of flash photolysis.

   iv)   How does the rate of enzymolysis is altered by temperature?

   v)   Define partition function. Write the equation for rotational partition function and explain the terms there in.

b)   Calculate the frequency factor for a reaction having a rate constant $4 \times 10^{-7}$ units at 227°C. If the energy of activation is 100 kJ mole$^{-1}$.
                                                                                    **[3]**

*Q6)* a)   Answer the following:                                                    **[6]**

   i)   Derive an expression for the relaxation time for a first order reaction.

   ii)   Explain the effect of pH and temperature on enzyme catalysed reaction.

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

   i)   Show that unimolecular gas phase reactions are pressure dependent.

   ii)  Calculate the diffusion controlled rate coefficient at 27°C for the reactant species in *n*-pentane.

   [Given : Viscosity of n -pentane = $0.22 \times 10^{-3}$ kg m$^{-1}$s$^{-1}$]


**Q7)** a)   Answer the following:                                             **[6]**

   i)   Explain explosive reactions with suitable example.

   ii)  What is sterling approximation? Which equation determines the sterling approximation?

   b)   State Boltzmann's distribution law. Obtain an expression for Boltzmann distribution law.                                                           **[6]**


**Q8)** a)   Derive the Eyring equation on the basis of transition state theory.   **[6]**

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

   i)   Discuss in brief Bose-Einstein statistics.

   ii)  The rotational constant of iodine molecule at 100 K is 0.0374 cm$^{-1}$. Evaluate the rotational partition function of iodine molecule.


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[5909]-12

# M.Sc. - I
## INORGANIC CHEMISTRY
### CCTP-2, CHI - 130 : Molecular Symmetry and Chemistry of P Block Elements
### (CBCS 2019 Pattern) (Semester - I) (4 Credits)

*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 side indicate full marks.*
4) *Use of logtables/Character tables and callculator is allowed.*

## SECTION - I

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

     a) Mention the symmetry elements, order and classes of $D_3h$ point group.

     b) Define proper axis of rotation and find the principle axis in $BF_3$ molecule.

     c) How many number of degrees of vibrational freedom possessed by carbon dioxide molecule.

     d) How will you distinguish between $C_4V$ and $C_2h$ point group.

   B) Give all associative operation in $S_4$ axis. **[3]**

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

     a) Derive the character table for $C_2h$ point group using great orthogonality theorem.

     b) What is similarity transformation. From the given multiplication table find the set of elements which are conjugate with $c_2^z$ and $\sigma_v^{xz}$ Given multiplication table.

|  | E | $c_2^z$ | $\sigma_v^{xz}$ | $\sigma_v^{yz}$ |
|---|---|---|---|---|
| E | E | $c_2^z$ | $\sigma_v^{xz}$ | $\sigma_v^{yz}$ |
| $c_2^z$ | $c_2^z$ | E | $\sigma_v^{yz}$ | $\sigma_v^{xz}$ |
| $\sigma_v^{xz}$ | $\sigma_v^{xz}$ | $\sigma_v^{yz}$ | E | $c_2^z$ |
| $\sigma_v^{yz}$ | $\sigma_v^{yz}$ | $\sigma_v^{xz}$ | $c_2^z$ | E |

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

a) What are planes of symmetry? How are they classified? Show different planes in $BH_3$ molecule.

b) Give the matrix representation for $\sigma_v^{xz}$ and $\sigma_v^{yz}$ symmetry operation. Find out their product by matrix multiplication method.

c) Assign the following molecules/ions into appropriate point group.

i) $B_3N_3H_6$

ii) $IC\bar{I}_2$

iii) Trans $[Co(NH_3)_4Cl_2]^+$

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

a) Sketch and explain all symmetry elements in $XeOF_4$ molecule and classify it into appropriate point group.

b) Find out the normolized SALC using projection operator Alg irreducible representation which operates on $\sigma_1$ orbital of $[ptcl_4]^{-2}$ complex ion

| $D_4h$ | E | 2c4 | $c_2$ | $2c_2^1$ | i | $2S_4$ | $\sigma_h$ | $2\sigma_v$ | $2\sigma_d$ |
|---|---|---|---|---|---|---|---|---|---|
| Alg | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

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

a) Explain with the help of example centre of inversion.

b) Find whether the following operation is commutative or non commutative $C3X\sigma_v$ in$NF_3$

c) What is point group symmetry of eclipsed and staggered ferrocene.

## SECTION - II

**Q4)** A) Answer the following. **[8]**

a) What are saline hydrides? Explain with suitable examples.

b) What are crown ethers? Explain with examples.

c) Give the classification of interhalogens with suitable examples.

d) Give the reactions for the synthesis of xenon oxides.

B) Give the classification of boranes with suitable example. **[3]**

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

    a) Explain the structure and bonding in -

        i) $B_2H_6$

        ii) $IF_7$

    b) Write a note on phosphazenes.

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

    a) Write a note on electron deficient hydrides.

    b) Give an account of oxoacids and oxoanions of halogens.

    c) Give the syntnesis, reactions and applications of xenon fluorides.

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

    a) Draw the structures of following.

        i) $B_4H_{10}$

        ii) $H_3B_3N_3Cl_3$

        iii) $S_4N_4$

        iv) $N_2O_5$

        v) $BrF_3$

        vi) $A_5H_3$

    b) Write a note on oxoacids and oxoanions of nitrogen.

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

    a) Write a note on psendonalogens.

    b) Give an account of zeolites as molecular sieves.

    c) Write a note on carboranes.

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SEAT No. :

**[Total No. of Pages : 6**

**[5909]-13**

# M.Sc.-I

# ORGANIC CHEMISTRY-I

## CCTP-3 : CHO-150 Basic Organic Chemistry

### (2019 Pattern) (Semester-I)

*Time : 3 Hours]*           *[Max. Marks : 70*

*Instructions to the candidates:*

1) *Q. 1 and Q. 5 are compulsory and carry 11 marks each.*

2) *Attempt any two questions from Q. 2 to Q. 4 and two questions. from Q. 6 to Q. 8.*

3) *Answer to the two sections should be written in separate answer books.*

4) *Figures to right inicate full marks.*

## SECTION-I

*Q1)* a) Attempt the following.         **[9]**

     i) Comment on Benzenoid and non-Benzenoid compounds.

     ii) Write the synthesis of Furan from 1,4 diketone.

     iii) Pyridine readily undergo nucleophillic substitution reaction. Explain.

   b) Define stereoselective reactions with suitable example.     **[2]**

*Q2)* Attempt any four of the following.        **[12]**

   a) Draw all possible conformational isomers of 1,4 dimethyl cyclohexane.

   b) Explain with suitable example aromaticity in Heterocyclic compounds.

   c) Assign E/Z designation to the following.
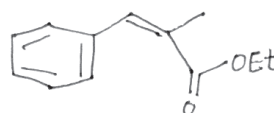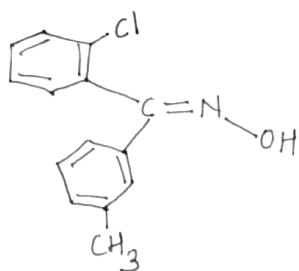
**d)** Assign Re and Si fall labels to the followings.
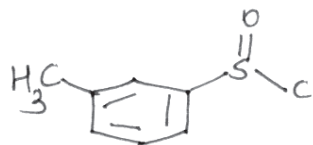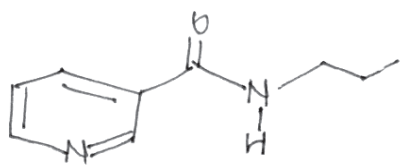


**e)** Write the mechanism for following reaction and Justify your answer.
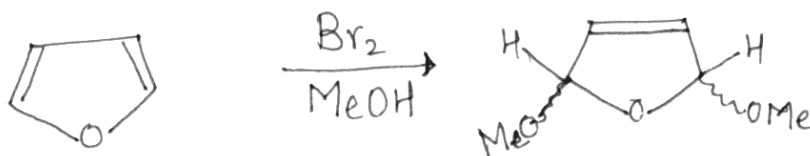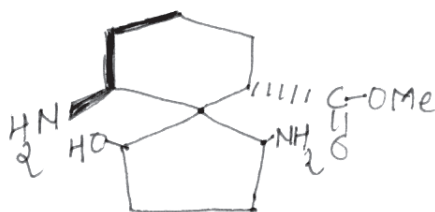


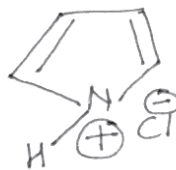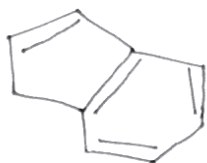**Q3)** Attempt any four of the following. **[12]**

a) Comment on the optical activity of allenes.

b) Electrophillic substitution Reaction on Thiophene takes place on 2-postiton. Explain.

c) Assign R/S configuration to the following compound and Justify your answer.
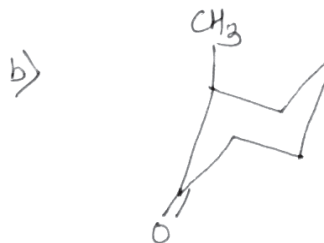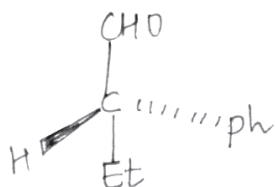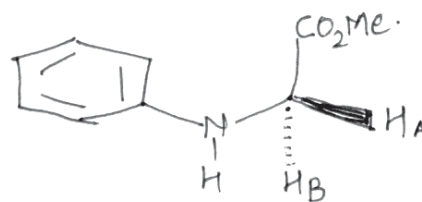


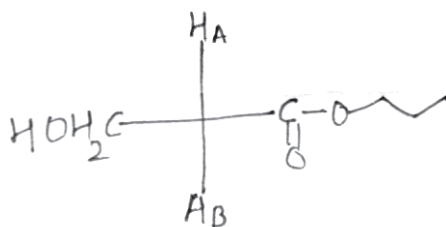d) Comment on optical activity of the following. Justify.

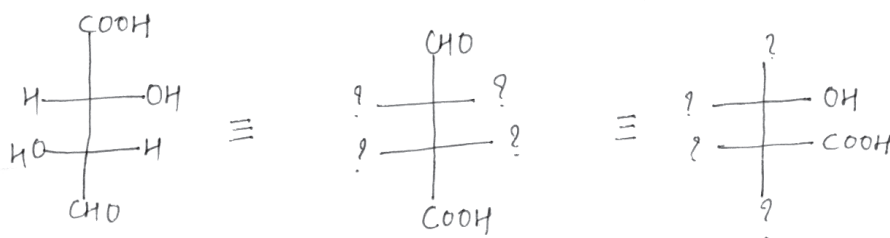e) Comment on the stability of the following.



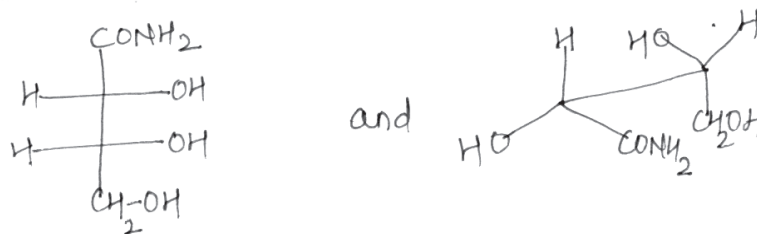**Q4)** Attempt any four of the following. **[12]**

a) Write note on : Antiaromaticity

b) Write not on : Paal Knorr synthesis.

c) Assign Pro-R and Pro-S labels to $H_A$ & $H_B$.



d) Write equivalent structures.



e) What is the stereochemical relationship between the following compounds.

## SECTION-II

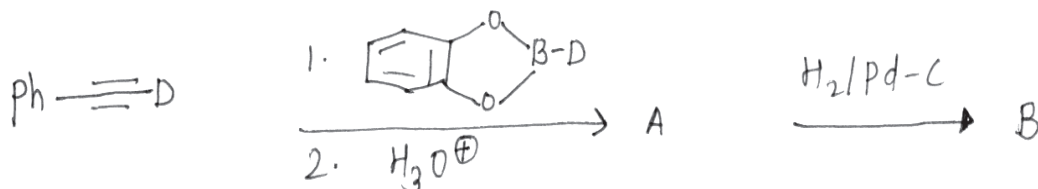**Q5)** a) Attempt the following. [9]

   i) Explain structure and Stability of carbanion.

   ii) Describe the use of Bayer-villiger Rearrangment in organic synthesis.

   iii) What is sulfur ylides? Give two methods for the synthesis of sulfur ylides.
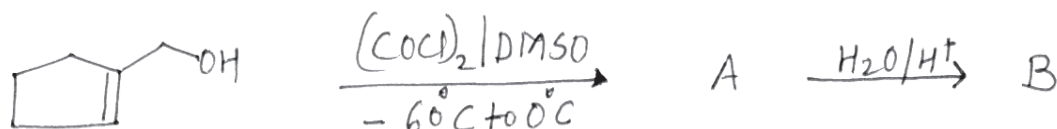
   b) Write any two applications of [2]

   i) PCC

   b) $H_2$/Pd-C

**Q6)** Attempt any four of the followings. [12]

   a) Write note on : Favorskii Rearrangements.

   b) Write note on : Clemenson Reduction

   c) Predict the products and Justify your answer.
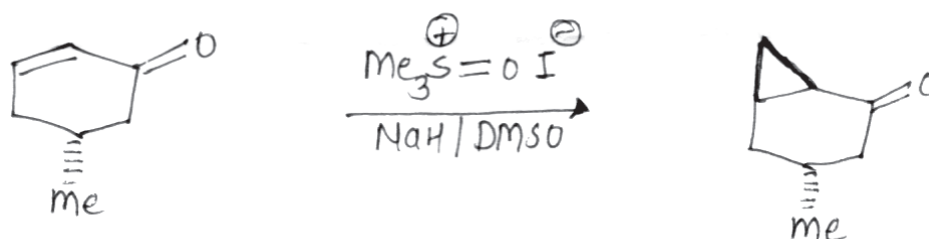


   d) Predict the products and Justify your answer.
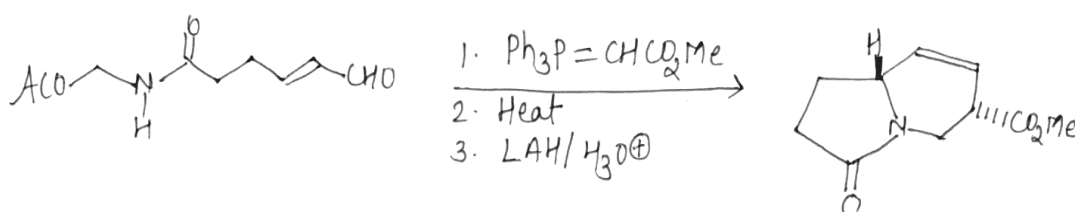


   e) Comment on stability of Free Radicals.

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

a) Comment on Dess Martin Reaction.

b) Comment on Oxidative cleavage Reactions.

c) Write the mechanism ond Justify your answer



d) Write the mechanism and Justify your answer.



e) $CH_3-CH_2-S-CH_2-CH_2-Cl$ undergoes $10^7$ times faster hydrolysis than $CH_3-CH_2-O-CH_2-CH_2-Cl$. Explain.

*Q8)* Attempt any four of the following. **[12]**

a) Describe Lossen Rearrangment with suitable example.

b) Explain any one method for the synthesis of lactones.

c)   Factors affecting stability of Free radicals. Explain?

d)   Predict the products andsuggest the mechanism.
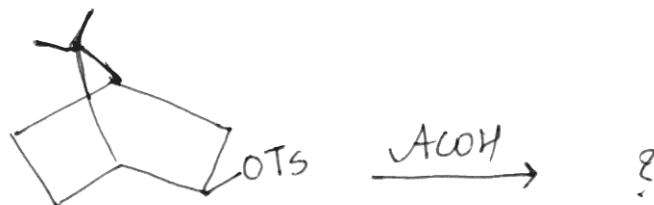


e)   Predict the products and suggest the mechanism.



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**[5909]-14**

**M.Sc. - I (Chemistry)**

**CHG - 190 CBOP - 1 : INTRODUCTION TO SOLID STATE OF MATTER**

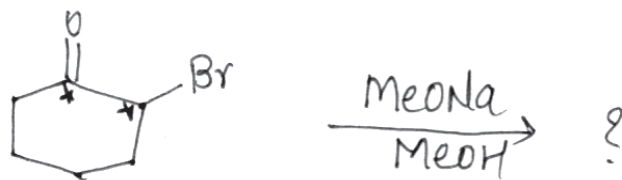**(2019 Pattern) (Semester - I) (2 - Credits) (Elective Option - A)**

*Time : 2 Hours]*

*[Max. Marks : 35*

*Instructions to the candidates:*
1) *Question 1 is compulsory.*
2) *Solve any two questions from Q.2 to Q.4.*
3) *Questions 2 to 4 carry equal marks.*
4) *Figures to right indicate full marks.*

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

    i) What is p-n junction?

    ii) What is Josephson effect?

    iii) Mention any four methods for the synthesis of solids.

    iv) What is the major difference between intrinsic and extrinsic defects?

    v) What is photoconductor? Give example.

  b) Write note on synthesis silver nanoparticles. **[3]**

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

    i) Combustion synthesis of solids.

    ii) Ionic conductivity in β-Alumina.

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

    i) Explain why TiO and VO are metallic conductors while FeO, NiO and CoO are semiconductors?

    ii) Explain construction and working of FET.

*Q3)* a) What are point defects? Explain schottky and frenkel defect with suitable example. **[6]**

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

   i) Write note on fuel cell.

   ii) Explain BCS theory of superconductivity.

*Q4)* a) Give the assumptions of the band theory of solids. Explain formation of bands in silicon and germanium. How tetrahedral crystal structure favour semiconductivity in solids? **[6]**

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

   i) Give the synthesis of ZnO nanoparticles.

   ii) Explain non stoichiometry in FeO.

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**PA-3191**

**[5909]-14**
# M.Sc. - I (Chemistry)
## GENERAL CHEMISTRY
## CHG - 190 - CBOP - 1 : Mathematics for Chemists
### (2019 Pattern) (Semester - I) (2 Credits) (Elective Option-B)

*Time : 2 Hours]* *[Max. Marks : 35*
*Instructions to the candidates:*
  1) *Question 1 is compulsory.*
  2) *Questions 2 to 4 carry equal marks.*
  3) *Solve any two questions from Q.2 to Q.4.*
  4) *Figures to the right indicate full marks.*

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

  i) What is Vector triple product?

  ii) What is a null matrix?

  iii) Find the order of the following matrix $\begin{bmatrix} 3 & 4 & 6 & 8 \\ -1 & 0 & 2 & 3 \\ 9 & 8 & 5 & 2 \end{bmatrix}$.

  iv) Write any two rules of partial differentiation.

  v) What is the derivative of sec$x$?

  b) Explain the Taylor and Mclaurin series of differentiation. [3]

*Q2)* a) i) If $x = \dfrac{1+t^2}{1-t^2}$ and $y = \dfrac{1-t^2}{1+t^2}$ find $\dfrac{dy}{dx}$. [6]

  ii) Find the minima and minima of $x^3 - 3x^2 - 9$.

b) Evaluate the following integrals **[6]**

   i)    $\int x \, e^x dx$

   ii)   $\int \dfrac{dx}{(x-a)(x-b)}$

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

   i)    Find the differential coefficient of the following function

       $y = \log \log \log x$

   ii)   Find the derivative of $y = (2x + 3)^{x+5}$

b)  Find the inverse of the matrix $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$. **[6]**

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

   Evaluate by substitution method

   i)    $\int e^{12x} dx$

   ii)   $\int \cos(ax + b) dx$

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

   i)    Vector

   ii)   Cusp

   iii)  Node

   iv)  Definite integral

   v)   Transpose

   vi)  Determinant

✘   ✘   ✘

**PA-3191**

**[5909]-14**
## M.Sc. - I (Chemistry)
### GENERAL CHEMISTRY
### CHG - 190-CBOP-1 : Introduction to Chemical Biology - I
### (2019 Pattern) (Semester - I) (2 Credits) (Elective Option C)

*Time : 2 Hours]* *[Max. Marks : 35*
*Instructions to the candidates:*
 *1) Question 1 is compulsory.*
 *2) Questions 2 to 4 carry equal marks.*
 *3) Solve any two questions from Q.2 to Q.4.*
 *4) Draw diagram wherever necessary.*

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

 i) In the following peptide, where might bends or turns occur? Where might intrachain disulfide cross linkages be formed.

 Ala - His - Tyr - Pro - Gly - Phe - Glu - Met - Cys - Pro - Asp - Thr

 1    2    3    4    5    6    7    8    9    10    11    12

 - Arg - Cys - Ile - Leu - Lys - Trp - Glu - Lys.

 13    14    15    16    17    18    19    20

 ii) Give significance of endoplasmic reticulum.

 iii) When wool, sweater or socks are washed in hot water and air dried, they shrink but silk on the other hand does not shrink at same condition. Why?

 iv) Draw the structure of D-glucose and D-fructose.

 v) Given these molecular components; Glycerol, fatty acid, phosphate, long chain alcohol and carbohydrate answer the following.

 1) Which two components are present in both fats and phosphatidyl choline

 2) Which component is present in ganglioside but not in fat.

 b) Classify lipids with example. **[3]**

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

b) Solve the following [6]

i) Give detail mechanism of transport of 3 Na$^+$ out of cell and 2K$^+$ into the cell by Na$^+$ K$^+$ ATP ase.

ii) Discuss in detail secondary structure of proteins.

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

i) Draw and label fluid mosaic model of cell membrane. Enumerate its functions.

ii) Comment in brief on

1) Saponification number

2) Iodine number

3) Acid number

b) Discuss the following : [6]

i) Physico chemical properties of amino acids.

ii) Derwed sugars and their significance.

*Q4)* a) Discuss the concept of proteomics. [6]

b) Solve the following [6]

i) Give the distinguishing features of prokaryotic and eukaryotic cell.

ii) Indicate whether each pair of following sugars consists of anomers, epimers or aldose - ketose pair.

1) D-glyceral dehyde and Dihydroxy acetone phosphate

2) D-glucose and D-mannose

3) D-glucose and D-fructose

4) D-rubose and D-ribulose

5) α-D-glucose and β-D-glucose

6) D-galactose and D-glucose

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**[5909]-21**
**F.Y. M.Sc.**
**PHYSICAL CHEMISTRY**
**CHP-210 : Molecular Spectroscopy & Nuclear Chemistry**
**(2019 Pattern)  (Semester - II)**

*Time : 3 Hours]*                                                                                           *[Max. Marks : 70*

*Instructions to the candidates:*

 *1)* *Answer to the Two sections should be written in SEPARATE answer books.*

 *2)* *Questions 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 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 | $= 6.022 \times 10^{23}$ mol$^{-1}$ |
| 2. | Boltzmann Constant | k | $= 1.38 \times 10^{-16}$ erg K$^{-1}$molecule$^{-1}$ |
| | | | $= 1.38 \times 10^{-23}$ J K$^{-1}$ molecule$^{-1}$ |
| 3. | Planck Constant | h | $= 6.626 \times 10^{-27}$ erg s |
| | | | $= 6.626 \times 10^{-34}$ Js |
| 4. | Electronic Charge | e | $= 4.803 \times 10^{-10}$ esu |
| | | | $= 1.602 \times 10^{-19}$ C |
| 5. | 1 eV | | $= 23.06$ kcal mol$^{-1}$ |
| | | | $= 1.602 \times 10^{-12}$ erg |
| | | | $= 1.602 \times 10^{-19}$ J |
| | | | $= 8065.5$ cm$^{-1}$ |
| 6. | Gas Constant | R | $= 8.314 \times 10^{7}$ erg K$^{-1}$ mol$^{-1}$ |
| | | | $= 8.314$ J K$^{-1}$ mol$^{-1}$ |
| | | | $= 1.987$ cal K$^{-1}$ mor1$^{-1}$ |
| 7. | Faraday Constant | F | $= 96487$ C equiv$^{-1}$ |
| 8. | Speed of light | c | $= 2.997 \times 10^{10}$ cm s$^{-1}$ |
| | | | $= 2.997 \times 10^{8}$ m s$^{-1}$ |
| 9. | 1 cal | | $= 4.184 \times 10^{7}$ erg |
| | | | $= 4.184$ J |
| 10. | 1 amu | | $= 1.673 \times 10^{-27}$ kg |
| 11. | Bohr magneton | $\beta_e$ | $= -9.274 \times 10^{-24}$ J T$^{-1}$ |
| 12. | Nuclear magneton | $\beta_n$ | $= 5.051 \times 10^{-27}$ J T$^{-1}$ |
| 13. | Mass of an electron | $m_e$ | $= 9.11 \times 10^{-31}$ kg |

*P.T.O.*

# SECTION - I

**Q1) a)** Attempt any four : **[8]**

i) Classify the molecules on the basis of moments of inertia

$CH_3F$, $BCl_3$ $CH_4$ and $C_2H_2$

ii) Among the following nuclei, which are Mossbauer active?

$^{129}I$, $^{57}Co$, $^{57}Fe$, $^{121}Sb$
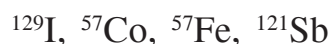
iii) How many fundamental modes of vibrations are there in

$H_2O$, $CO_2$, $C_{60}$, $CH_4$

iv) Explain the relative intensities of stokes and anti-stokes lines in Raman spectroscopy.

v) What is Franck-Condon principle?

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

The IR spectrum of a diatomic molecule exhibits transitions at 2144, 4262 and 6354 cm$^{-1}$ corresponding to excitations from the ground state to the first, second and third vibration states respectively. Calculate the fundamental transition and an harmonic constant of the molecule.

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

i) Derive the expressions for the fundamental transition and first hot band for anharmonic oscillator.

ii) Explain the rotational fine structure in electronic spectroscopy.

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

i) Explain the principle of Mossbauer spectroscopy.

ii) The rotational lines of DI was observed at 65.070 and 71.577 cm$^{-1}$. Calculate the bond distance of the molecule. [Atomic masses of D = 2.015 amu I = 126.904 amu]

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

   i) What is foxtrat diagram? What is its relevance in electronic spectroscopy?

   ii) Write a note on Birge-Sponer extrapolation plot.

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

   i) Discuss the change in polarizability ellipsoid during the vibrations in $H_2O$ molecule.

   ii) The vibrational energy levels v" = 0 and v' = 1 of a diatomic molecule are separated by 2143 cm$^{-1}$ and its anharmonicity constant is 0.0145. Calculate the $\bar{v}_e$ and first over tone position of this molecule.

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

   i) What is Raman effect? Derive the expressions for the rotational stokes and anti-stokes lines.

   ii) What is degree of depolarisation and its significance is Raman spectroscopy.

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

   i) Explain the principle of Mossbauer spectroscopy and give its one application.

   ii) For $^{14}N_2$ molecule, the values of $\bar{x}_e = 6.087 \times 10^{-3}$ and $\bar{v}_e = 2374.05$ Cm$^{-1}$. Calculate the dissociation energy of the molecule.

## SECTION - II

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

   i) What do you mean by Auger's effect?

   ii) Define the terms rad and Gray.

   iii) What is neutron evaporation?

   iv) Write the equation for the preparation of $^{14}C$.

   v) Explain the application of radioisotope in structure determination with one example.

b) Calculate the mass absorption coefficient for 1 MeV gamma radiation for $NaIO_3$. **[3]**

   (Given : all values; O = 1.69, Na = 2.32, I = 12.03 b/atom, atomic masses of O = 16, Na = 23 & I = 127 amu)

*Q6)* a) i) What are general characteristics at radioactive decay? **[3]**

ii) Write a note on Compton effect. **[3]**

b) i) Explain the energy spectrum of fragments of fission at $^{235}$U by thermal neutrons. **[3]**

ii) 10 g sample containing Mn was irradiated in a neutron flux of $10^{12}$ n.Cm$^{-2}$ sec$^{-1}$ for 2 hrs. The activating measured after 5 hrs of cooling period was 14500 cpm with detector whose efficiency of 20%. Determine the percentage of Mn in this sample. (Given : = 13.6 b, $t_{1/2}$ = 2.58 hr, for $^{56}$Mn natural abundance = 100%)

**[3]**

*Q7)* a) Explain the following medical applications in radioactivity. **[6]**

i) Thyroidities

ii) Assessing the volume of blood in patient.

b) i) Discuss the term fission energy and what is the process of nuclear fission. **[3]**

ii) Explain the Geiger - Nuttal's law. **[3]**

*Q8)* a) i) Define the following terms. **[3]**

Rad, Gray, Röntgen and RBE

ii) Write a note on Fricke dosimetry. **[3]**

b) i) Discuss the Szilard-Chalmers reaction. **[3]**

ii) Given the filation relation. **[3]**

$$^{140}\text{Ba} \xrightarrow[12\,days]{\beta^-} {}^{140}\text{La} \xrightarrow[10hr]{\beta^-} {}^{140}\text{Ce} \text{ (stable)}$$
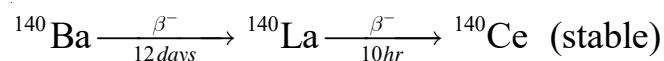
Find the activity due to $^{140}$Ba at the end of 24 day. It we had pure $^{140}$Ba only initially within activity of 2000 disintegrations per second.

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**Total No. of Questions : 6]**

**PA-3193**

SEAT No. :

**[Total No. of Pages : 7**

**[5909]-22**

**M.Sc. I**

**CHEMISTRY**

**CCTP-5: CHI-230: Coordination and Bioinorganic Chemistry**

**(2019 Pattern) (Semester - II) (4 Credits)**

*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 and labelled diagrams must be drawn wherever necessary.*

*Given: Atomic numbers Ni = 28, Ce = 58, Cu = 29, Mn = 25, Fe = 26, Ti = 22, Cr = 24.*

**SECTION - I**

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

i) Which one of the following complex is more intense in colour? Why?

Cis [Cu (NH$_3$)$_4$ Cl$_2$] and Trans [Cu (NH$_3$)$_4$ Cl$_2$]

ii) Give the ground state term symbol for the following ions.

1) Ti$^{2+}$

2) Mn$^{+2}$

iii) Calculate the degeneracy of the following terms/states/configuration.

1) $^6$I

2) f'd'

*P.T.O.*

iv) Arrange the following terms in increasing order of energies. Justify $^3F$, $^1D$, $^1G$, $^1S$, $^3P$.

b) Calculate $\mu_{eff}$ for $[Ni(H_2O)_6]SO_4$ complex. **[3]**

Given $\lambda = -320$ cm$^{-1}$, Dq = 850 cm$^{-1}$.

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

i) Prepare a table of microstate and hence derive the allowed R-S terms for p'd' configuration.

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

1) $A_{2g} \rightarrow A_{1g}$

2) $E_g \rightarrow E_g$

3) $A_{2u} \rightarrow T_{2g}$
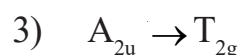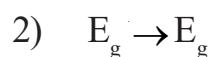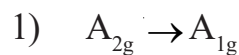
b) Answer any two of the following : **[6]**

i) For hexa aquo Co(II) complex two absorption bands are observed at 16000 cm$^{-1}$ and 19417 cm$^{-1}$. Determine the third band with the help of following data. Also calculate crystal field parameter and inter electronic repulsion parameter.

Comment on nephelaxetic ratio.

Given:

1) $B = \dfrac{v_1 + v_3 + v_2}{15}$

2) $10Dq = v_2 - v_1$

3) $B_o = 971$ cm$^{-1}$

4) $B = 825$ cm$^{-1}$.

ii) Determine the ground state term for the following complex ions.

1) $[Cr(OX)_3]^{3-}$

2) $[Ni(H_2O)_6]^{2+}$

3) $[Co(NH_3)_5Cl]Cl_2$

iii) Describe in brief Orgel diagram for D ground state term.

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

i) Give the splitting of 5D R-S term in weak cubic field using character table for pure rotational point grouped 'O' and reduction formula.

ii) Assign the spin multiplicities to the states arising from eg$^2$ configuration infinitely strong field is relaxed to strong field using Bethe's method of descending symmetry, correlation table and direct product table.

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

i) Predict the expected electronic transition in $[FeCl_4]^{2-}$ complex ion.

ii) Ni$^{2+}$(oh) complex shows 15% increase in its observed magnetic moment value. Calculate orbital coupling constant ($\lambda$) for Ni$^{2+}$ ion using following data.

Dq = 850 cm$^{-1}$.

iii) Explain why KMnO$_4$ is intense purple in colour.

**Direct Product**

1. **Group of the form G x i or G x σh**

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

   g x g = u x u = g, g x u = u, 'x' = ''x''=

2. **Product of the form A x A,  B x B, A x B**

   For all groups:

   Letter Symbol: A x A  =A. B x B = A , A x B = B

   Subscript: 1 x 1 = 1, 2 x 2 = 1, 1 x 2 = 2

   Except for the B representations of $D_2$ and $D_2$ where

   B x  B = B, and 1 x 2 = 3. 2 x 3 = 1, 3 x 1 = 2

3. **Products of the forms:  A x E, B x E:**

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

   (b) For all groups except $D_4h$. $D_4d$. $S_8$:

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

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

   (c) For $D_4h$:

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

   Irrespective of the suffix on B:

   (d) For $D_4d$, $S_8$:

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

   Irrespective of the suffix on B:

4. **Products of  the form E x E:**

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

   (a) For Oh. O. $T_3$, $D_6h$. $D_2$, $C_6v$. $C_6h$. $C_6$. $S_6$, $D_2d$, $D_2h$. $D_3$. $C_2$ $C_3h$. $C_3$:

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

   (b) For $D_4h$. $D_4$. $C_4v$, $C_4h$, $C_4$, $S_4$, $D_2d$:

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

   (c) For $D_6d$:

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

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

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

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

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

   $E_1 + E_3 = B_4 + B_2 + E4$.  $E_2 \times E_4 = B_1 + B_2 + E_2$,

   (d) $D_5d$, $D_2h$, $D_3$, $C_3v$, $C_3h$, $C_3$:

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

   $E_1 \times E_2 = E_1 + E_2$

   (e) For $D_4d$, $S_8$

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

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

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

5. **Product involving the T ( or F ) representation of Oh, O, Td:**

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

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

   $T_1 \times T_1 = T_2 \times T_2 = A1 + B + T_1 + T_2$

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

6. To Complete result for O are

| O | $A_1$ | $A_2$ | E | $T_1$ | $T_2$ |
|---|---|---|---|---|---|
| $A_1$ | $A_1$ | $A_2$ | E | $T_1$ | $T_2$ |
| $A_2$ | $A_2$ | $A_1$ | E | $T_2$ | $T_1$ |
| E | E | E | $A_1 + A_2 + E$ | $T_1 + T_2$ | $T_1 + T_2$ |
| $T_1$ | $T_1$ | $T_2$ | $T_1 + T_2$ | $A_1 + E + T_1 + T_2$ | $A_2 + E + T_1 + T_2$ |
| $T_2$ | $T_2$ | $T_1$ | $T_1 + T_2$ | $A_2 + E + T_1 + T_2$ | $A_1 + E + T_1 + T_2$ |

## Character Table for O rotational group

| O | E | $6C_4$ | $3C_2(=C_4^2)$ | $8C_3$ | $6C_2$ | | |
|---|---|---|---|---|---|---|---|
| $A_1$ | 1 | 1 | 1 | 1 | 1 | | $x^2 + y^2 + z^2$ |
| $A_2$ | 1 | -1 | 1 | 1 | -1 | | $(2z^2 - x^2 - y^2,$ |
| E | 2 | 0 | 2 | -1 | 0 | | $x^2 - y^2)$ |
| $T_1$ | 3 | 1 | -1 | 0 | -1 | $(R_x, R_y, R_z);(x,y,z)$ | $(xy, xz, yz)$ |
| $T_2$ | 3 | -1 | -1 | 0 | 1 | | |

## Correlation table for group Oh

| Oh | O | Td | $D_4h$ | $D_2d$ | $C_{4v}$ | $C_{2v}$ | $D_3d$ | $D_3$ | $C_2h$ |
|---|---|---|---|---|---|---|---|---|---|
| $A_1g$ | $A_1$ | $A_1$ | $A_1g$ | $A_1$ | $A_1$ | $A_1$ | $A_1g$ | $A_1$ | Ag |
| $A_2g$ | $A_2$ | $A_2$ | $B_1g$ | $B_1$ | $B_1$ | $A_2$ | $A_2g$ | $A_2$ | Bg |
| Eg | E | E | $A_1g + B_1g$ | $A_1 + B_1$ | $A_1 + B_1$ | $A_1 + A_2$ | Eg | E | Ag + Bg |
| $T_1g$ | $T_1$ | $T_1$ | $A_2g + E_g$ | $A_2 + E$ | $A_2 + E$ | $A_2 + B_1 + B_2$ | $A_2g + Eg$ | $A_2 + E$ | Ag + 2Bg |
| $T_2g$ | $T_2$ | $T_2$ | $B_2g + Eg$ | $B_2 + E$ | $B_2 + E$ | $A_1 + B_1 + B_2$ | $A_1g + Eg$ | $A_1 + E$ | 2Ag + Bg |
| $A_1u$ | $A_1$ | $A_1$ | $A_1u$ | $B_1$ | $A_2$ | $A_2$ | $A_1u$ | $A_1$ | Au |
| $A_2u$ | $A_2$ | $A_1$ | $B_1u$ | $A_1$ | $B_2$ | $A_1$ | $A_2u$ | $A_2$ | Bu |
| Eu | E | E | $A_1u + B_1u$ | $A_1 + B_1$ | $A_2 + B_2$ | $A_1 + A_2$ | Eu | E | Au + Bu |
| $T_1u$ | $T_1$ | $T_2$ | $A_2u + Eu$ | $B_2 + E$ | $A_1 + E$ | $A_1 + B_1 + B_2$ | $A_2u + Eu$ | $A_1 + E$ | Au + 2Bu |
| $T_2u$ | $T_2$ | $T_1$ | $B_2u + Eu$ | $A_2 + E$ | $B_1 + E$ | $A_2 + B_1 + B_2$ | $A_1u + Eu$ | $A_1 + E$ | 2Au + Bu |

## SECTION - II

**Q4)** a) Answer the following : **[8]**

     i)     Explain the role of copper in biological system.

     ii)    Enlist the biologically important element.

     iii)   Explain the term template effect with suitable example.

     iv)   Explain the structural differences between Hemoglobin and myoglobin.

     b) Explain different classes of oxygen transport proteins. **[3]**

**Q5)** a) Answer <u>any one</u> of the following : **[6]**

     i)     Explain with the help of example how metal ion affect the reaction of coordinated ligand?

     ii)    Explain administration and in vivo chemistry of the anticancer drug cis platin.

     b) Answer <u>any two</u> of the following : **[6]**

     i)     Explain the types of substitution reaction in metal complexes.

     ii)    Write note on vitamin $B_{12}$.

     iii)   Write note on metals in medicine.

*Q6)* a) Answer <u>any one</u> of the following : [6]

      i)    Explain in detail role of calcium in blood coagulation.

      ii)   Explain with the help of scheme the ATP dependent export of three $Na^+$ and two $K^+$ ion import by the $Na^+$–$K^+$–ATpase.

b) Answer <u>any two</u> of the following : [6]

      i)    Write note on iron storage protein.

      ii)   Explain the synthetic model for iron sulfur cluster.

      iii)  Explain the electron transfer reaction in metal complexes with suitable example.

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## [5909]-23
## M.Sc. (Part - I)
## CCTP-6 : ORGANIC CHEMISTRY - II
## CHO-250 : Photochemistry, Pericyclic and Organic Spectroscopy
## (2019 Pattern) (Semester - II)

*Time : 3 Hours]*

*[Max. Marks : 70*

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

## SECTION - I

*Q1)* A) Predict the products with exact stereochemistry. Justify your answer.**[8]**

a) 

b) 

c) 

d) 
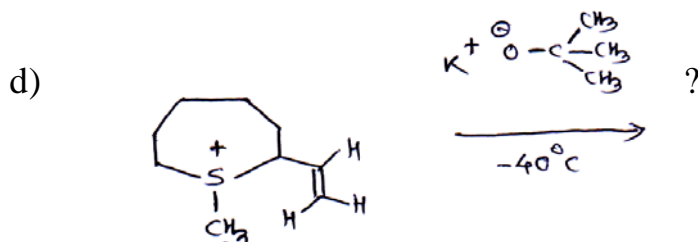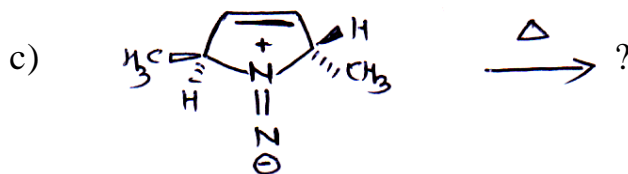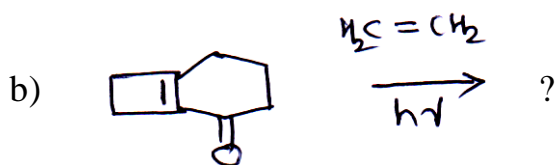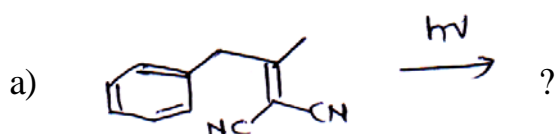
B) Write a note on Jablonski diagram. **[3]**

*P.T.O.*

*Q2)* A) Attempt <u>any three</u> of the following. [9]

a) Explain Paterno Buchi reaction with suitable examples.

b) Explain following reaction via concerted mechanism



$$\xrightarrow{250\overset{\circ}{C}}$$
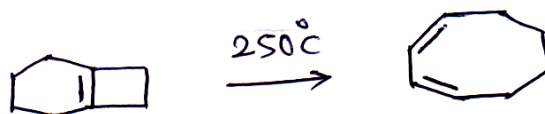
c) Write a note on 'Norish-II' reaction.

d) Explain the following conversion
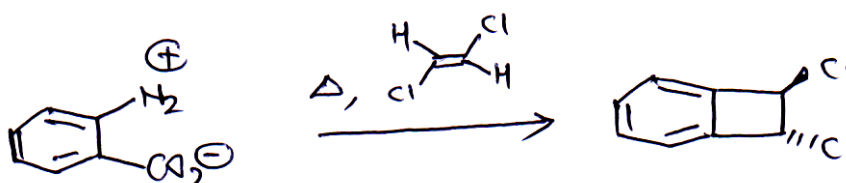


B) Suggest the mechanism for following reaction.



[3]
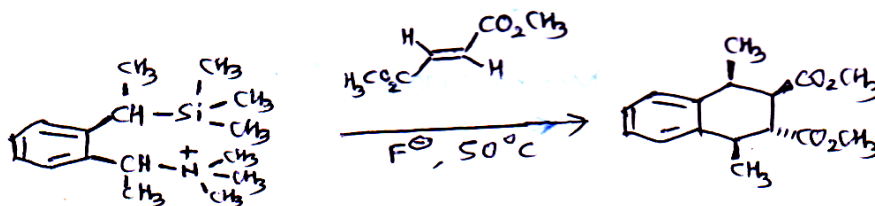
*Q3)* A) Answser the following. (any three). [9]

a) Justify following transformation.
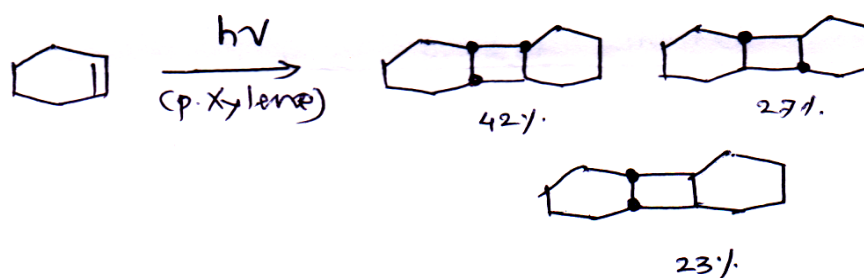


b) Explain following transformation.
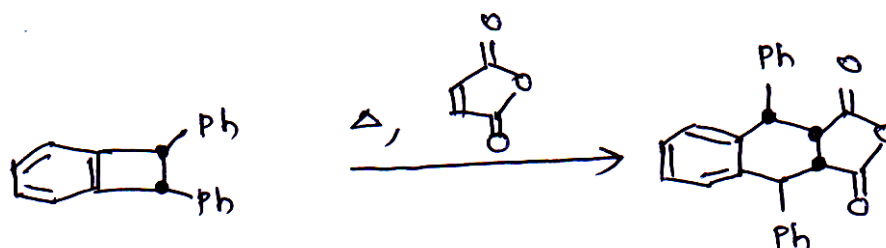
c) Write a note on 'Ene Reaction'.

d) Explain Barton reaction with suitable examples.

B) What is photo fries migration? Explain with suitable examples. **[3]**

**Q4) A)** Attempt <u>any three</u> of the following. **[9]**

a) What are Electrocyclic reactions? Explain with any two examples.

b) Draw correlation diagram for electrocyclic ring formation of butadiene. Predict whether reaction will be thermally or photochemically allowed.

c) Explain the formation of prodcut in following reaction.



d) Suggest the mechanism for following reaction.
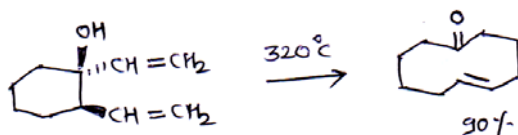


B) Write a note on cheletropic reaction. **[3]**

**SECTION - II**

**Q5) A)** Attempt the following. **[8]**

a) Which compounds give a $^1$H.NMR spectrum with two signals in a ratio 2 : 3
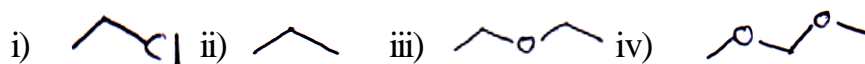


b) A compound with molecular formula $C_4H_8O$ shows all it's $^{13}C$ NMR signals below 160 ppm. Deduce the structure.

c) Calculate λmax for following compound.
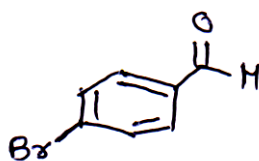
d) Explain the genesis of peaks in following compound
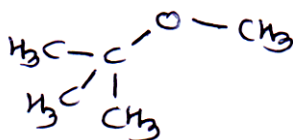


B) Explain the role of deuterated solvents in NMR spectroscopy. **[3]**

**Q6)** A) Attempt <u>any three</u> of the following. **[9]**

a) Which solvents are suitable for uv. spectroscopy? Explain.

b) Deduce the structure

M.F. : $C_9H_{10}O$

IR : 1688 cm$^{-1}$

PMR : 1.22 (t, 3H)

2.95 (q, 2H)

7.28 - 7.95 (m, 5H)

c) Using 300 MHz NMR machine :

i) How many Hz downfield from TMS is a signal at 2.5 ppm?

ii) If a signal comes at 1200 Hz downfield from TMS, at what ppm does it occur?

d) ¹H NMR of 1, 3, 5 trihydroxybenzene in water containing one equivalent of NaOH shows a singlet at 6.03 ppm for 3 protons on addition of a second equivalent of NaOH shows two singlets at 3.0 ppm and 6.0 ppm. What are the compounds formed in these solutions?

B) 2-Heptanone shows base peak at m/z = 43, white 3-heptanone at m/z = 57. Justify. **[3]**

**Q7)** A) Attempt <u>any three</u> of the following. **[9]**

a) Explain chemical ionization method in mass spectroscopy.

b) Explain the principle of IR spectroscopy.

c)   Predict the structure.

M.F : $C_7H_5NO_3$
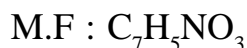
IR : 2728, 1688, 1565, 1520, 1450, 1365

PMR 8.2 (d, J = 8.2 Hz, 2H)

8.5 (d, J = 8.2 Hz, 2H)

10.2 (S, 1H)

d)   Draw and explain $^1$H.NMR spectrum of acetoacetic ester.

B)   Explain the principle of NMR spectroscopy.          **[3]**


**Q8) A)**   Attempt the following. (Any three)          **[9]**

a)   How will you follow following reaction using IR spectroscopy.
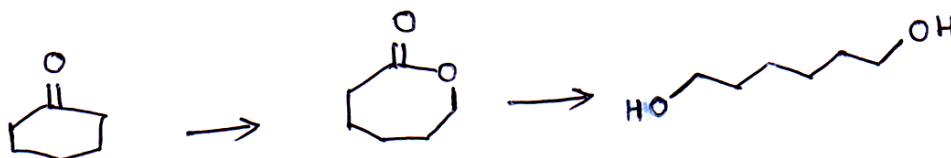


b)   Explain the factors affecting the stretching frequencies in IR spectroscopy.

c)   Distinguish following compounds by $^{13}$C.NMR spectroscopy
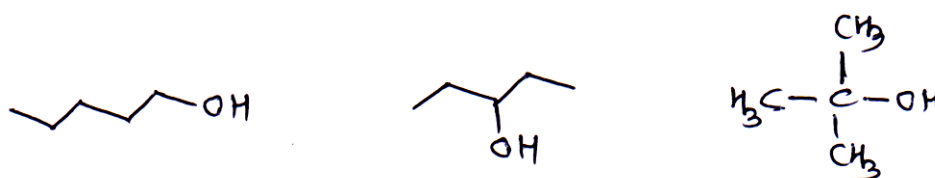


d)   Explain chemical shift? Give any two factors that are responsible for change in chemical shifts.

B)   How will you use $^{13}$C-NMR and $^1$H.NMR spectra to distinguish following isomers.          **[3]**
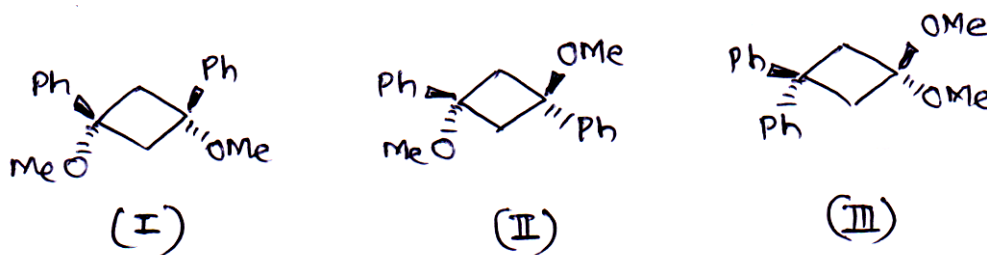
SEAT No. :

[Total No. of Pages : 6

## [5909]-24
## M.Sc. - I (Chemistry)
### CBOP - 2, CHG-290, Option - A
### MATERIALS CHARACTERIZATION TECHNIQUE
### (2019 Pattern) (Semester - II) (2 Credits)

*Time : 2 Hours]*                                                                                    *[Max. Marks : 35*

*Instructions to the candidates:*
1) *Q.1 is compulsory.*
2) *Solve any two questions from Q.2 to Q.4.*
3) *Figures to right indicate full marks.*
4) *Question 2,3,4 carry equal marks.*
5) *Use of calculator/logtable is allowed.*

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

 i)   Enlist the factors affecting distortion of diffraction spectra?

 ii)  What are the types of contrast in SEM? Which electrons are responsible for them.

 iii) What is prethinning in TEM?

 iv)  Enlist the analyzing crystals used in WDS.

 v)   What are the selection rules for electron transition between two shells?

 **b)**   Calculate the smallest glancing angle at Which K-copper line at 1.549Å will reflected from the crustral having atomic spacing 4.255Å.       **[3]**

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

 i)   Explain construction and working of x-ray tube.

 ii)  Describe electron-specimen interaction in SEM.

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

 i)   Working atmosphere and sample preparation in XRF.

 ii)  Advances in energy dispersive spectroscopy.

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

    i)    What are the applications of x-ray diffractometer? Explain one application in detail.

    ii)    Discuss the phase contrast in TEM.

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

    i)    Explain Wavelength dispersive spectroscopy.

    ii)    Discuss various applications of XRF.

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

    i)    Explain thermionic gun in TEM.

    ii)    Discuss Everhart-Thornely detector in SEM.

    **b)** **Write a note on :** **[6]**

    i)    Energy dispersive spectra.

    ii)    Bragg's diffraction.

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**PA-3195**

**[5909]-24**
# M.Sc. - I (Chemistry)
## CBOP - 2, CHG-290, Option - B
## ORGANOMETALLIC AND INORGANIC REACTION MECHANISM
### (2019 Pattern) (Semester - II)

*Time : 2 Hours]*        *[Max. Marks : 35*
*Instructions to the candidates:*
    *1)*    *Q.1 is compulsory.*
    *2)*    *Solve any two questions from Q.2 to Q.4.*
    *3)*    *Question 2,3 and 4 carry equal marks.*
    *4)*    *Figures to right indicate full marks.*
    *5)*    *Use of logtable and calculators is allowed.*

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

    i)    Determine valence shell electron count for the following :

      A)    $[(\eta^3 - C_5H_5)(\eta^5 - C_5H_5) Ru (CO)]$

      B)    $[M_n (pph_3)_2 Cl_2 N]$

    ii)    Indentify the second row transition metal in the following $18e^-$ species.

      A)    $[(\eta^4 - C_8H_8)M (CN)_3]$

      B)    $[ClM (CO)_5]$

    iii)    Predict the product and type of following reaction.

      $[Co (CO)_5H] + F_2C = CF_2 \rightarrow$

    iv)    Give the rate law for dissociative reaction.

    v)    Define oxidative addition with suitable example.

   **b)**    Discuss the methods for synthesis of binary carbonyl complexes.    **[3]**

*Q2)* **a)**    Explain bonding in ferrocene.      **[6]**

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

    i)    Reductive elimination in organometallic compounds.

    ii)    Kinetic chelate effect.

*Q3)* **a)** Discuss Monsanto acetic acid process. **[6]**

**b)** **Write notes on following :**

i) The trans effect. **[3]**

ii) Dissociation reaction in coordination compounds. **[3]**

*Q4)* **a)** Explain the conjugate base mechanism with suitable examples. **[6]**

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

i) Give an account of pd-catalysed cross coupling cycle.

ii) Explain characterization of carbonyl compounds by IR spectroscopy.

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**PA-3195**

## [5909]-24
## M.Sc. - I (Chemistry)
## (General Chemistry)
## CBOP - 2, CHG-290, Option - C
## INTRODUCTION TO CHEMICAL BIOLOGY - II
### (2019 Pattern) (Semester - II) (2 Credits) (Elective)

*Time : 2 Hours]*             *[Max. Marks : 35*

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

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

     i)     How enzyme concentration affects enzyme activity?

     ii)    What are the advantages of Gene therapy?

     iii)   What is transamination reaction? Explain with example.

     iv)   What is non-competitive inhibition? Explain with example.

     v)    Write the sequence of mRNA molecule synthesize from DNA template strand having the sequence 5' - ATCGTTTAACCGGTAA - 3'.

   **b)**    Discuss the elongation step of translation process.        **[3]**

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

   **a)**    Discuss the fate of pyruvate under aerobic and anaerobic conditions.

   **b)**    **Solve the following :**

     i)    Differentiate between DNA and RNA.        **[3]**

     ii)   Explain the following terms.        **[3]**

        1)    Enzyme

        2)    Km

        3)    Allosteric enzyme

*Q3)* **Solve the following questions :**

a) Discuss semiconservative replication of DNA. Add a note on its significance. **[6]**

b) i) Write a note on reverse dialysis. **[3]**

ii) How does 16C palmitic acid undergoes β-oxidation. **[3]**

*Q4)* **Attempt the following questions :**

a) Explain in detail principle, working and applications of Thin Layer Chromatography. **[6]**

b) i) What is meant by Enzyme inhibition? With suitable example explain irreversible inhibition. **[3]**

ii) Explain in brief tRNA structure and its functions. **[3]**

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SEAT No. :

[**Total No. of Pages : 4**

**[5909]-31**

**M.Sc. - II**

**PHYSICAL CHEMISTRY**

**CCPT - 7. CHP - 310 : Quantum and Solid State Chemistry**

**(2019 Pattern) (Semester - III) (Credit - 4)**

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

## SECTION - I

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

   i)  What are the conditions for the wavefunction to be acceptable?

   ii)  Define Ladder operator and give it's importance.

   iii)  What is Paulis' exclusion principle.

   iv)  Construct the Hamiltonian operator for $H_2^-$ ion.

   v)  Find $\left[ \dfrac{d}{dx}, x \right]$.

   b)  Derive the equation for linear momentum operator ($Px$). [3]

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

   i)  Explain expansion theorem.

   ii)  Explain variation theorem.

   b)  Attempt the following:

   i)  Construct the energy operator for $H_2^-$ ion. [3]

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

*Q3)* a)  Discuss the application of variation method to helium atom. [6]

   b)  Attempt the following.

   i)  Obtain an expression for the ground state energy of helium atom using variation method. [3]

   ii)  Derive the expression for the first order correction to the wave function for non-degenerate pertarbation method. [3]

*Q4)* a) Discuss the Hartree-Fock self consistent field method for many electron system. **[6]**

b) Attempt the following.

    i) Explain the properties of quantum mechanical operator. **[3]**

    ii) If $g = \hat{A}F$, find $g$ for each of the following choices of $\hat{A}$ and F.**[3]**

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

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

        3) $\hat{A} = (\ )^2$ and $F = \sin x$

## SECTION - II

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

    i) Define elastic and plastic deformation.

    ii) Enlist the various types of crystal growth technique.

    iii) Define nucleation and induction period.

    iv) Explain the formation of colour centres in a crystals.

    v) What is p-n junction?

b) Discuss any one method of growing crystals from it's melt with merits and demetits. **[3]**

*Q6)* a)  Attempt the following:                                          **[6]**

   i)   State and explain the various method of electric breakdown in insulator.

   ii)  Write a note on extrinsic semiconductor.

   b)  Attempt the following:

   i)   Discuss the various rate lows for gas solid reaction.      **[3]**

   ii)  If the average energy required to create a vacancy in a metal is 1ev, calculate the ratio of vacancies in the metal at 300 k.      **[3]**


*Q7)* a)  Derive the expression for number of Schottky defects present in a crystal at a given temperature.      **[6]**

   b)  Attempt the following:

   i)   Explain the mechanism of crystal growth from vapour phase.  **[3]**

   ii)  Explain the origin of colour centers in halide crystals.   **[3]**


*Q8)* a)  Explain the mechanism of following solid gas reaction:      **[6]**

   i)   $MgO_{(s)} + Al_2O_{3(s)} \rightarrow MgAl_2O_{4(s)}$

   ii)  $AgO_{(s)} + NaI_{(s)} \rightarrow AgI_{(s)} + NaCl_{(s)}$

   b)  Attempt the following:

   i)   State and explain Kirkendall effect.      **[3]**

   ii)  How deep will Aluminium penetrate in Silicon at 1450°C in one hour?      **[3]**

   Given     $\Delta H = 73 kcal / mol$

   $D_o = 1.55 \ cm^2 / s$


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**[5909]-32**

# M.Sc. - II
## PHYSICAL CHEMISTRY
## CHP - 311, CCTP - 8 : Nuclear, Radiation and Polymer Chemistry
## (2019 Pattern) (Semester - III) (New) (4 Credits)

*Time : 3 Hours]*          *[Max. Marks : 70*

*Instructions to the candidates:*

1) *Answer to the two sections should be written in SEPARATE answer books.*
2) *Questions 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 the right side indicate full marks.*
5) *Use of logarithmic table, calculator is allowed.*
6) *Neat diagrams musrt be drawn wherever necessary.*

## Physico-Chemical Constants

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

*P.T.O.*

(Nuclear and Rodiation Chemistry)

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

  i)    State different types of nuclear reactions.

  ii)   Differentiate between fissile and fissionable nuclides.

  iii)  State limitations of liquid drop model.

  iv)   What is the principle of PIXE technique?

  v)    What are the properties of scintillators?

  b)   Explain the conservation of protons and neutrons in the nuclear reactions.**[3]**

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

  i)    Explain the working of surface barrier semiconductor detector.

  ii)   Discuss nuclear shell model.

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

  i)    State the characteristics of thermal, fast and intermediate reaction.

  ii)   Explain briefly projective accelerator & target preparation in ion beam analysis technique.

*Q3)* a)   Describe different types of nuclear research reactions.                      **[6]**

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

  i)    Explain the role of T1 in NaI(T1) scintillator.

  ii)   Write a note on photonuclear reactions.

*Q4)* a) Discuss liquid drop model with its merits & demerits. **[6]**

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

      i) Draw and explain schematic diagram of Rutherford back scattering experiment.

      ii) Calculate the energies of the two peaks in the RBS spectrum correspond to $^{28}$Si and $^{65}$Cu, assuming an incident $^{4}$He$^{+}$ ions of 2 Mev energy and a scattering angle of 170º.

## SECTION - II

### (Polymer Chemistry)

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

      i) What is meant by thermosetting polymer.

      ii) Define condensation polymerization.

      iii) State the assumptions of krigbaum theory.

      iv) Define the term copoly merization.

      v) State the principle of viscosity technique.

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

      i) If the degree of polymerization of polystyrene is 710. Find out molecular weight of polystyrene.

*Q6)* a) Answer the following. **[6]**

      i) Describe the chemical bonding in polymers.

      ii) Explain characterization of polymers.

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

      i) Give an account of the steps involved in polymerization process.

      ii) Write a note on flory - krigbaum theory.

*Q7)* a)   Derive and explain copolymer equation. **[6]**

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

i)   Distinguish between thermosetting polymer and thermoplastic polymer.

ii)   Describe and group analysis for addition polymer.

*Q8)* a)   Explain vapour phase osmometry techniue for molecular weight determination of polymer solution. **[6]**

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

i)   Write a note on ultra centrifugation technique for determination of molecular weight of polymer.

ii)   250gm of vinyl chloride and 86gm of methyl acrylate copolymerize. Find the polymer composition. (Monomer reactivity ratios : 0.23 and 1.68 respectively At. wts C = 12, H = 1, C1 = 35.5, 0 = 16)

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**[5909]-33**
# 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) *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 Q2, Q3 and Q4 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

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| | | $= 6.626 \times 10^{-34}$ J s |
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| | | $= 1.602 \times 10^{-19}$ C |
| 5) | 1 eV | $= 23.06$ k cal mol$^{-1}$ |
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| | | $= 8065.5$ cm$^{-1}$ |
| 6) | Gas Constant | $R = 8.314 \times 10^{7}$ erg K$^{-1}$ mol$^{-1}$ |
| | | $= 8.314$ J K$^{-1}$ mol$^{-1}$ |
| | | $= 1.987$ cal K$^{-1}$ mol$^{-1}$ |
| 7) | Faraday Constant | $F = 96487$ C equivalent$^{-1}$ |
| 8) | Speed of light | $c = 2.997 \times 10^{10}$ cm s$^{-1}$ |
| | | $= 2.997 \times 10^{8}$ m s$^{-1}$ |
| 9) | 1 cal | $= 4.187 \times 10^{7}$ erg |
| | | $= 4.187$ J |
| 10) | 1 amu | $= 1.673 \times 10^{-27}$ kg |
| 11) | Bohr Magneton | $\beta_e = -9.274 \times 10^{-24}$ J T$^{-1}$ |
| 12) | Nuclear Magneton | $\beta_n = 5.051 \times 10^{-27}$ J T$^{-1}$ |
| 13) | Mass of an electron | $m_e = 9.11 \times 10^{-31}$ Kg |

*P.T.O.*

*Q1)* a)   Solve any four.                                                              **[8]**

   i)   Define absorptive edge and state its use.

   ii)   What is meant by EXAFS? Give two applications of X-ray absorption.

   iii)   Define the term binding energy and work function used in ESCA.

   iv)   Why does weight of empty crucible change when it is heated upto 1000ºC in TGA technique.

   v)   Explain the ways by which an excited ion relax in ESCA technique.

   b)   Discuss the applications of TGA technique.                              **[3]**


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

   i)   What are the advantages of X-ray radioactive source?

   ii)   Explain chemical shift observed in ESCA technique.

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

   i)   Describe with an example neutralization thermometric titration.

   ii)   Estimate the thickness of foil of the alloy having absorption coefficient 450.55cm$^2$/gm at 0.430 nm. The detector recorded 9586 counts per two minutes of transmitted X-rays when foil was not in path of X-rays and 856 counts per minute. When foil was placed in the path. The density of alloy is 8.01 gm/cm$^3$.


*Q3)* a)   Explain with a neat labelled diagram electron microprobe used in electron probe X-ray microanalysis technique.                                      **[6]**

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

   i)   Describe retarding potential analyzer used in ESCA.

   ii)   Explain the various factors which affect thermogravimetric analysis.

*Q4)* a) Discuss the applications of ESCA technique. **[6]**

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

   i) Explain chemical analysis by X-ray absorption.

   ii) Gypsum showed mass loss of about 15% of original sample mass due to complete dehydration at 170ºC. Determine the number of water molecules present in gypsum.

   [Given : At : wt. of Ca = 40, S = 32, O = 16, H = 1]

## SECTION - II

*Q5)* a) Solve any four. **[8]**

   i) State the principle of hydrodynamic voltammetry.

   ii) Define plasma and give the advantages of using plasma is atomic emission spectroscopy.

   iii) What are the fundamental requirement to perform coulometric titrations?

   iv) Differentiate between fluorescence and phosphorescence.

   v) State the principles of amperometric titrations.

b) Explain 'T' route mechanism for electro chemiluminescence. **[3]**

*Q6)* a) Answer the following. **[6]**

   i) Write a technique of amperometric titrations.

   ii) Discuss briefly the technique of pulse voltammetry.

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

   i) Draw a neat labelled diagram of a typical cyclic voltagram.

   ii) A current of 1.7A is passed through 300 ml of 0.16 M solution of $ZnSO_4$ for 250 s with current efficiency of 90%. Find out the molarity of $Zn^{2+}$ after the deposition of Zn.

*Q7)* a) Explain the application of coulometry to perform neutralisation titrations.**[6]**

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

   i) What is heavy - atom effect observed in photoluminescence?

   ii) Define the terms

      a) Voltagram

      b) Potentiostat


*Q8)* a) Compare ICP technique with the conventional atomic emission technique. **[6]**

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

   i) Explain the types of plasma.

   ii) Constant current coulometry was used to assay solution containing $Fe^{2+}$. To ensure 100% current efficiency the assay was performed in 0.1M $Ce^{3+}$ acidic solution at the end point of titration 30ml sample, a contralled of 6.45 mA had flowed for 185 second. Calculate the concentration of $Fe^{2+}$ in the sample.


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# M.Sc. - II (Physical Chemistry)

## CHP - 313(A)-CBOP - 3 : PHOTOCHEMISTRY AND TECHNIQUES IN POLYMER CHEMISTRY

### (2019 Pattern) (Semester - III) (Elective) (Option - A)

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

*P.T.O.*

## SECTION - I

*Q1)* a) Solve any 4 of the following. **[8]**

    i) State the law of Photochemical equivalance.

    ii) Explain the terms stimulated emmission.

    iii) Explain singlet and triplet state.

    iv) Give two important characteristics of Fluorescence.

    v) Define :

        1) The natural radioactive life time of the atom and

        2) Oscillator strength

  b) What is meant by quenching and state it's importance. **[3]**

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

    i) Explain the working of Ruby and Nd: YAG laser.

    ii) Discuss the working of Photomultimeter tube.

  b) Answer the following.

    i) Discuss the Einsteins treatment on absorption Phenomenon. **[3]**

    ii) Explain the term delayed Fluorescence. **[3]**

*Q3)* a) Derive the stem-volmer equation for the kinetics of Collisional quenening. **[6]**

  b) Answer the following.

    i) Explain the term stimulated emission. **[3]**

    ii) What are the types of electronic transition in organic molecule. **[3]**

*Q4)* a) Discuss the phenomena of fluorescence and phosphorescence with the help of Jablonski diagram. **[6]**

b) Answer the following.

    i) What is depth profiling technique? **[3]**

    ii) State Grotthus-Draper's law. **[3]**


## SECTION - II

*Q5)* a) Solve any 4 of the following. **[8]**

    i) Define Conducting Polymer with example.

    ii) Distinguish between molding and casting.

    iii) What is rubber elasticity?

    iv) Explain the term carbon blocks.

    v) Explain the Wet Spinning process.

b) Describe the voigt model of viscoelastic behaviour. **[3]**


*Q6)* a) Explain in details: **[6]**

    i) Compare textile properties and fabric properties of Polymers.

    ii) How IR spectra usefull in polymer analysis.

b) i) Give an account of extrusion molding. **[3]**

    ii) Define Calendering, dry spinning, Wet spinning. **[3]**

*Q7)* a) Explain DTA in polymer analysis. [6]

    b) i) Explain glass transition temperature. [3]

        ii) Explain the term polymer utilization. [3]

*Q8)* a) Write a note on determination of molecular weight of a polymer by vapour phase osmometry technique. [6]

    b) i) Discuss the use of TGA technique in analysis polymer. [3]

        ii) Describe injection moulding with neat diagram. [3]

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# M.Sc. - II (Physical Chemistry)
## CHP - 313(B) - CBOP - 3 : SPECIAL TOPICS IN PHYSICAL CHEMISTRY
### (2019 Pattern) (Semester - III)

*Time : 3 Hours]*            *[Max. Marks : 70*
*Instructions to the candidates:*
1) *Answer to the Two sections should be written in Separate answer 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 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 | $N = 6.023 \times 10^{23}$ mol$^{-1}$ |
| 2) | Boltzmann Constant | $k = 1.38 \times 10^{-16}$ erg K$^{-1}$ molecule$^{-1}$ |
| | | $= 1.38 \times 10^{-23}$ J K$^{-1}$ molecule$^{-1}$ |
| 3) | Planck Constant | $h = 6.626 \times 10^{-16}$ erg s |
| | | $= 6.626 \times 10^{-34}$ J s |
| 4) | Electronic Charge | $e = 4.803 \times 10^{-10}$ esu |
| | | $= 1.602 \times 10^{-19}$ C |
| 5) | 1 eV | $= 23.06$ k cal mol$^{-1}$ |
| | | $= 1.602 \times 10^{-12}$ erg |
| | | $= 1.602 \times 10^{-19}$ J |
| | | $= 8065.5$ cm$^{-1}$ |
| 6) | Gas Constant | $R = 8.314 \times 10^{7}$ erg K$^{-1}$ mol$^{-1}$ |
| | | $= 8.314$ J K$^{-1}$ mol$^{-1}$ |
| | | $= 1.987$ cal K$^{-1}$ mol$^{-1}$ |
| 7) | Faraday Constant | $F = 96487$ C equivalent$^{-1}$ |
| 8) | Speed of light | $c = 2.997 \times 10^{10}$ cm s$^{-1}$ |
| | | $= 2.997 \times 10^{8}$ m s$^{-1}$ |
| 9) | 1 cal | $= 4.187 \times 10^{7}$ erg |
| | | $= 4.187$ J |
| 10) | 1 amu | $= 1.673 \times 10^{-27}$ kg |
| 11) | Bohr Magneton | $\beta_e = -9.274 \times 10^{-24}$ J T$^{-1}$ |
| 12) | Nuclear Magneton | $\beta_n = 5.051 \times 10^{-27}$ J T$^{-1}$ |
| 13) | Mass of an electron | $m_e = 9.11 \times 10^{-31}$ Kg |

# SECTION - I

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

      i) Define the terms : absolute error and relative error.

      ii) Explain the difference between mean and median.

      iii) Define pH and pOH. How they are inter-related?

      iv) Explain the principle of spectrophotometry.

      v) Explain, why nephelometry more sensitive than turbidimetry?

  b) Four different samples of silver alloy were analysed for silver and were found to contain 16.37, 16.29, 16.39 and 16.35% of silver. Calculate the mean deviation, standard deviation and relative mean deviation. **[3]**

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

      i) Write the mass balance, proton balance and charge balance equations of 0.15M $H_2 CrO_4$.

      ii) Explain the term 'significant figures' with suitable example for numerical products and quotients.

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

      i) Explain the method of least square analysis.

      ii) Calculate the pH, the hydrogen and hydroxyl ion concentrations, of a $2.8 \times 10^{-4}$ M solution of magnesium hydroxide in water at 25°C. [Given : $K_W = 1.0 \times 10^{-14}$]

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

   i) Explain the choice between nephelometry and turbidimetry for analysis.

   ii) What is logarithmic concentration diagram? How does logarithmic concentration diagram change with change in concentrations.

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

   i) Explain the principle of nephelometry with suitable block diagram.

   ii) What is regression analysis? Explain the method of linear regression analysis.

*Q4)* a) What is charge balance equation? Explain, how charge balance equation be useful for equilibrium calculations with suitable example. **[6]**

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

   i) Define probability and permutation. What is the relation between probability and permutation?

   ii) What is the role of the conditioning reagent? Explain the method of turbidimetric determination of sulphate in water.


## SECTION - II

*Q5)* a) Attempt any four of the following. **[8]**

   i) What is nano aerogel? Give its two applications.

   ii) Explain any two size dependent properties of nanoparticles.

   iii) State and explain the factors affecting on physisorption.

   iv) Explain, why chemisorption is not useful for the particle storage of hydrogen?

   v) What are smart materials? Give an example.

   b) Give an account of semiconductor nanocrystals. **[3]**

*Q6)* a) Answer the following: [6]

      i) Define nanoparticles. How are they used in cosmetics and sunscreen.

      ii) Explain the hydrogen storage capability of buckyball.

   b) Answer the following: [6]

      i) What are shape memory alloys? Give their applications.

      ii) Discuss the properties of nanoparticles.

*Q7)* a) Answer the following: [6]

      i) Write a note on piezoelectric materials.

      ii) Describe in brief the role of physisorption in hydrogen storage.

   b) Answer the following: [6]

      i) Explain the functioning of smart windows and smart glasses.

      ii) Write a short note on Ceramics.

*Q8)* a) What are carbon nanotubes? How they are used in hydrogen storage?[6]

   b) Answer the following: [6]
      i) Define smart polymers and give their uses.

      ii) Explain the sol-gel method for the preparation of nanoparticles.

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**M.Sc.-II**

**INORGANIC CHEMISTRY**

**CHI-330, CCTP-7 : Organometallics and Homogeneous Catalysis**

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

*Time : 3 Hours]*                                                                      *[Max. Marks : 70*

*Instructions to the candidates:*

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

## SECTION-I

### (Organometallic Chemistry)

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

     i)    Draw the principal co-ordination modes of CO ligand.

     ii)   Describe cone angle and bite angle.

     iii)  Define heptacity. What is heptacity for arene and cyclopentadiene?

     iv)   Define synergic bonding with example.

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

Give systematic classification of $\sigma$-bonded transition metal hydrocarbyls.

*Q2)* a)    Answer <u>any one</u> of the following.                                      **[6]**

     i)    Describe the use of organometallic compounds as an eletrophile and nucleophiles.

     ii)   Give difference between Fischer carbene and Schrock carbene.

   b)    Answer <u>any two</u> of the following.                                     **[6]**

     i)    Write a note on metallocene with example.

     ii)   Explain in detail Fluxional behaviour of organometallic compounds.

     iii)  Explain properites of cyclobutadiene complexes.

*Q3)* a)    Answer <u>any one</u> of the following.                                      **[6]**

     i)    Give an account of synthesis, bonding, properties and applications of phosphine compounds.

     ii)   Explain synthesis of metal carbene and carbyne complexes with examples.

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b)  Answer <u>any two</u> of the following.                           [6]
   i)   Explain the term π-acid ligand.
   ii)  Arrange the M-co according to decreasing order of CO.stretching frequency. Justify M-CO, $M_2CO$ $M_3$-CO.
   iii) Which complexes obey $18\bar{e}$ rule.
       1)  $CH_3Mn$ (CO)5
       2)  CO $(\eta^5–C_5H_5)_2$
       3)  $Fe_2$ (CO)9 (At. No. Mn=25, Fe=26, Co=27)

## SECTION-II
### (Homegeneous Catalysis)

**Q4)** a)  Answer the following.                                      [8]
   i)   What are the advantages of homogeneous catalyst over heterogeneous catalyst?
   ii)  What are the perticular conditions for assymetric catalysis?
   iii) List out various biphasic systems.
   iv)  Discuss regio selectivity with suitable example.

   b)  Attempt the following.                                          [3]
   Explain in detail Tollman catalytic cycle.

**Q5)** a)  Answer <u>any one</u> of the following.                    [6]
   i)   What is olefin epoxidation? Which transition metal complexes plays important role in it?
   ii)  Explain in detail cativa process.

   b)  Answer <u>any two</u> of the following.                         [6]
   i)   Explain reductive elimination reaction with example.
   ii)  Write a note on metathesis reaction.
   iii) Draw the structure of Grubb's first and second generation catalyst for olefin metathesis.

**Q6)** a)  Answer <u>any one</u> of the following.                    [6]
   i)   What do you mean by C–C bond formation? Discuss the mechanism of Heck reaction.
   ii)  Give an account of metallocene based catalyst for polymerization of propylene.

   b)  Answer any two of the following.                                [6]
   i)   Write a note on assymetric catalysis.
   ii)  Explain with examples insertion and migration reactions.
   iii) Give difference between suzuki and Heck coupling reaction.

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**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CCTP-8 - CHI-331 :Inorganic Reaction Mechanism**

**(CBCS 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 indicates full marks.*
4) *Use logarithmic table and calculator are allowed.*
5) *Answer to the two sections should be written in seperate answer sheets.*

**SECTION-I**

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

i)    Thermodynamic stability of a complex is determined by which parameters?

ii)    What is trans effect? Explain with suitable example.

iii)    What do you mean by atom or group transfer reaction? Give suitable example.

iv)    Explain the mechanism of cis-trans isomerisation in following metal complexes.

cis-[Co (en)$_2$ Cl$_2$]$^+$ $\rightarrow$ trans- [Co (en)$_2$ Cl$_2$]$^+$.

b)    Give the classification of Inorganic reactions of coordination compounds.

**[3]**

*Q2)* a)    Answer <u>any one</u> of the following:                                            **[6]**

i)    Differentiate between intimate and stoichiometric mechanism.

ii)    Nucleophilic substitution in square planer complexes takes place with retension of configuration. Explain.

b)    Answer <u>any two</u> of the following:                                            **[6]**

i)    Discuss the mechanism of cis-trans isomerisation in square planer complexes.

ii)    Discuss the role of spectator ligand in substitution of square planer complexes.

iii)    Discuss the role of solvent in octahedral substitution reaction.

*P.T.O.*

*Q3)* a) Answer <u>any one</u> of the following: **[6]**
   i)   What do you mean by acid hydrolysis. Discuss its mechanism and the controlling factors.
   ii)  Discuss the mechanism of inner sphere electron transfer reaction with the help of cobalt complexes.

   b) Answer <u>any two</u> of the following: **[6]**
   i)   Polarisation theory of trans effect.
   ii)  Beller-Twist mechanism for racemisation.
   iii) Two electron transfer reaction.

## SECTION-II

*Q4)* a) Answer the following: **[8]**
   i)   What do you mean by quantum yield in photochemical reaction.
   ii)  What is photochemical reaction? Where does it occurs.
   iii) What is oxidative addition? Which metal center favour oxidative addition?
   iv)  Describe the mechanism of alkylation of coordinating sulpher.

   b) Describe the phenomenon of phospheresicence. **[3]**

*Q5)* a) Answer <u>any one</u> of the following: **[6]**
   i)   Give an account on non chelate ring forming reactions of coordinated ligands.
   ii)  Give an account of methyl migration reaction.

   b) Answer <u>any two</u> of the following: **[6]**
   i)   Comment on substitution by reversible oxidative addition.
   ii)  Draw and discuss the experimental set up for study of photochemical reaction.
   iii) Comment on chelate ring modifying reactions.

*Q6)* a) Answer <u>any one</u> of the following: **[6]**
   i)   Discuss the light induced substitution reactions and redox reactions of Co (III) ammine complexes.
   ii)  Give an overview about solvolysis of coordinated phosphorous atoms.

   b) Write note on <u>any two</u> of the following: **[6]**
   i)   Importance of photochemistry.
   ii)  Reactions of organometallic compounds.
   iii) Reactions of coordinated ligand.

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# M.Sc.-II
# INORGANIC CHEMISTRY
## CCTP-9-CHI-332 : Bioinorganic 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 to the right indicates full marks.*
3) *Draw neat diagram wherever necessary.*
4) *Answer to the two sections should be written in separate answer books.*

### SECTION-I
### (Bioinorganic Chemistry)

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

   i) What is the effect of deficiency invit $B_{12}$?

   ii) What are the common ligands for Zn in biological system?

   iii) Write a note on Antagonism.

   iv) What is a Zinc Finger Nuclease (ZFN)?

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

   Why tyrosinase enzyme is called mixed-function catalase? Explain with examples or reactions.

*Q2)* a) Attempt <u>any one</u> of the following:                     **[6]**

   i) Explain with mechanism the reaction catalyzed by amine oxidase enzyme.

   ii) Give an account of metal clusters in nitrogenases.

   b) Attempt <u>any two</u> of the following:                        **[6]**

   i) Define P-cluster. Give its role.

   ii) Multisite redox enzymes are known in biology. Comment on the hydrogenases in Nickel.

   iii) Draw the structure of Cu-PSTM and Cu-ASTM. Give its role.

*Q3)* a) Attempt <u>any one</u> of the following: [6]

    i) Discuss the mechanistic aspects of the reactions of hydrolysis of $CO_2$ catalyzed by carboanhydrase.

    ii) Explain the structure and function of Fe-Mo

  b) Write note on any two [6]

    i) Role of Apoenzyme.

    ii) Non-heme Iron

    iii) Ribonucleotide reductase.

## SECTION-II

*Q4)* a) Answer the following: [8]

    i) Explain the use of Tc-99 in radio pharmaceuticals.

    ii) Draw the structure of

        1) Myochrisin

        2) Aurinofin

    iii) What is the effect of binding of Cis-platin to DNA with respect to structure of DNA?

    iv) Explain the general route to develop the inorganic complex.

  b) Attempt the following: [3]

Explain with the help of suitable diagram the nuclease activity of $[Cu(phen)_x]^+$ complex.

*Q5)* a) Attempt <u>any one</u> of the following: [6]

    i) Define radio phar maceuticals. Explain Tc- based Renal imaging & Bone imaging agents.

    ii) Give an account of the fundamental interactions of metal complexes with nucleic acids.

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

    i) Explain the role of lithium isotope in precise localization of lithium on cells.

    ii) What do you understand by " metallo foot printing agents". Explain with the help of suitable examples.

    iii) Draw the structure of carboplation, spiroplatin and iproplatin explain their role as an anticancer agent.

*Q6)* a) Attempt <u>any one</u> of the following: [6]

    i) What is the oxidation state of vanadium in amavadin? Explain the structural features of amavadin. Explain the structural features and insulin modification.

    ii) What do you understand by chemotherapy? Name the metals used in chemotherapy and discuss their role in chemotherapy.

b) Write note on <u>any two</u> [6]

    i) Heart and Brain imaging agent.

    ii) Non Tc based renal imaging agent.

    iii) Methylcobalamine as cofactor.

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SEAT No. :

**[Total No. of Pages : 6**

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# M.Sc. - II (Inorganic Chemistry)

## CBOP - 3(T) - CHI - 333 : (A) MODERN INSTRUMENTAL METHODS IN INORGANIC CHEMISTRY

### (2019 Pattern) (Semester - III) (4 Credits)

*Time : 3 Hours]*        *[Max. Marks : 70*

*Instructions to the candidates:*
1) *Answers to the two sections should be written in two answer books.*
2) *All questions are compulsory.*
3) *Figures to the right indicate full marks.*
4) *Use of logarithm table and calculator is allowed.*

## SECTION-I

### (Thermal and Spectroscopic Techniques)

*Q1)* A) Attempt any Four of the following:      **[8]**

     a) What is principle of D.T.A.?

     b) What is full form of TMS? Why it is used in NMR Spectroscopy?

     c) Explain principle of T.P.D.

     d) Explain working of FTIR spectroscopy.

     e) Which steps involved in Auger electron spectroscopy?

   B) Explain ESR spectrum of Deuterium and Nopthalene.     **[3]**

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

     a) What is TGA? Explain construction, working, factors affecting and applications of TGA.

     b) Derive expression $n\lambda = 2d \sin \theta$ and Define Goniometer and Collimeter.

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

     a) Explain types of DSC.

     b) Explain working of IR spectroscopy.

     c) Draw block diagram of T.P.D.

*Q3)* A) Attempt any <u>One</u> of the following: [6]

    a) What is flurescence? Explain construction, working and applications of fluorescence spectroscopy.

    b) 1) What is Scintillation counter?

       2) Draw the Joblonski diagram.

  B) Attempt any <u>Two</u> of the following: [6]

    a) Explain applications of I.R. Spectroscopy.

    b) Explain construction and working of NMR.

    c) Explain working of DTA.


# SECTION-II

## (Imaging and Analytical Techniques)

*Q4)* A) Attempt any Four of the following: [8]

    a) What is principle of SEM?

    b) Explain working of cyclic Voltametry.

    c) What is magnetic moment?

    d) What is Hypochromic Shift? Explain with example.

    e) Explain working of XPS.

  B) Draw flow sheet diagram of TEM. [3]


*Q5)* A) Attempt any <u>One</u> of the following: [6]

    a) What is ultra-violet spectroscopy? Explain construction, working and applications of ultra-visible spectroscopy.

    b) What are magnetic materials? Explain paramagnetic and dimagnetic materials. Explain in Normal and Inverse Spinels.

B) Attempt any <u>Two</u> of the following:                     **[6]**

a) Explain $^{13}C$ and $^1H$ NMR.

b) Give applications of Flame Photometry.

c) What is Homo and Lumo?

*Q6)* A) Attempt any <u>One</u> of the following:                     **[6]**

a) What is magnetic susceptibility? Explain constructon, working and applications of Magnetic Susceptibility.

b) i) Define :

1) Neubulisation

2) Aspiration

3) Retentivity

ii) Distinguish between hard and soft magnets.

B) Attempt any <u>Two</u> of the following:                     **[6]**

a) What is Blue Shift? Explain with suitable example.

b) What is Currie's Law?

c) Explain Photodegradation process.

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## M.Sc. - II (Inorganic Chemistry)

## CBOP - 3 - CHI - 333 : (B) INORGANIC MAGNETO 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 in separate answer books.*
2) *All questions are compulsory.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the4 right indicate full marks.*
5) *Use of logarithmic table and calculator is allowed.*

### SECTION-I

### (Magneto Chemistry)

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

     a) Define paramagnetic and diamagnetic substances with suitable example.

     b) What is magnetically concentrated system? Give example.

     c) Define Neel Temperature. Give it's example.

     d) What is spin canting? Explain with suitable example.

   B) Explain the experimental magnetic moment of the following: **[3]**

     a) $Mn^{2+}$ $\mu_{expt} =\sim 4.9\,BM$    Atomic Number; $Mn = 25$

     b) $Fe^{2+}$ $\mu_{expt} =\sim 5.5\,BM$    Atomic Number; $Fe = 26$

*Q2)* A) Attempt any <u>One</u> of the following: **[6]**

     a) Explain potential energy for high spin cross over complex.

     b) Describe temperature independent paramagnetism.

B) Attempt any <u>Two</u> of the following: **[6]**

   a) Discuss the application of magnetic materials.

   b) Discuss the structure and magnetic interaction in spinels.

   c) Write a note on anti-ferromagnetic materials.

*Q3)* A) Answer any <u>one</u> of the following: **[6]**

   a) Give in brief an account of Gouy method.

   b) What are mixed valence compounds? How are they classified, comment on their magnetic behaviour.

   B) Answer any <u>two</u> of the following: **[6]**

   a) Differentiate between Soft & Hard ferrites.

   b) Give the applications of Van-Vleck equation.

   c) Discuss in brief the magnetic behaviour of lanthanides and actinides.

## SECTION-II

### (Inorganic Polymer)

*Q4)* A) Attempt the following: **[8]**

   a) Define homopolar inorganic polymer with suitable example.

   b) Draw the structure of borazine. Give any one reaction of borazine.

   c) What is polyphosphazenes? Give any one application of it.

   d) Give the classification of polymer based on origin.

   B) Discuss in brief polymeric compounds of sulphur. **[3]**

*Q5)* A) Answer any <u>one</u> of the following: [6]

    a) Explain preparation, properties and applications of silicates.

    b) Explain the role of inorganic polymer as a catalyst.

  B) Attempt any <u>two</u> of the following: [6]

    a) Discuss the method for preparation of silicon carbide.

    b) Discuss the role of metal containing polymer for medical purposes.

    c) Differentiate between natural and synthetic polymers.

*Q6)* A) Answer any <u>one</u> of the following: [6]

    a) Discuss the synthesis and reactions of coordination polymers.

    b) Give an account of steps involved in polymerization process.

  B) Answer any <u>two</u> of the following: [6]

    a) Write a note on luminescent inorganic polymers.

    b) Draw structure of hexachlorophosphazene. Give its chemical reaction with benzene in presence of $AlCl_3$.

    c) Differentiate between organic and inorganic polymers.

✈ ✈ ✈

**[5909]-39**

**M.Sc. - II**

**ORGANIC CHEMISTRY**

**CCTP - 7, CHO - 350 : Organic Reaction Mechanism and Biogenesis**

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

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

   1) *Question 1 and 5 are compulsory and carry 11 marks each.*

   2) *Attempt any two questions from Q2 to Q4 and two questions from Q6 to Q8.*

   3) *Answer to the two sections should be written in separate answer books.*

   4) *Figures to the right indicates full marks.*

### SECTION-I

*Q1)* Attempt the following:

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

   i)
   

   ii)
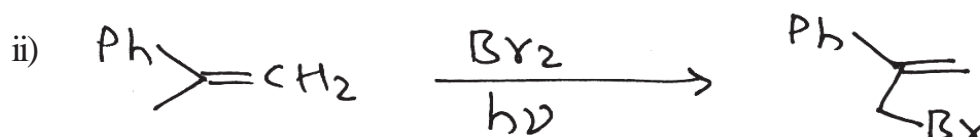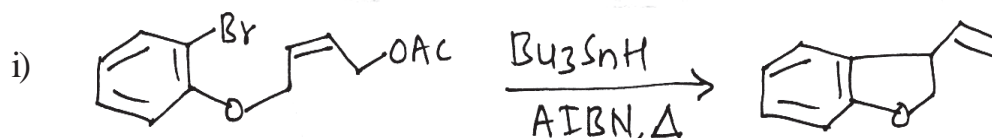   

   b) Suggest the reagents for the following conversions and explain the mechanism. **[6]**

   i)
   

   ii) $CH_2=CH-CH_2-Br \xrightarrow{\text{?}} H_2C-CH_2-CH_2$ with $Br$ and $Br$ substituents
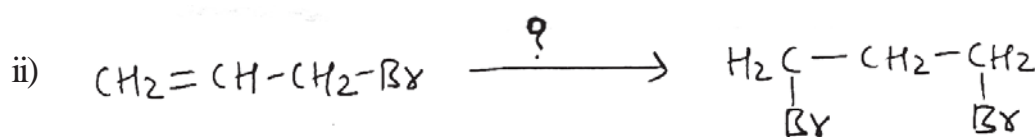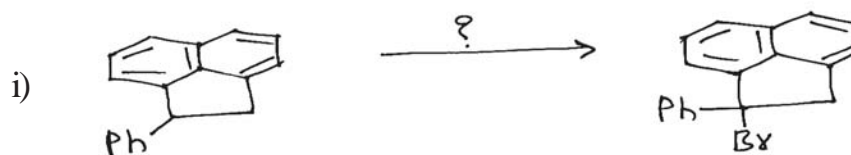
*Q2)* Write short notes on <u>any three</u> of the following: **[12]**

    a)    McMurry coupling.

    b)    Trapping of intermediates.

    c)    Autoxidation.

    d)    Taft equation.

*Q3)* Attempt <u>any four</u> of the following: **[12]**

    a)    Predict the sign of Hammett σ (Sigma) constant for following substituents:

        i)     M-NO$_2$

        ii)    M-COOH

        iv)   P-OME

    b)    Write stereochemical evidences to determine reaction mechanism.

    c)    What are free radicals? Comment on their stability.

    d)    Predict the ρ(rho) value for following reaction with reason.
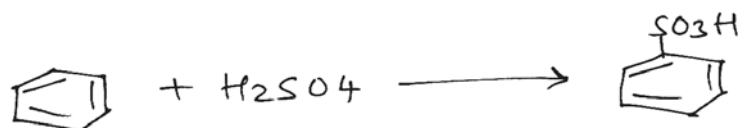


    e)    Explain the Barton reaction with suitable example.

*Q4)* Attempt <u>any four</u> of the following: **[12]**

    a)    The Pka of P - methoxy benzoic acid is 4.49 and benzoic acid is 4.19. Calculate σ for P-Meo.

    b)    How cross-over experiment helps to decide the reaction mechanism? Explain with suitable example.

    c)    Predict the product with mechanism.
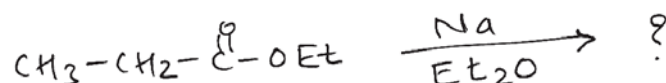


    d)    Derive the Hammett equation.

    e)    Predict the product with mechanism.
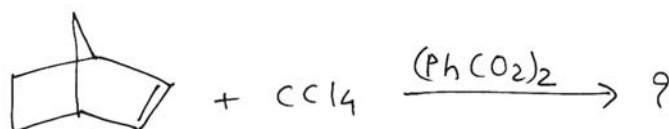
## SECTION-II

**Q5)** Attempt the following:

a) Suggest the biosynthesis scheme for following. **[5]**

i) 

ii) L-lysine → 
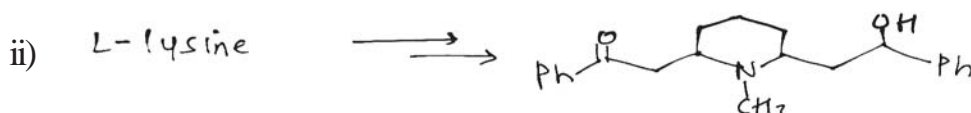
b) Complete the following biogenetic conversion. **[6]**

i) 

ii) 
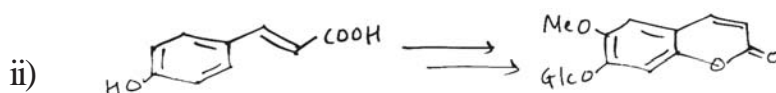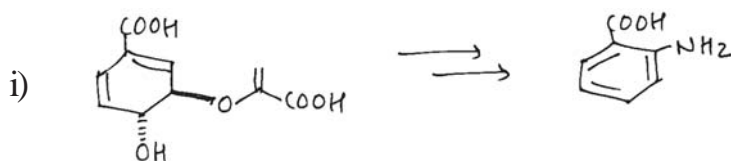
**Q6)** Write short note on <u>any three</u> of the following: **[12]**

a) Role of pyridoxal phosphate in oxidative deamination in biogenesis of alkaloid.

b) Polyketide biogenesis.

c) Steps involved in the conversion of acetyl CoA to Mevalonic acid.

d) Importance of Mannich reaction in the biosynthesis of alkaloids.

**Q7)** Complete the following biogenesis (any four): **[12]**

a) Cinnamic acid → 

b) Ornithine →

c) DMAPP $\longrightarrow$ 

d)  $\longrightarrow$ 

e) $1-{}^{13}C$- GPP $\longrightarrow$ 
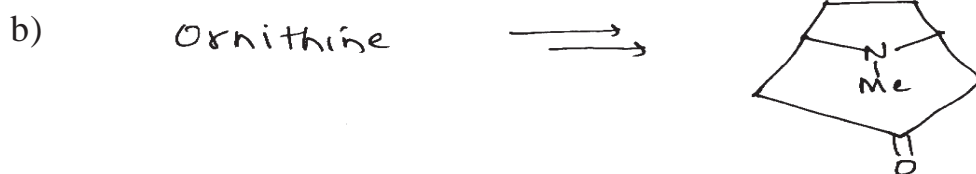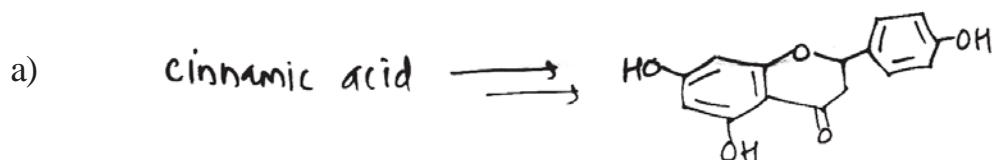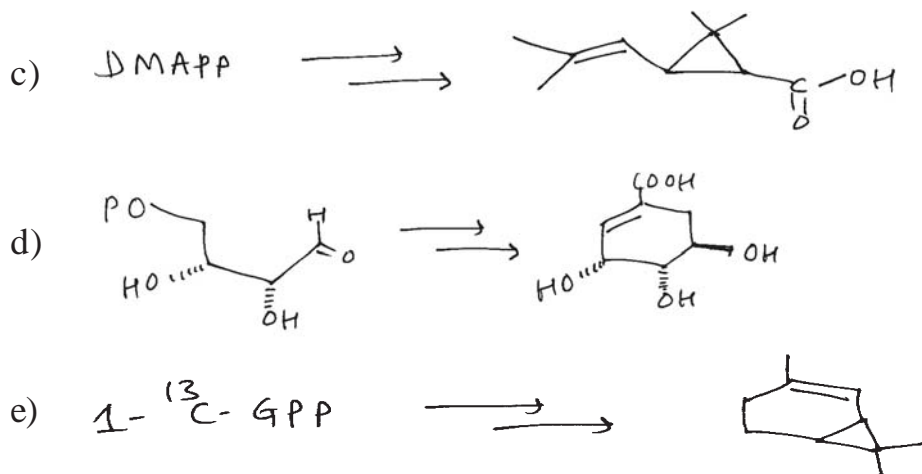
*Q8)* Attempt <u>any four</u> of the following: [12]

   a) Write short note on cyclo addition reaction in piperine.

   b) Indicate the position of label in each step and in the final product.

   Ornithine $[2-{}^{14}C]$ $\longrightarrow$ 
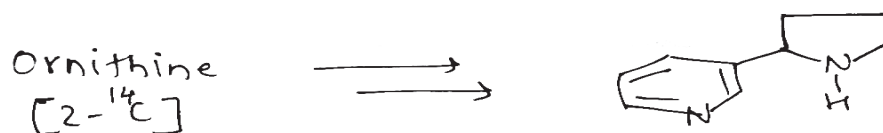
   c) Complete the following biosynthetic step.

   FPP $\longrightarrow$ 
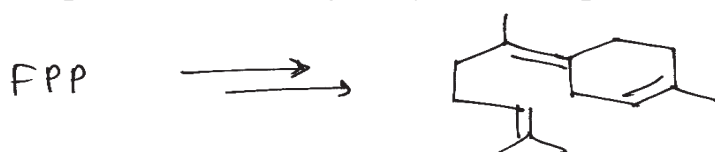
   d) Outline the steps involved in the given biogenesis.

   L- Lysine $\longrightarrow$ 
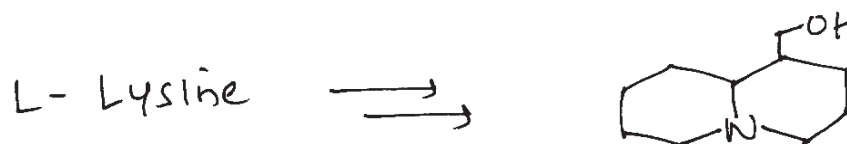
   e) Complete the given biogenesis.

   Tyrosine $\longrightarrow$ 

$\dashv$   $\dashv$   $\dashv$
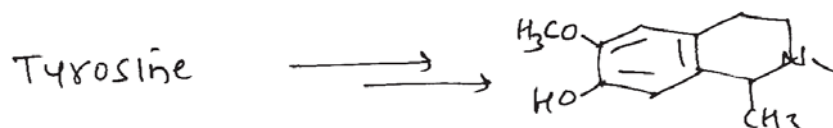
**SEAT No. :**

**[5909]-40**

# M.Sc. (Part - II)
## ORGANIC CHEMISTRY
### CCTP-8 : 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.1 and Q.5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.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) The NMR spectrum of unknown percentage mixture of p-dichlorobenzene and 1, 3, 5 - tri - chlorobenzene recorded in $CDCl_3$ and it exhibit two singlet of intensity 1:3 respectively. What will be the percentage of mixture. **[3]**

b) Deduce the structure from the following spectral data. **[8]**

    i)    M.F. :    $C_{12}H_{17}NO$

          IR :    1680 $cm^{-1}$

          PMR :   7.80 $\delta$ (2H, dd, 8Hz, 2Hz)

                   7.43 $\delta$ (2H, t, 8Hz)

                   7.48 $\delta$ (1H, tt, 2Hz, 8Hz)

                   3.88 $\delta$ (1H, Septet)

                   3.39 $\delta$ (2H, q)

                   1.26 $\delta$ (3H, t)

                   1.31 $\delta$ (6H, d)

          CMR :   170 (s), 136 (s), 130 (str., d),

                   128 (str., d), 126 (d, str.),

                   51.78 (d), 39 (t),

                   20 (quartet, str.)

                   14 (quartet, str.)

*P.T.O.*

ii) M.F. : $C_6H_6$

IR : 2250 cm$^{-1}$

PMR : 1.91 δ (s, 30 mm)

CMR : 2.7 δ (q)

63.9 (s)

70.7 (s)

**Q2)** Write a short note (Any three) : **[12]**

a) Use of Karplus equation in determination of vicinal coupling constant.

b) Use of HETCOR in structure determination.

c) AB and AX spectrum in PMR

d) FT-NMR benefits and Applications.

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

a) Ethyl acetoacetate shows nine signals in its CMR. Explain.

b) Axial - equitorial coupling is smaller than axial - axial coupling in cyclohexane system. Explain.

c) The size of cyclic olefine could be estimated from the $^3J$ values.

d) Deduce the structure from following spectral data.

M.F. : $C_6H_{12}O_3$

UV : Transparent

IR : 1200 cm$^{-1}$, 1180 cm$^{-1}$

Mass : 132 (M$^+$), 131, 117, 89, 87

45 (base peak), 43, 29

$^1$H-NMR: 1.3 (9H, d, J = 6Hz), 5.0 (3H, quartet J = 6Hz)

$^{13}$C-NMR : 20δ, 98δ

e) Deduce the structure from the following spectral data

M.F : $C_6H_{13}BrO_2$

UV : transparent above 210 nm

IR : 1120, 1060 cm$^{-1}$

$^1$H-NMR: 1.3 (t, J = 7 Hz, 35 mm)

3.3 (d, J = 6 Hz, 11.8 mm)

3.55 (q, J = 7 Hz, 24.11 mm)

4.7 (t, J = 6 Hz, 6 mm)

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

a) How will you differentiate the following pair of isomers by advanced $^1$H-NMR spectroscopy?



and
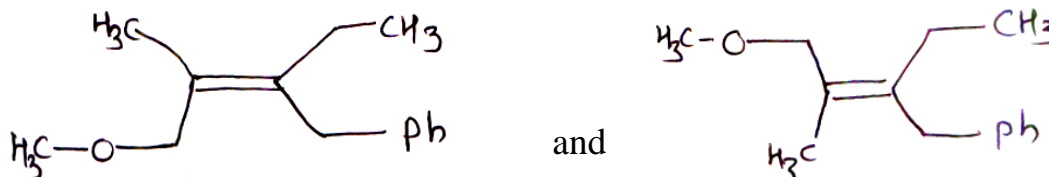
b) $CDCl_3$ shows a triplet of 1:1:1 intensity in CMR. Explain.

c) Deduce the structure from the following spectral data.

M.F = $C_5H_4O_2$

IR = 2800, 2700, 1680 cm$^{-1}$

PMR = 6.63 (dd, J = 5Hz & 2Hz, 4mm)

7.28 (d, J = 5Hz, 4mm)

7.72 (d, J = 2Hz, 4mm) 9.67 (S, 4mm)

d) Deduce the structure from following spectral data

      M.F :      $C_9H_{15}NO_5$

      IR :       $1700$ cm$^{-1}$, $1520$ cm$^{-1}$, $1180$, $1200$ cm$^{-1}$

      PMR :   $1.31$ (t, 7 Hz, 6 H)

                $4.28$ (q, 7 Hz, 4 H)

                $2.08$ (S, 3H)

                $5.18$ (d, J = 6 Hz, 1H)

                $6.61$ (bs, 1H)

## SECTION - II

**Q5)** A compound shows M+ (126) & M+2(128) with intensity 1:1 and IR : 2900, 710 cm$^{-1}$. The $^1$H-NMR, CMR, COSY and HETCOR spectra is given below. Deduce the structure of compound, assign the signals and also justify. **[11]**

**¹H-¹H COSY Spectrum**
(400 MHz, CDCl₃ solution)

**C-H Correlation Spectrum**
(¹H 400 MHz; ¹³C 100 MHz; CDCl₃ solution)
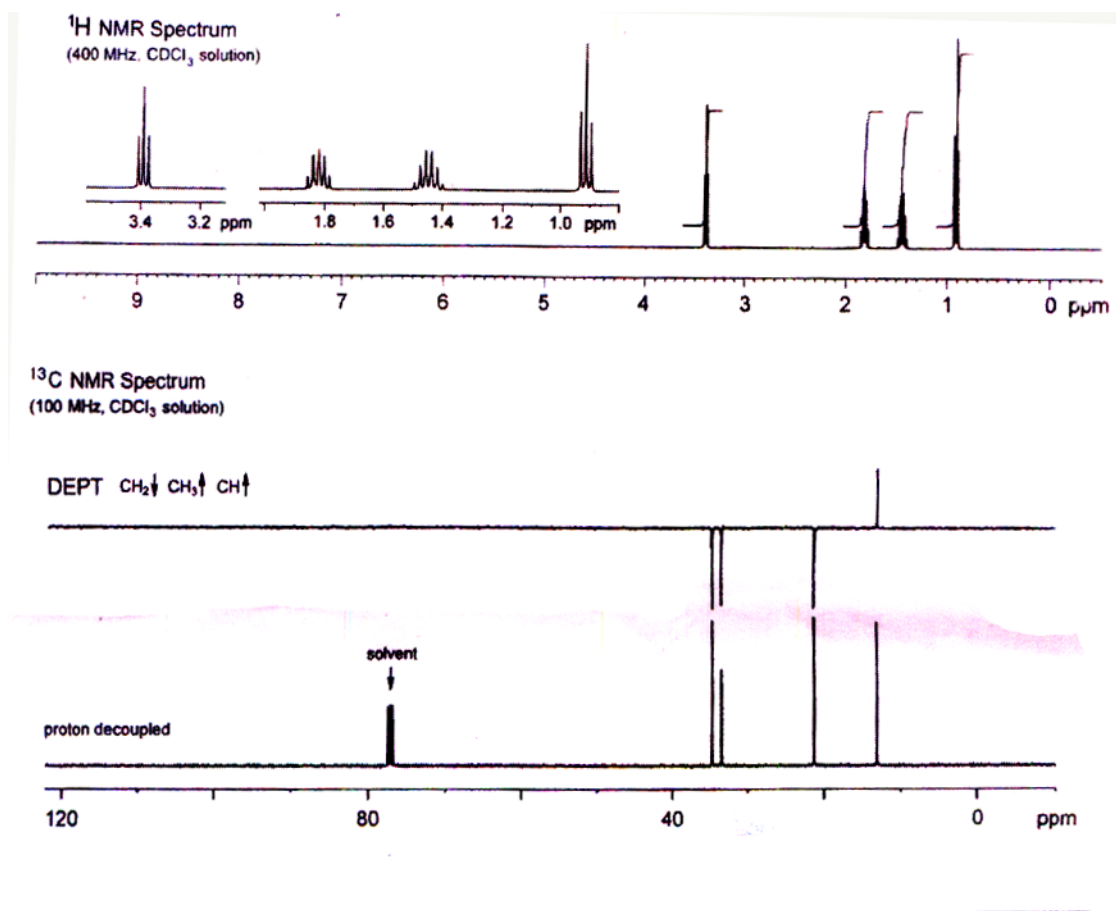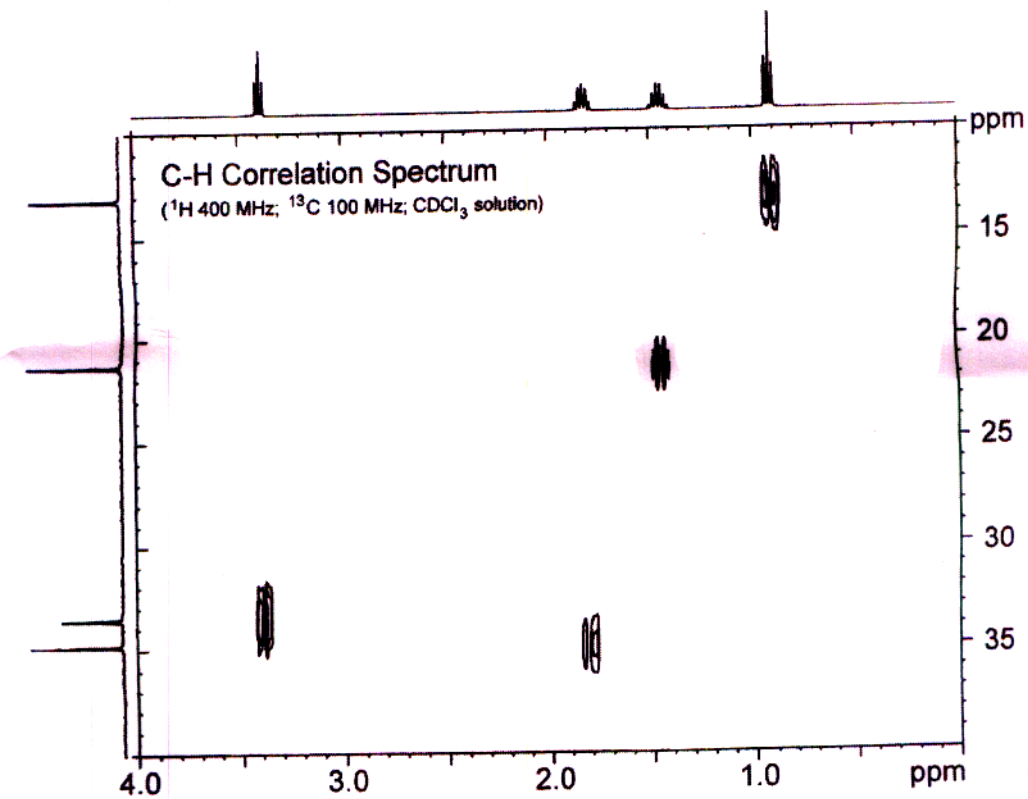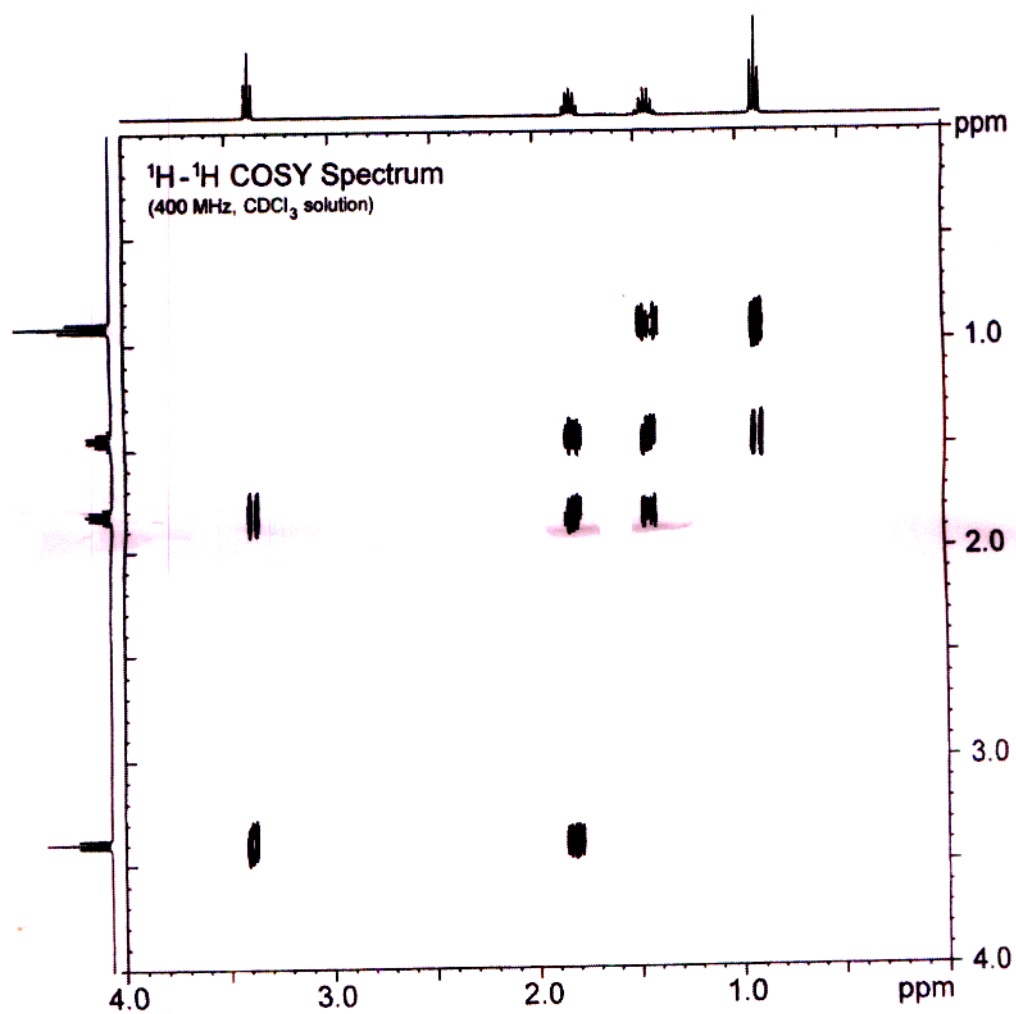
*Q6)* a) The PMR of compound A shows following signals. Assign signals to different protons using decoupling experiment. Justify your answer. **[6]**

[Note - underlined protons are not given]
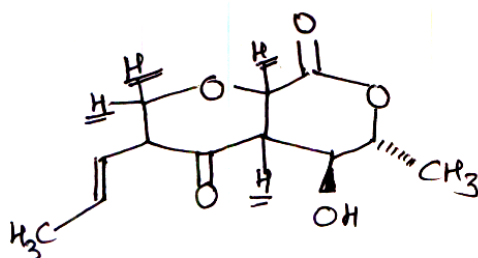
1.65 (3H, d, J = 7Hz)

1.97 (3H, dd, J = 1.5 and 7Hz)

3.86 (1H, bs, exch)

3.92 (1H, d, J = 5Hz)

4.32 (1H, dq, J = 5 and 7Hz)

5.87 (1H, d, J = 2Hz)

6.06 (1H, ddq, J = 1, 1.5, 2, 16Hz)

6.99 (1H, dq, J = 6 and 16 Hz)

Spin decoupling experiment -

| | Irradiation at | Change at |
|---|---|---|
| i) | 6.06 | 5.87 (s) |
| | | 1.97 (d, J = 6 Hz) |
| | | 6.99 (q, J = 6 Hz) |
| ii) | 3.92 | 4.32 (q, J = 7 Hz) |

b) Assign the given chemical shift to various carbon of following structure **[6]**
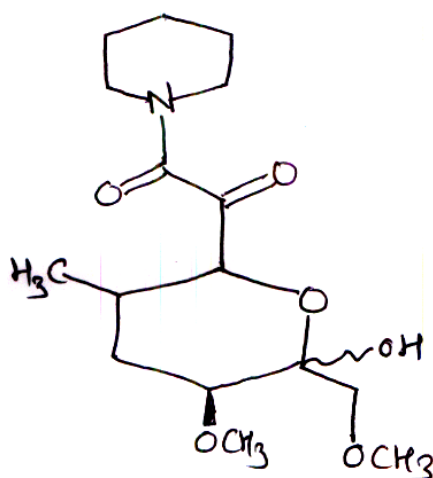
195 (s), 170.4 (s),

98(s), 74.5 (d),

56.3 (q), 52.4 (q),

51.5 (d), 39.1 (t),

34.2 (d), 31.7 (t)

26.5 (t), 24.4 (t)

21.2 (t), 15.5 (q)

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

a) Differentiate the following by mass spectrometry.
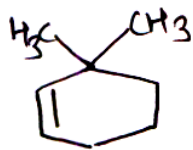


and



b) Differentiate the following by mass spectrometry
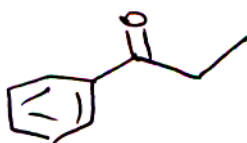


and
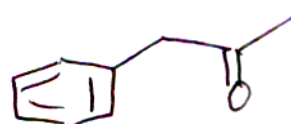


c) Write the genesis of the ions given below.
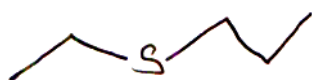


104, 61, 47

d) Write the genesis of the ions given below.
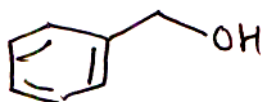


108, 107, 106, 105, 79, 77

e) $CH_2Br_2$ shows molecular ion peak at $M^+$, M+2 & M+4 with intensity 1:2:1. Explain.

**Q8)** Attempt any three of the following : **[12]**

a) Write a short note on MALDI & electron spray ionisation.

b) Compound 'X' methyl ether with M.F. $C_5H_{12}O$ having mass spectra analysis. Identify structure of X.

X : 88, 56, 45(100), 41, 29, 27

c) Explain ortho effect in mass spectrometry

d) Two isomers of $C_6H_{14}$ shows following mass spectral data. Assign the structures to each isomer.

X : 86 (15.5), 57(100), 43(81),

42(41), 41(70), 29(61)

Y : 86 (01), 57(98), 56(32)

42(100), 41(56), 29(48)

ॐॐॐ

**[5909]-41**

# M.Sc. - II

# ORGANIC CHEMISTRY

## CCTP - 9 : CHO - 352 : StereoChemistry and Asymmetric Synthesis of Organic Compounds

### (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.*
3) *Attempt any two questions form Q.6 to Q.8.*
4) *Answers to the two sections should be written in separate answer books.*
5) *Figures to the right indicate full marks.*

## SECTION - I

*Q1)* a) Suggest the Mechanism for the following :      **[5]**

    i)
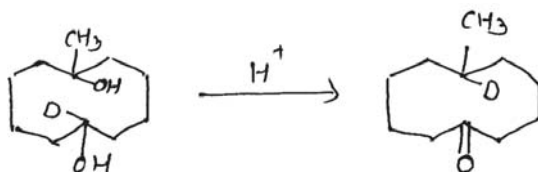


    ii)
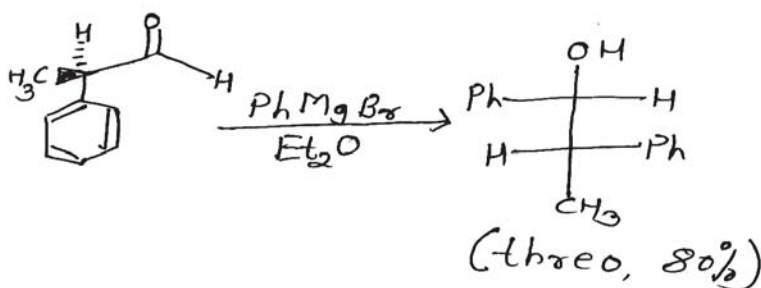


  b) Write the correct IUPAC nomenclature for the following compounds. **[3]**

    i)

ii)



iii)



c)  Explain any three name reactions used for the synthesis of fused or bridged ring compounds. **[3]**

**Q2)** Attempt any three of the following : **[12]**

a)  Write a note on Cram's rule.

b)  Describe the type of tacticity in polymers and write the impact of tacticity on polymer properties.

c)  The absolute energy (Enthalpy) of chair form of cyclohexane is 5.4 kcal/ mole. Explain

d)  Draw all possible conformations of perhydrophenanthrene. Comment on their optical activity.

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

a)  Explain the following observations.



$Li\,BH_4$        9   :   91

$Li\,B(^iBu)_3H$       86   :   14
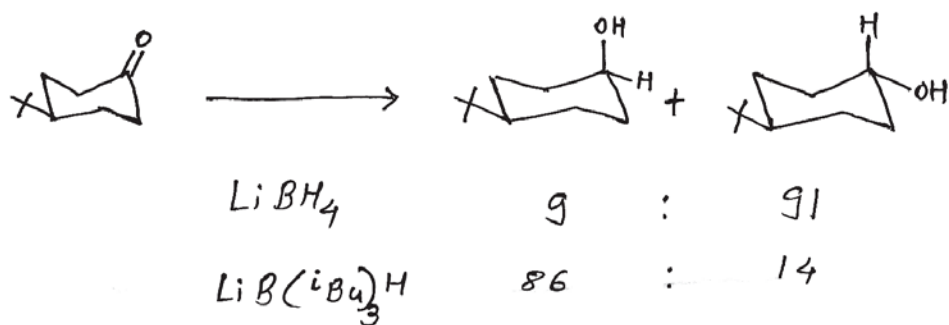
b)  Explain structure and stability of 1, 4 – di–$^t$ butylcyclohexane.

c)  Explain chiral coloumn chromatography method for resolution of enantiomers.

d)  Neomenthyl chloride undergoes base catalysed elimination about 200 times faster than menthyl chloride. Explain.

e)  Explain Bredt's rule with examples.

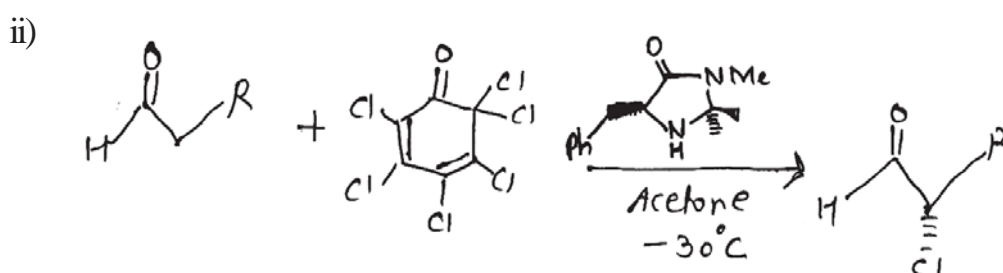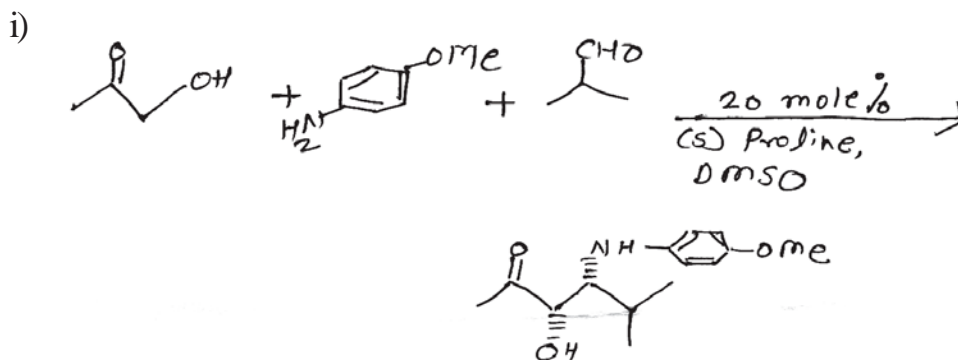**Q4)** Predict the product/s with stereochemical principle involved in it. (Any four)

[12]

a)



$$\xrightarrow[\text{Acetolysis}]{\ominus O A C} \quad ? \; + \; ?$$

b)



$$\xrightarrow{Na \, BH_4} \quad ?$$

c)



$$\xrightarrow{Base} \quad ?$$

d)



$$\xrightarrow{H \wedge I O_2} \quad ?$$

e)



$$\xrightarrow{MgBr} \quad$$
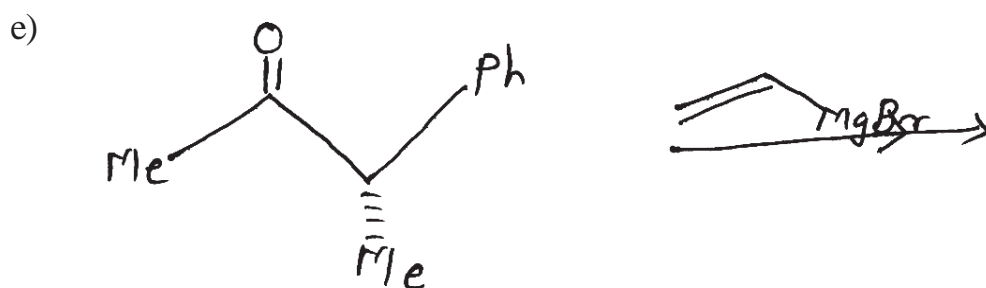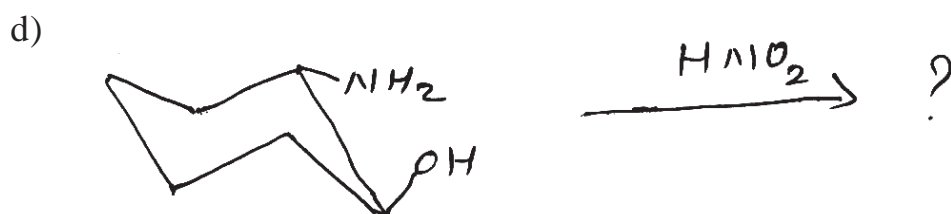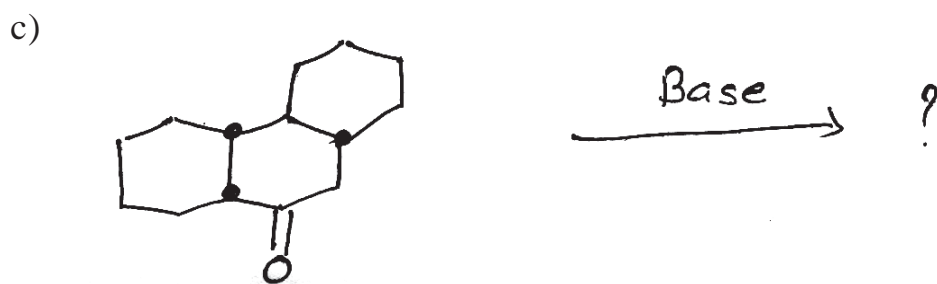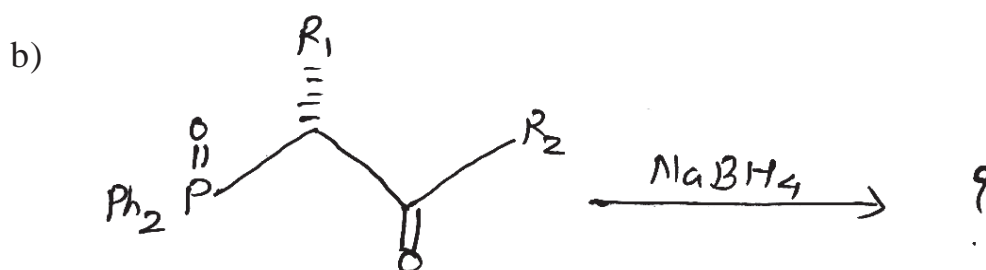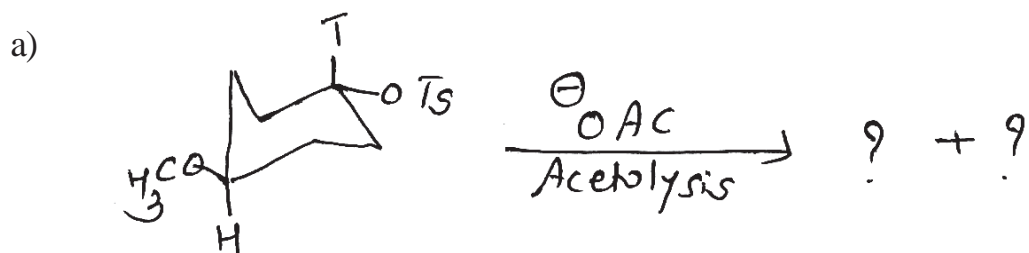
**Q5)** a) Suggest the mechanism [5]

i)



ii)



b) Attempt the following : [6]

i) Draw correct T.S. for the following reaction and identify the Re or Se face of carbonyl carbon which gives major product :



ii) Give the uses of proline in asymmetric synthesis.

**Q6)** Write a short note on : any three of the following : [12]

a) Asymmetric sharpless epoxidation.

b) Organocascade catalysis.

c) Boron mediated aldol reaction.

d) Chird pool synthesis.

*Q7)* a)  Predict the product.                                              **[6]**

i)



$$\xrightarrow[HBr]{NaNO_2} \quad ?$$

ii)



i) $Bu_2BOTf$
   $Et_3N$
ii) $PhCHO$                          $\longrightarrow$ ?
iii) $LiOH, H_2O, H_2O_2$.

iii)



$$\xrightarrow[\substack{K_2OsO_2(OH)_4 \\ tBuOH, H_2O, 0°c \\ K_3Fe(CN)_6, K_2CO_3 \\ MeSO_2NH_2}]{(DHQD)_2 PHAL} \quad ?$$
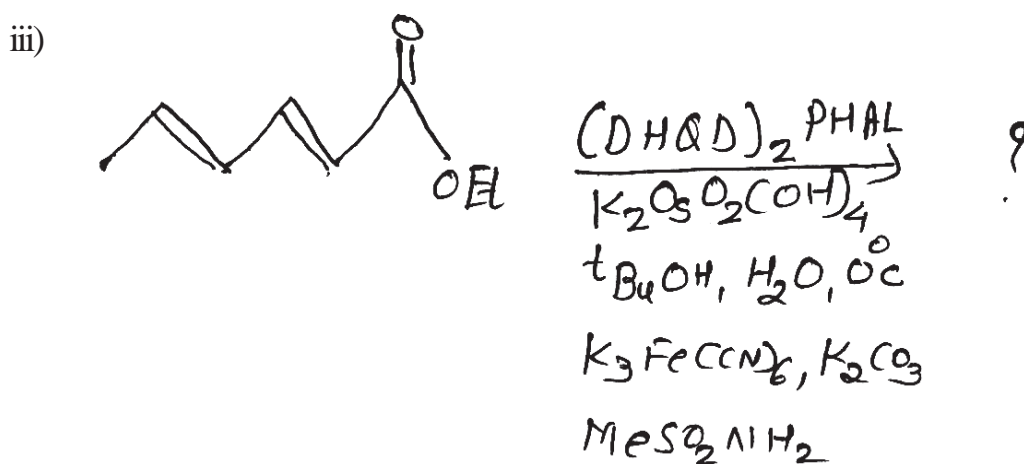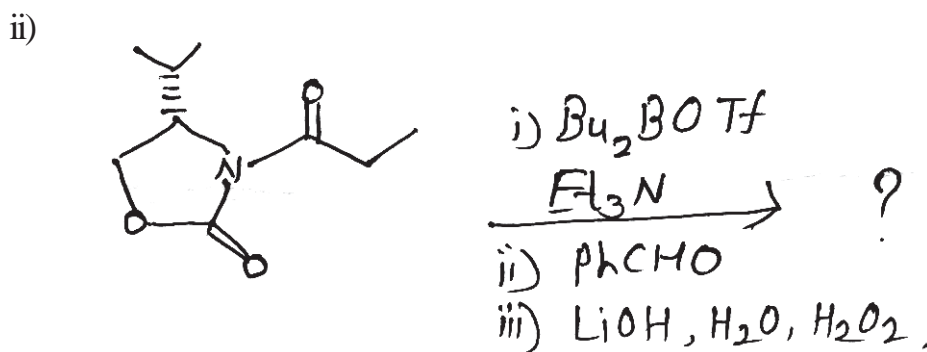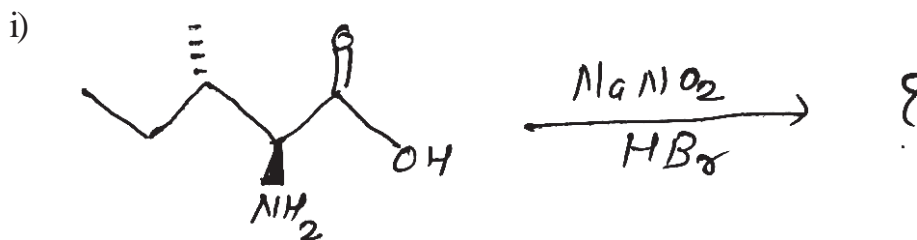
b)  Explain any two of the following :                                     **[6]**

i)   In aldol reaction 2-chiral aldehyde reacts with cis-enolate by anti
     Felkin selectivity whereas trans-enolate by Felkin selectivity.

ii)  Hydrogenation of acetophenone in presence of (s)BINAP/diamine-
     Ru and (R) BINAP/diamine - Ru gives different enantiomers.

iii) Asymmetric Diels-Alder reaction can be achieved by MacMillan
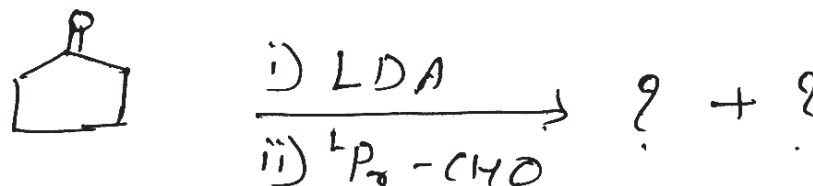     imidazolidinone catalyst.

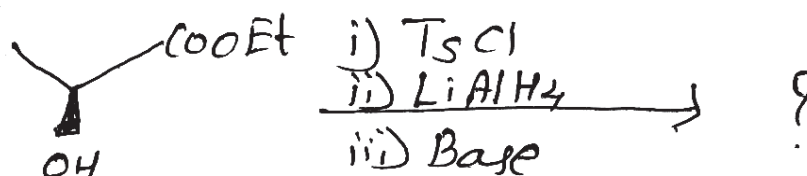*Q8)* a)  Predict the product/s with mechanism (Any two)          **[6]**

i)

NH$_2$

HOOC

i) PhCO$_2$Cl
ii) BH$_3$/THF
iii) $^t$BuOK/THF        →  ?

ii)

i) LDA
ii) $^t$P$_r$ -CHO        →  ? + ?

iii)

COOEt
OH

i) TsCl
ii) LiAlH$_4$
iii) Base        →  ?
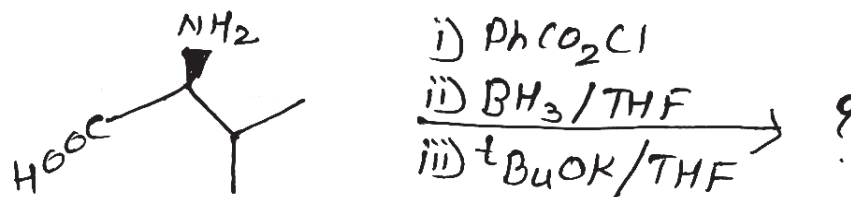
b)  Attempt the following :          **[6]**

i)  Explain use of RAMP and SAMP in assymmetric synthesis.

ii)  Explain organo-somo catalysis.

❄   ❄   ❄

**[5909]-42**

# M.Sc. (Part - II)
## ORGANIC CHEMISTRY
### CBOP 3 : 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)* *Q. 1 and Q. 5 are compulsory and carry 11 marks each.*

  *2)* *Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.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) Explain with mechanism protection of alcohol by using benzyl trichloroacetamide and dihydropyran. Suggest the suitable reagent for deprotection. **[5]**

  b) Explain with mechanism protection of amine by using F-moc and benzyl chloride. Suggest the suitable reagent for deprotection. **[6]**

*Q2)* Explain in detail synthesis of (–) 4-amino-3-hydroxy butyric acid from ascorbic acid with retrosynthesis. **[12]**

OR

Explain in detail synthesis of (R) and (S) epichlorohydrin from D-mannitol.

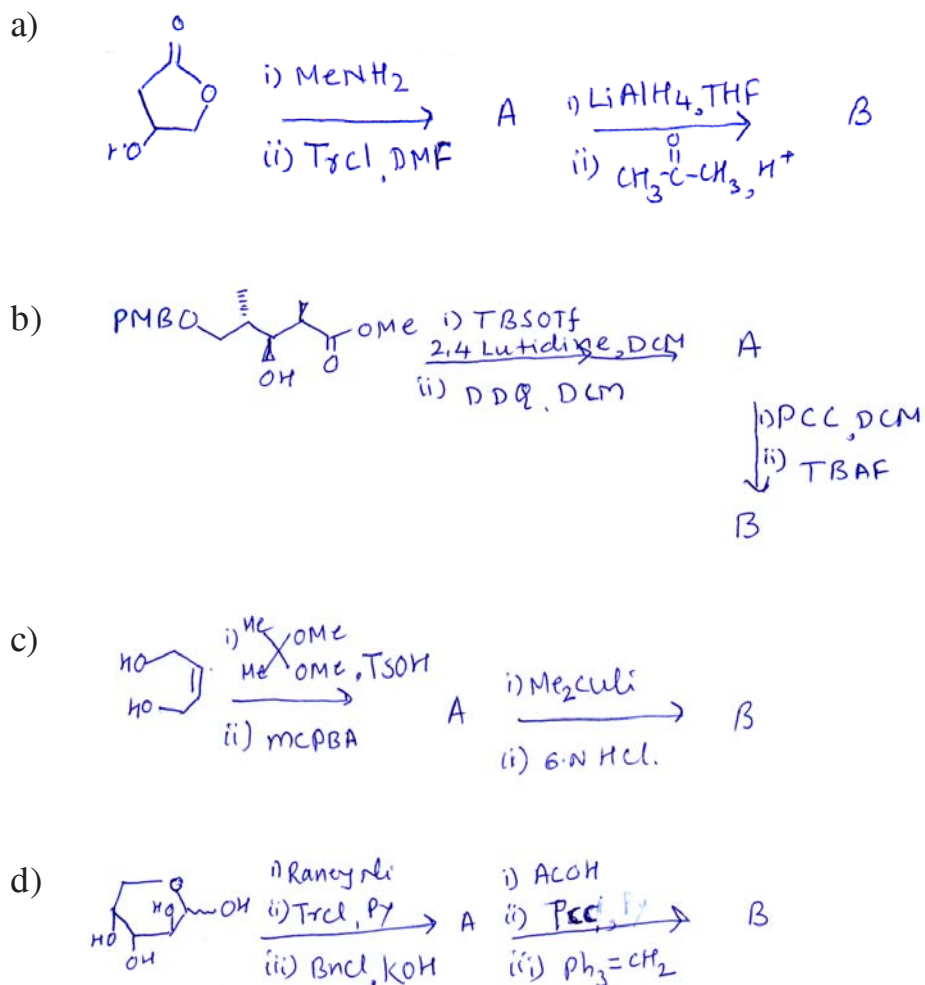*Q3)* Explain total synthesis of O-methyl (S) mandetic acid from D-arabinose. **[12]**

OR

How will you prepare tri-peptides from L-alanine and L-glycine?

*P.T.O.*

*Q4)* Attempt <u>any three</u> of the following : **[12]**

a)


i) MeNH₂
ii) TₓCl, DMF
A
i) LiAlH₄, THF
ii) CH₃-C-CH₃, H⁺
B

b)

PMBO⸺OMe
OH  O
i) TBSOTf
2,4 Lutidine, DCM
ii) DDQ, DCM
A

i) PCC, DCM
ii) TBAF
B

c)

HO⸺
HO⸺
i) Me OMe
Me OMe, TsOH
ii) mCPBA
A
i) Me₂CuLi
ii) 6·N HCl.
B

d)

HO⸺OH
HO
OH
i) Raney Ni
ii) TrCl, PY
iii) BnCl, KOH
A
i) AcOH
ii) PCC,
iii) Ph₃=CH₂
B

## SECTION - II

*Q5)* What are glycosyl acceptor and glycosyl donor? Explain the participation of group at $C_2$ in formation of 1, 2 trans and cis glycoside bond with respect to D-glucose glycosyl donor and acceptor. **[11]**

*Q6)* a) Draw the $^4C_1$ and $^1C_4$ conformation for D-allopyranose and D-idopyranose.

b) How will you prepare Iodo and Fluro glycosides? Explain with reference to D-glucose.

**[12]**

OR

a) Draw the $^4C_1$ and $^1C_4$ conformation of D-glucopyranose and D-galactopyranose.

b) Explain the reactions of dithiogalactose acetals with

    i)    HCl

    ii)   Per acid

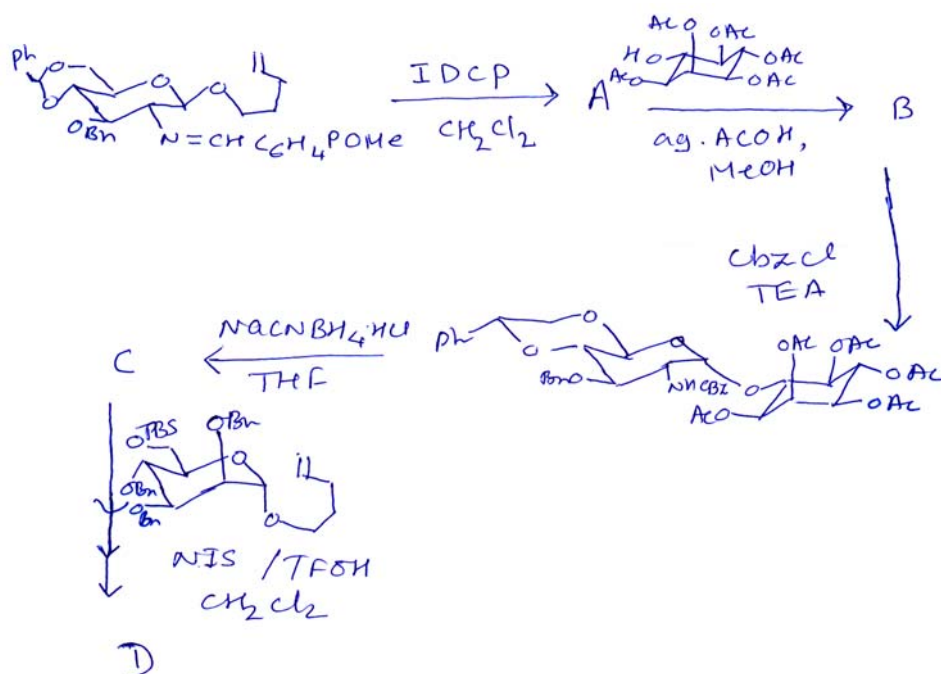    iii)  $AC_2O/PY$

**[12]**

*Q7)* Explain any two of the following : **[12]**

    a)  Step up and step down synthesis of monosaccharides.

    b)  Regioselective deprotection of D-mannose.

    c)  Reductive and oxidative cleavage of benzylidene acetals.

*Q8)* Write the correct structure of A, B, C, D in the following synthesis and justify your answer. **[12]**



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**PA-3207**

**[5909]-42**
# M.Sc. (Part - II)
## ORGANIC CHEMISTRY
## CBOP 3 : CHO-353 B : Designing Organic Synthesis and Heterocyclic Chemistry
### (2019 Pattern) (Semester - III)

*Time : 3 Hours]*          *[Max. Marks : 70*

*Instructions to the candidates:*

1) *Q. 1 and Q. 5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.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) Answer the following :      **[5]**

     i) Define unpolung concept. Explain acyl anion derived from nitroalkanes.

     ii) Explain the Paterno-Buchi reaction in the synthesis of Asteltoxin molecule.

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

     i) Explain linear method for the synthesis of target molecule with an example.

     ii) Give the synthetic equivalent to the following synthon :

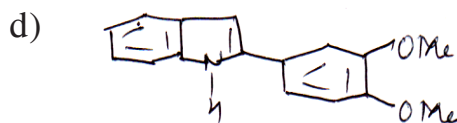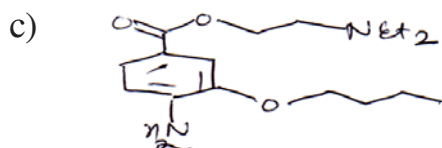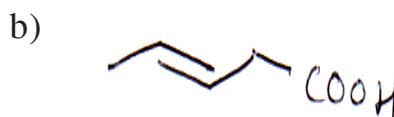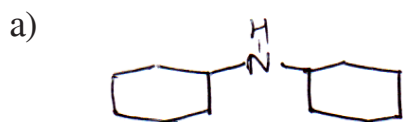$$EtOOC-\overset{\ominus}{C}H_2 \qquad \overset{O}{\underset{||}{H_3C-C}}{}^{\ominus}$$

     iii) Explain the role of [3, 3] sigmatropic rearrangement reaction in the synthesis of strychnine molecule.

*Q2)* Using retrosynthetic analysis, suggest suitable method to synthesize (Any three) : **[12]**

a) 

b) 

c) 

d) 
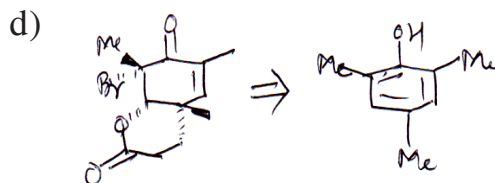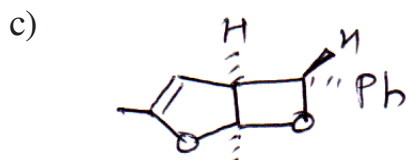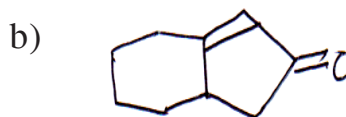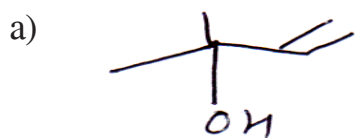
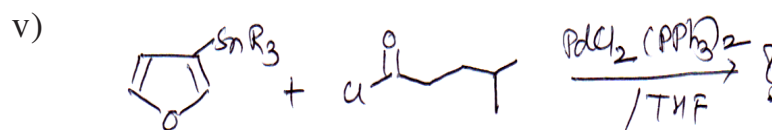*Q3)* How will you make the following compounds using disconnection approach (any four) : **[12]**
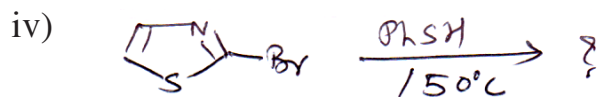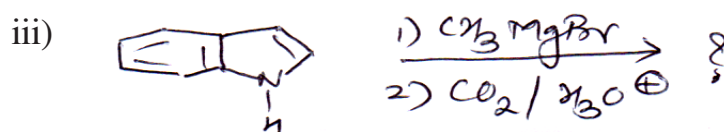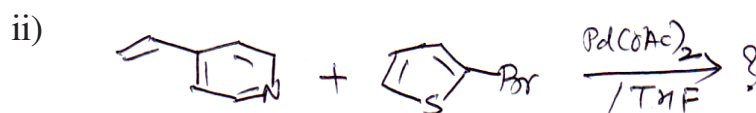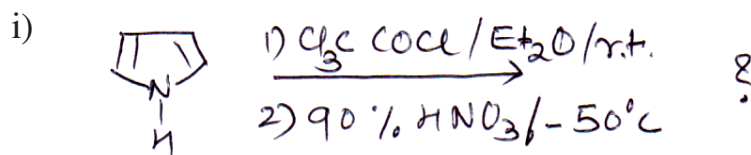
a) 

b) 

c) 

d) 

e) 

*Q4)* Answer the following (any three) : **[12]**

a) Explain the concept of donor and acceptor synthons with suitable example.

b) Explain disconnection in 1, 5-dicarbonyl compounds with suitable example.

c) Write a short note on retrosynthetic analysis of reserpine molecule.

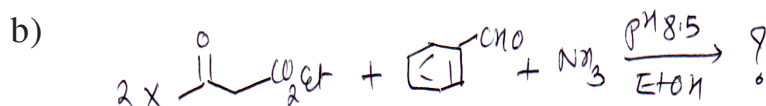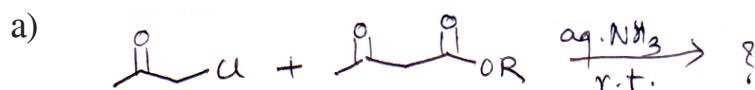d) Write a short note on retrosynthetic analysis of strychnine molecule.

## SECTION - II

**Q5)** a) Predict the product/s for the following reactions : **[5]**

i) 
$$\underset{\text{N}-\text{H}}{\boxed{\phantom{x}}} \xrightarrow[\text{2) } 90\% \ HNO_3/-50°C]{\text{1) } CH_3COCl/Et_2O/r.t.} \ ?$$

ii) 
$$\boxed{\phantom{x}}_N + \boxed{\phantom{x}}_S-Br \xrightarrow[\text{/THF}]{Pd(COAc)_2} \ ?$$

iii) 
$$\boxed{\phantom{x}}_{N-H} \xrightarrow[\text{2) } CO_2/H_3O^{\oplus}]{\text{1) } CH_3MgBr} \ ?$$

iv) 
$$\boxed{\phantom{x}}_S-Br \xrightarrow[/50°C]{PhSH} \ ?$$

v) 
$$\boxed{\phantom{x}}_O-SnR_3 + Cl \overset{O}{\underset{}{\diagdown}} \xrightarrow[\text{/THF}]{PdCl_2(PPh_3)_2} \ ?$$

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

i) Fisher Indore synthesis

ii) Paal Knorr synthesis

iii) Combe's quindine synthesis

**Q6)** Write suitable mechanism and final product/s for the following reactions (Any four) : **[12]**

a) 
$$\overset{O}{\underset{}{\diagdown}}-Cl + \overset{O}{\underset{}{\diagdown}}\overset{O}{\underset{}{\diagdown}}-OR \xrightarrow[r.t.]{aq.NH_3} \ ?$$

b) 
$$2 \times \overset{O}{\underset{}{\diagdown}}-CO_2Et + \boxed{\phantom{x}}-CHO + NH_3 \xrightarrow[EtOH]{pH \ 8.5} \ ?$$

c)



d)



e)
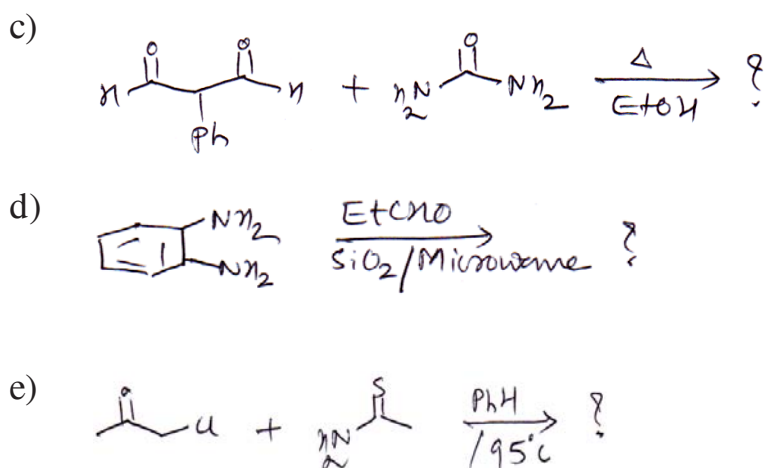


**Q7)** Answer the following (Any four) : **[12]**

a) Arrange the given bromo compounds as per their reactivity order towards NaOEt.
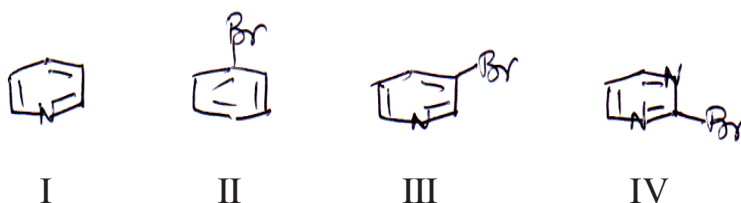


  I          II          III          IV

b) Write the synthesis of 3-bromo, 2, 5-dimethyl thiophere from 2, 5-hexane-dione.

c) Write the synthesis and mechanism for the formation of 2-methoxy, 4-pheryl quinolene by rearranging the reagents given below in a proper sequence :

NaOMe, POCl₃, Δ / 200°C, Heat /
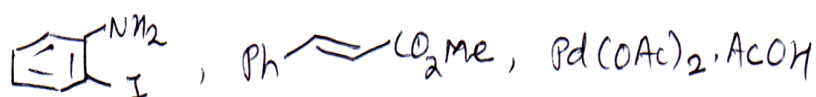


d) For the synthesis of 2-ethyl, 3-methyl indore identify an aldehyde or ketone required with phenyl hydrazine and write the mechanism.

e) Quinoline undergoes nucleophilic substitution at $C_2$ & $C_4$ where as isoquinoline at $C_1$ position. Explain.

**Q8)** Suggest the mechanism for the following conversions (Any four) : **[12]**

a)



b)



c)



d)



e)



■ ■ ■
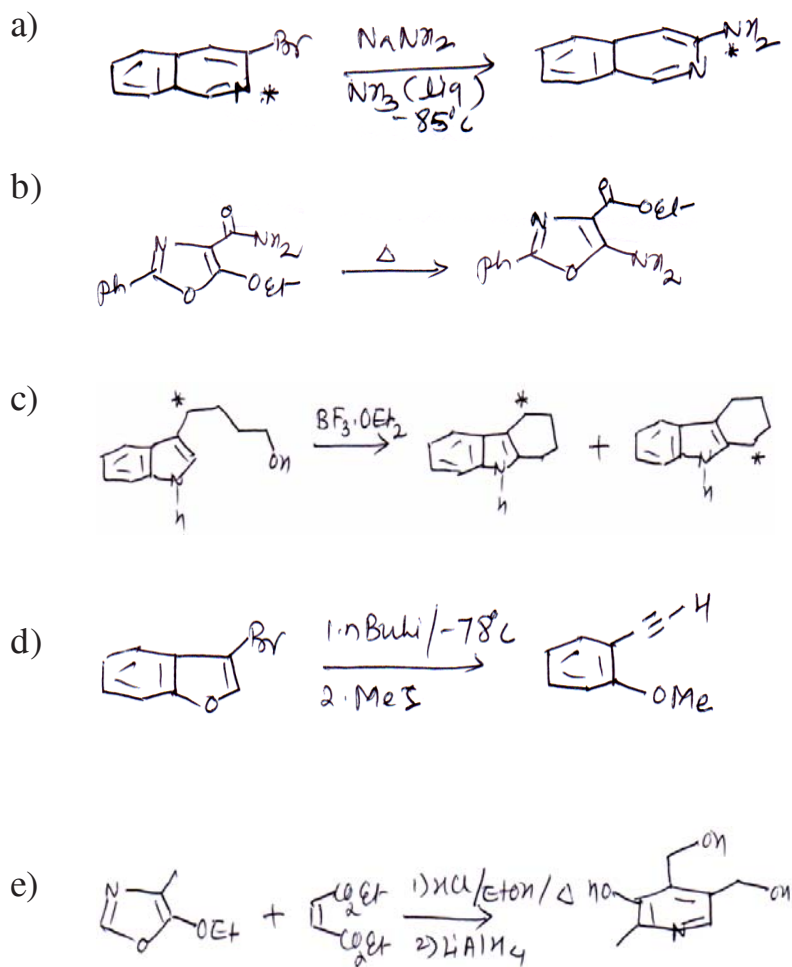
[5909]-43

# M.Sc.

## ANALYTICAL CHEMISTRY

### CHA-390 : Electrochemical and Thermogravimetric Methods of Chemical Analysis.

### (2019 Pattern) (Semester - III) (4 Credits)

*Time : 3 Hours]* *[Max. Marks : 70*

*Instructions to the candidates:*

*1) Question 1 and 5 are compulsory.*

*2) Question 2 to 4 and question 6 to 8 carry equal marks.*

*3) Solve any two questions from 2 to 4 and any two from 6 to 8.*

*4) Figures to the right indicate full marks.*

*5) Use of log table and calculator are allowed.*

*6) Answers to two sections should be written on separate answers sheet.*

## SECTION - I

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

     i) State the Principle of coulometric titration.

     ii) Explain 'Oxygen interference' in Polarography.

     iii) Sketch and label 'Clark Oxygen Sensor'.

     iv) Write Ilkovic equation and give meanings of terms involved in it.

     v) What is 'Polarographic Maxima' give two examples of maxima supressor.

b) The Fe(III) in a 0.8202 gm sample was determined by coulometric reduction to Fe(II) at a platinum cathode. Calculate the percentage of $Fe_2 (SO_4)_3$ M.W. <u>399.88 gm/mol</u>. in the sample if 103.2775 coulomb were required for reduction. **[3]**

*P.T.O.*

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

      i) What is Hydrodynamic voltametry. Give the applications of hydrodynamic voltametry.

      ii) For a solution of $pb^{2+}$ (lead ion) of concentration 1.0 mM the limiting diffusion current is 8.76 µA and the capillary constant value is found to be 1.9987. Calculate diffusion coefficient of $pb^{2+}$.

  b) Differentiate between following : **[6]**

      i) Anodic stripping and cathodic stripping voltametry.

      ii) Normal pulse Polarography and differential pulse polarography.

*Q3)* a) What is coulometric titration? Give applications of coulometric titration in detail. **[6]**

  b) i) Explain Quasireversible and irreversible processes in cyclic voltametry. **[3]**

      ii) List the advantages and disadvantages of DME over platinum Or carbon Electrodes. **[3]**

*Q4)* a) State the principle of Square wave Polarography. Give its application in Estimation of 'Cu' and Zn from water. **[6]**

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

      i) Write a note on "Amperometric Titration".

      ii) Give the construction and working of rotating ring disc electrode. State its advantages over DME.

## SECTION - II

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

   i) Define Thermal Analysis. Enlist the types of the thermal methods of analysis.

   ii) Explain - polymer blends.

   iii) Define the term power compensated DSC and Heat flux dsc.

   iv) Enlist the factors affecting thermal analysis results.

   v) Explain crystalline phase transition.

   b) Magnesium Carbonate was dissolved in aqueous oxalic acid and crystalline product 'A' is obtained when 'A' was heated in Air, 9.20m g of 'A' lost mass in two stages only; 2.23 mg were lost upto 220º C and further 4.49 mg by 500º C. Write the balance chemical equation for the preparation and decomposition of 'A'. **[3]**

**Q6)** a) What is DTA. Draw and explain components of DTA apparatus. **[6]**

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

   i) Explain simultaneous TG-DTA give its any two applications.

   ii) Explain detection and identification of evolved gases by EGA.

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

   i) A sample of 6.68 mg of high purity Indium gave a peak of area 21.94 cm$^2$. Calculate calorimetric sensitivity constant at 150º C.

   (Given : Enthalpy of Fusion of Indium = 28.71 J/g)

   ii) Write a note on TG - MS.

   b) i) When heating rate is changed on DSC or DTA instrument without changing sensitivity, what will be effect on the base line, endothermic melting peak and exothermic reaction peak. **[3]**

   ii) Write a note on 'Heat flux Dsc. **[3]**

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

      i)    Which of the following changes could not be detected by DTA. a) loss of moisture  b) sublimation c) desorption of vapour.

      ii)   Write a note on Dielectric Thermal Analysis (DETA).

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

      i)    Explain simultaneous TG-DSC give its applications.

      ii)   What is mean by Thermomicroscopy? Give any two applications of thermomicroscopy.

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**[5909]-44**

# M.Sc. (Part - II)
# 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)* *Question 1 and Q. 5 is compulsory.*

*2)* *Question 2 to 4 Q. 6 to 8 carry equal marks.*

*3)* *Solve any two questions from 2 to 4 and 6 to 8.*

*4)* *Figures to the right indicate full marks.*

*5)* *Use of log tables and scientific calculators is allowed.*

### SECTION - I

*Q1)* a) Solve <u>any four</u> of the following : **[8]**

    i) Define assay validation.

    ii) Define LOD.

    iii) Which geographical regions are a part of ICH.

    iv) What is multiple point calibration?

    v) What is RSD?

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

In an analysis of stainless steel alloy the expected percentage of chromium is 13%. The values obtained by three analysts are 14.2%, 12% and 15%. Estimate the absolute error, relative error and percentage error.

*P.T.O.*

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

   i) Compare the parameters of selectivity and sensitivity.

   ii) What is revalidation? When is it necessary?

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

   i) Which agencies form the industry members from Japan in ICH?

   ii) The following data was collected as a part of quality control study for the analysis of an ore with respect to mangnese : 25%, 26%, 27%, 31%, 33%. Estimate the mean, median and range for the above data.


*Q3)* a) What is precision? Explain different types of precision in detail. **[6]**

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

   i) Give two special features of Dissolution apparatus Type 2.

   ii) Describe comparative testing.


*Q4)* a) What are errors? Describe different types of errors with suitable examples. **[6]**

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

   i) What are the requirements of analytical method transfer?

   ii) A standard containing 1.5 ppm of nitrate nitrogen was treated with colourizing agents to give an absorbance of 0.25 at 507 nm. A sample treated in the same manner gave an absorbance of 0.17 at the same wavelength-Determine the concentration of nitrate nitrogen in this sample.


## SECTION - II

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

   i) Write five stages of SPE.

   ii) Give conditions for selection of an organic solvent for MAE.

   iii) How can emulsion be removed.

   iv) Define distribution ratio and dielectric const.

   v) Enlist the postextraction technique.

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

A metal chelate was extracted to the extend of 90% when volume of organic phase is double than aqeous phase were shaken together. What will be the percent extraction when volume of organic phase is equal to volume of aqeous phase.

*Q6)* a) Attempt the following : **[6]**

    i)    Explain in detail determination of lead by dithiozone method.

    ii)   Give any one applications of ion exchange SPE.

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

    i)    Give Instrumentation of pressurised fluid extraction.

    ii)   Explain in detail headspace SPME.

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

    i)    Explain in detail Microwave heating and conventional heating with neat labelled diagram.

    ii)   Explain factors affecting on Liquid-Liquid extractions.

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

    i)    Write a note on practical aspects for sampling of solid samples.

    ii)   Give any one application of PFE.

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

    i)    Explain in detail purge and trap technique.

    ii)   Give method for determination of molybdenum by thiocynate method.

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

    i)    Discuss types of SPE media.

    ii)   Explain in detail coupling of SPME with GC.

□□□

**[5909]-45**

# M.Sc.-II (Semester - III)

## ANALYTICAL CHEMISTRY

### CCTP-9:CHA - 392 : Advanced Chromatographic Methods of Chemical Analysis

### (2019 Pattern) (4 Credits)

*Time : 3 Hours]*                                                    *[Max. Marks : 70*

*Instructions to the candidates:*

    *1)*    *Answer to two sections must be written on two separate answer books.*

    *2)*    *Figures to the right indicate full marks.*

    *3)*    *Draw neat and labeled diagram wherever necessary*

    *4)*    *Use of logtable and calculator is allowed.*

## SECTION - I

Note:    i)    Q.1 is compulsory.

          ii)    From Q.2 to 4 solve any two.

          iii)    Q.2 to 4 carry equal marks.

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

    i)    Give the types of chromatography on the basis of stationary and mobile phases.

    ii)    What is partition coefficient? Give equation for it.

    iii)    Enlist different detectors used in mass chromatography.

    iv)    Explain the term resolution in chromatography.

    v)    What is HETP? Give equation for calculation of HETP.

    B)    Calculate the column resolution if retention time of component - A is 2.53 and component-B is 4.75. The peak width for component - A is 0.28 while for component - B is 0.55.    **[3]**

*Q2)* A) Explain in detail: **[6]**

  i) Chemical ionization in MS.

  ii) Analysis of organochlorine pesticides in water by LLEGS method-I.

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

  i) Give the applications of Gc-MS.

  ii) Calculate the number of theoretical plates if retention time is 2.53min and peak width at half height is 0.28 min.

*Q3)* A) Discuss the following: **[6]**

  i) Nitrogen rule and ring-plus-double bonds in MS interpretation.

  ii) Construction and working of quadrapole mass analyser in MS instrument.

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

  i) Explain direct split and open split interface in GC-MS.

  ii) Explain construction and working of thermal conductivity detector.

*Q4)* A) Discuss the following: **[6]**

  i) Stationary phases for packed column in GC.

  ii) Analysis of a mixture of substances using internal normalization method.

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

  i) Explain selected ion monitoring in gas chromatography mass spectrometry.

  ii) For three component system GC peak areas are 2040, 1538 and 2290 mv.sec. Then calculate the percent of each component in the mixture.

## SECTION - II

Note:    i)    Q.5 is compulsory.

ii)   Q.6 to 8 carry equal marks.

iii)  From Q.6 to 8 solve any two.


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

i)    Give the difference between normal and reverse phase in HPLC.

ii)   What is linear dynamic range of detector?

iii)  What is drift in baseline?

iv)   Why water is not suitable in conservation of column when it is not in use?

v)    What is the function of interface in LC-MS instrument?

**B)** A sample was analysed by internal standard method. In standard and sample peak area for internal standard was 6300. Peak area for standard was 5400 and sample 3600. Conc. of standard was 0.109/100ml. Calculate amount of sample in solution.                                              [3]


**Q6) A)** Answer the following:                                          [6]

i)    What is derivetization? Explain pre and post column derivetization in HPLC detection of samples.

ii)   Explain UV-visible detector in HPLC.

**B)** Discuss the following:                                            [6]

i)    Mobile phases in HPLC.

ii)   Bonded phases in HPLC.


**Q7) A)** Explain in detail electrospray interface in HPLC.            [6]

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

i)    What is supercritical fluid chromatography? Explain mobile phase used in supercritical fluid chromatography.

ii)   Explain the applications of ion exchange HPLC method for quantitative analysis.

*Q8)* A) Explain principle of size exclusion chromatography. Give application of size exclusion chromatography for the molecular weight determination.**[6]**

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

   i)   Explain analysis of drug metabolites by LC-MS method.

   ii)  The sample was analysed by HPLC by calibration curve method. Calibration curve was set by using 0.01 to 0.05 mg/ml standard. The slope of line peak area against conc. of standard is $10 \times 10^3$. If 0.1 sample dissolved in 500 ml sample showed peak area 720 then calculate mg of sample in 0.1g quantity.

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SEAT No. :

[**Total No. of Pages : 7**

### [5909]-46
### M.Sc. - II
### ANALYTICAL CHEMISTRY
### CBOP - 3 - CHA - 393 (A) : Bioanalytical Chemistry
### (2019 Pattern) (Semester - III)

*Time : 3 Hours]*                                         [*Max. Marks : 70*

*Instructions to the candidates:*
   *1)   Answer to the two sections should be written on separate answer books.*
   *2)   Figures to the right indicate full makrs.*
   *3)   Use of logtable and calculator is allowed.*

#### SECTION - I

**Instructions :**

   1)   **Question 1 is compulsory.**

   2)   **From questions 2 to 4 solve any two.**

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

   i)     What is isoelectric focusing?

   ii)    Give the principle of HPTLC-MS detection in HPTLC method.

   iii)   What is the effect of pore size on electrophoretic mobility?

   iv)    Discuss the application of capillary electrophoresis.

   v)     Explain the role of applied potential in electrophoresis.

   **B)**   Write note on cellulose acetate as support media in electrophoresis. **[3]**

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

   i)     Write note on optical method for detection of separated components in electrophoresis.

   ii)    What is zone electrophoresis? Explain principle of capillary zone electrophoresis.

   **B)**   What are the different types of electrophoretic system? Discuss moving boundary electrophoresis in details. What are its drawbacks?    **[6]**

*Q3)* **A)** **Answer the following :** **[6]**

   i)   Explain mass-Spectrometric detection in TLC with respect to atmospheric pressure mass-Spectrometry.

   ii)  Discuss what do you mean by sensitivity detection limit and linear range for detector in capillary electrophoresis?

   **B)** Discuss theory of electrophoretic migration. **[6]**


*Q4)* **A)** **Answer the following :** **[6]**

   i)   Discuss quantitative analysis by HPTLC method.

   ii)  Explain in details electroosmosis.

   **B)** Discuss fluorescence detection in capillary electrophoresis and spectral distribution in HPTLC plate. **[6]**


## SECTION - II

**Instructions :**

   1)   **Q. 5 is compulsory.**

   2)   **From Q. 6 to 8, solve any two.**


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

   i)   Give the mechanism by which $Na_2EDTA$ and oxalate avoid coagulation of blood.

   ii)  How collected blood sample is preserved?

   iii) What are water insoluble vitamins? Give four examples.

   iv)  What is indirect ELISA?

   v)   What are the defficiency symptoms of Vitamin - B- 2.

   **B)** Vitamin - C was analysed by volumetric method. 0.15 mg/ml 10 ml standard required 9.3 ml 2,6 dichlorophenol indophenol solution. 5 ml urine sample required 3.8 ml 2,6 dichlorophenol indophenol solution. Calculate Vitamin - C in mg per 100ml in sample. **[3]**

*Q6)* **A)** **Explain the following :** [6]

i) Estimation of the serum creatinine by colorimetry.

ii) Estimation of glucose by glucose oxidose method.

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

i) Discuss the determination of blood potassium level by flame photometry.

ii) Blood phosphate level was analysed by colorimetry. 0.5ml standard containing 0.2 mm01/L phosphate was treated with protein precipitant and coloring agent. It showed absorbance 0.230 at 680 nm. similarly treated 2ml blood sample displayed absorbance 0.210. Calculate blood serum phosphate in mm01/L.

*Q7)* **A)** **Discuss the following :** [6]

i) Estimation of Vitamin -A by spectrometry.

ii) Estimation of Vitamin $B_2$ by fluorometry.

**B)** Explain different stages in ELISA experiment. [6]

*Q8)* **A)** What is sandwitch ELISA? Explain direct and indirect sandwitch ELISA in detail. [6]

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

i) What is the function of immune system? Explain innate and adaptive immunity in detail.

ii) Explain diagnostic usefulness of antigen and antibodies in infectious diseases.

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**PA-3211**

# [5909]-46
## M.Sc. - II
## ANALYTICAL CHEMISTRY
## CBOP - 3 - CHA - 393 (B) : Analysis of Food and Controlled Substances
## (2019 Pattern) (Semester - III)

*Time : 3 Hours]*                                            *[Max. Marks : 70*

*Instructions to the candidates:*
1) *Answer to two sections should be written on separate answer books.*
2) *Figures to the right indicate full marks.*
3) *Use of logtables and calculators is allowed.*

### SECTION - I

**Instructions :**

1) **Question 1 is compulsory.**
2) **Solve any two from Q. 2 to 4.**

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

    i)    Define :  a)   Sample                b)   Sampling

    ii)   Describe different forms of water in food products.

    iii)   What is Ash? Write the principal of dry asking method.

    iv)   What are the important criteria in selecting a technique for analysis?

    v)   Give any two characteristic tests for carbohydrates.

  **B)**   A sample of oil was analyzed for its FAME by GC. Following observations were obtained -                   **[3]**

| Peak | Peak area |
|------|-----------|
|      | (In arbitrary units) |
| A | 2853369 |
| B | 1182738 |
| C | 38999438 |

Calculate the percent composition of all three fatty acids.

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

      i)    How is saccharine estimated from food material?

      ii)   What is degree of gelatinization? How it is determined?

  **B)**  i)    Describe the Hanus method for the estimation of iodine value of oil. [3]

      ii)   0.3 gm oil sample was treated with Hanus iodine solution. After 30 minutes it was treated with 10% KI solution and liberated iodine was titrated with 0.1M $Na_2S_2O_3$. It gave a burette reading of 8.6 ml. If the blank titration reading was 25ml, calculate the iodine value of oil. (At. wt. of I = 126.9) [3]

*Q3)* **A)** **Attempt the following :** [6]

      i)    Discuss the estimation of protein by Lowery's method.

      ii)   Calculate the amount of benzoic acid in 100gm food material when the alcohol extract is titrated with 0.05 N NaOH solution and required 4.5ml of the titrant. (Mw benzoic acid = 122)

  **B)**  i)    Describe the method for the determination of glucose by enzyme method. [3]

      ii)   Write a note on importance and major components of dietary fibers. [3]

*Q4)* **A)** **Attempt the following :** [6]

      i)    Describe semicontinuous solvent extraction method for lipid determination.

      ii)   Describe the Tanner's method for the determination of $SO_2$.

  **B)**  i)    Describe the functional properties associated with proteins as food ingredients. [3]

      ii)   A biological sample was analyzed for Net Protein Utilisation, Digestibility and Biological Value and gave following observations-

         a)    Intake Nitrogen                   = 20.2 mg

         b)    Faecal Nitrogen                   = 10.7 mg

         c)    Endogenous Faecal Nitrogen     = 7.3 mg

         d)    Urinary Nitrogen                  = 10.1 mg

         e)    Endogenous Urinary Nitrogen    = 6.8 mg

         Calculate NPU, D and BV. [3]

## SECTION - II

**Instructions :**

    **1)**   **Q. 5 is compulsory.**

    **2)**   **Solve any two from Q. 6 to 8.**

*Q5)* **A)**   **Attempt any four of the following :**           **[8]**

      i)    Explain the chemistry of colour formation.

      ii)   Write the structures of MDMA and MDEA.

      iii)  Write any two aqueous test reagents.

      iv)  Give the origin & sources of diamorphine.

      v)   Define -  a)   Narcotic drugs

                       b)   Psychotropic drugs

    **B)**   Sample containing drugs was analyzed by TLC using a mixture of ethyl alcohol and ammonium hydroxide as mobile phase. When the distance travelled by solvent, amphetamine, methamphetamine and 3,4-Methylenedioxy amphetamine were 10.2 cm, 2.1cm, 3.5cm and 4.3cm respectively, calculate the $R_f$ value of each compound in the sample.**[3]**

*Q6)* **A)**   **Attempt the following :**           **[6]**

      i)    Write the presumptive test for LSD.

      ii)   Give the synthesis of pure cocaine.

    **B)**  i)    Discuss the identification of herbal and other materials from <u>Cannabis Sativa</u> samples.         **[3]**

      ii)   Describe Zimmerman test for benzodiazepines.     **[3]**

*Q7)* **A)**   **Attempt the following :**           **[6]**

      i)    Write a note on identification of khat.

      ii)   Discuss the analysis of barbiturates by TLC.

**B)** i) Explain the quantification of cocaine by GC-MS. **[3]**

ii) A sample containing amphetamine was analyzed by Gas chromatography method. It gave following observations. **[3]**

a) Concentration of known amphetamine = 3.4 µg/ml

b) Peak area of drug in sample = 6.4 mAUmin

c) Peak area of internal standard = 4.7 mAUmin

d) Peak area of known drug sample = 3.4 mAUmin

e) Peak area of internal standard in the reference solution = 7.6 mAUmin.

Calculate the concentration of amphetamine in the given sample.

*Q8)* **A)** **Attempt the following :** **[6]**
i) Explain the bulk and trace sampling procedures for diamorphine.
ii) Explain TLC analysis of mescaline.
**B)** i) Describe any one confirmatory test for the presence of LSD. **[3]**
ii) Describe the Corinth IV salt test for cannabis. **[3]**

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# M.Sc. (Part - II)
# PHYSICAL CHEMISTRY
## CHP - 410 : Molecular structure and Spectroscopy
### (2019 Pattern) (Semester - IV) (CCTP - 10)

*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 Q2, Q3 and Q4 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          $N = 6.023 \times 10^{23}$ mol$^{-1}$
2)  Boltzmann Constant       $k = 1.38 \times 10^{-16}$ erg K$^{-1}$ molecule$^{-1}$
                             $= 1.38 \times 10^{-23}$ J K$^{-1}$ molecule$^{-1}$
3)  Planck Constant          $h = 6.626 \times 10^{-16}$ erg s
                             $= 6.626 \times 10^{-34}$ J s
4)  Electronic Charge        $e = 4.803 \times 10^{-10}$ esu
                             $= 1.602 \times 10^{-19}$ C
5)  1 eV                     $= 23.06$ k cal mol$^{-1}$
                             $= 1.602 \times 10^{-12}$ erg
                             $= 1.602 \times 10^{-19}$ J
                             $= 8065.5$ cm$^{-1}$
6)  Gas Constant             $R = 8.314 \times 10^7$ erg K$^{-1}$ mol$^{-1}$
                             $= 8.314$ J K$^{-1}$ mol$^{-1}$
                             $= 1.987$ cal K$^{-1}$ mol$^{-1}$
7)  Faraday Constant         $F = 96487$ C equivalent$^{-1}$
8)  Speed of light           $c = 2.997 \times 10^{10}$ cm s$^{-1}$
                             $= 2.997 \times 10^8$ m s$^{-1}$
9)  1 cal                    $= 4.187 \times 10^7$ erg
                             $= 4.187$ J
10) 1 amu                    $= 1.673 \times 10^{-27}$ kg
11) Bohr Magneton            $\beta_e = -9.274 \times 10^{-24}$ J T$^{-1}$
12) Nuclear Magneton         $\beta_n = 5.051 \times 10^{-27}$ J T$^{-1}$
13) Mass of an electron      $m_e = 9.11 \times 10^{-31}$ Kg

*P.T.O.*

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

   i)    Distinguish between δ and τ chemical shift scales.

   ii)   Give the advantages of FT-NMR.

   iii)  Explain the theory of spin-spin interaction for an ABC type molecule.

   iv)   Why microwave radiations are used to observe ESR signals?

   v)    Write the application of nqr.

b)   Predict the intensity distribution in the hyperfine lines of the esr spectrum of the radicals. $\bullet CH_3$ and $\bullet CD_3$.                          [3]

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

   i)    State the characteristics of high resolution nmr instrumentation.

   ii)   Explain the concept of electric field gradient.

b)   Attempt the following.

   i)    State the application of 19f spectroscopy.                          [3]

   ii)   Explain the principles of esr.                                       [3]

*Q3)* a)   Describe the instrumentation used in nqr spectroscopy with suitable diagram.                                                                [6]

b)   Attempt the following.

   i)    Write a note on 31p nmr spectroscopy.                              [3]

   ii)   What is the need of reference for recording high resolution nmr? Give the advantages of TMS.                                             [3]

*Q4)* a) Describe the instrumentation used in esr spectroscopy with suitable diagram. **[6]**

b) Attempt the following.

   i) Distinguish between 13c nmr and esr spectroscopy. **[3]**

   ii) Calculate the frequency, required to excite proton **[3]**

       from $m_1 = \frac{1}{2}$ to $m_1 = -\frac{1}{2}$

       Given : $g_N = 5.585$, $H_0 = 1.4T$

## SECTION - II

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

   i) What is magnetic moment and magnetic susceptibility?

   ii) What is pascal's constants? Give its uses.

   iii) What is scattering intensity in electron diffraction?

   iv) State van vlecks equation and explain each term.

   v) State and explain de broglies hypothesis.

b) A powder diffraction photograph from tungsten shows lines that index are (110) (200) (211) (220) (310) (222) (321) (400). Identify the (Bravais) lattice type of unit cell. **[3]**

*Q6)* a) Answer the following. **[6]**

   i) State Langevin equation and explain it's theory of paramagnetism.

   ii) Distinguish between neutron diffraction and electron diffraction technique for the molecular structural analysis.

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

   i) What is the structure factor of simple cubic and face centre cubic lattice?

   ii) At 25°C, the molar magnetic susceptibility of water is $-13.0 \times 10^{-6} cm^3 mol^{-1}$ and its density is 0.9970 $gcm^{-3}$. Calculate the specific magnetic susceptibility of water at this temperature.

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

      i)   Write a note on ferro and antiferromagnetism.

      ii)   Discuss the elucidation method of structure of gas phase molecule by electron diffraction.

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

      i)   Explain, the Gouy method for the measurement of magnetic susceptibility.

      ii)   What is the phase problem and how do you solve it in XRD?

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

      i)   Write a note on low energy electron diffraction technique.

      ii)   Explain the phenomena of scattering of neutron by solid and liquid.

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

      i)   State the application of neutron diffraction technique in the framework of molecular structure.

      ii)   A powder pattern of Mgo known to crystallize in the cubic system show diffraction line at $\sin\theta$ values of 0.1461, 0.1690, 0.2801, 0.2935 and 0.3697. Determine the lattice type of Mgo.

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# M.Sc. (Part-II)
# PHYSICAL CHEMISTRY
## CHP-411 CCTP : Surface chemistry and electrochemistry
### (2019 Pattern)  (Semester-IV) (New) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

**Instructions to the candidates:**

1) *Answer to the two sections should be written in Separate answer books.*
2) *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 is allowed.*
5) *Neat diagram must be drawn Wherever necessary.*

## Physico-Chemical Constants

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

[35 marks]

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

i)    Write Gibbs adsorption equation and define the terms involved in it.

ii)    What is isosteric heat of adsorption?

iii)    Write any four assumptions of B.E.T. Theory

iv)    What is chemical adsorption?

v)    What is capillary condensation?

b)    Solve the following.    [3]

i)    The adsorption of a gas is described by langmuir isotherm with k=0.85 kPa$^{-1}$ at 25ºC Find the pressure at which surface coverage is 15%

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

i)    Describe assumptions of potential theory for multilayer adsorption.

ii)    What is hysteresis of adsorption? Draw different types of hysteresis loop.

b)    Answer the following:    [6]

i)    Describe the microtome method for verification of Gibbs adsorption equation.

ii)    Explain the gravimetric method of measurement of adsorption with a neat labelled diagram.

*Q3)* a)    Derive the equation for isosteric heat of adsorption.    [6]

b)    Answer the following:    [6]

i)    Discuss the mechanism of detergency.

ii)    Explain the mechanism of chemisorption on metal oxides.

*Q4)* a) Derive and explain Gibb's adsorption equation. **[6]**

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

    i) Describe mercury porosity meter method of determination of pore size.

    ii) Nitrogen gas adsorbed on charcoal to extent of 0.921 $Cm^2$/gm at 4.8 atm and 190 k temperature but at 250 k temperature the same amount of adsorption is achieved only when pressure was increased to 32 atm. calculate the molar enthalpy of adsorption of $N^2$ on charcoal.

## SECTION-II

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

    i) What is activity and activity coefficient?

    ii) Write the nernst- Einstein equation.

    iii) What is liquid-junction potential.

    iv) What is zeta potential.

    v) Write a types of electrode.

b) Calculate the equilibrium constant for the reaction **[3]**

$$Fe^{2+} + Ce^{4+} \rightarrow Fe^{3+} + Ce^{3+}$$

Given $E^o$ $Ce^{4+}/Ce^{3+}$=1.44v and $E^o Fe^{3+}/Fe^{2+}$=0.68v

*Q6)* a) Answer the following: **[6]**

    i) Discuss tafel equation in detail.

    ii) Derive expression to calculate the electrical work

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

    i) What is electrical double-layer.

    ii) Derive an expression showing the relation between $c_p$ and $E_{cell}$.

*Q7)* a) Answer the following: **[6]**

    i) Discuss the limitation of Debye-Hückel theory

    ii) Write a note on butler-volmer equation.

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

    i) Show that $\Delta s = n F \times \left[ \dfrac{\partial E}{\partial T} \right]_P$

    ii) Calculate the solublity product of silver iodide from following cell.

$$^\ominus Ag|AgI|0.25MKI||0.05MAgNo3|Ag^\oplus$$

$$E_{cell} = 0.788V$$

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

  i) Discuss the plot of $\log \gamma V_s \sqrt{I}$

  ii) Discuss the effect of temperature on E.M.F.

 b) Solve the following:

  i) In an experiment, where pt, $H_2/H^+$ electrode is involved the following data was obtained [6]

| n(mv) | 50 | 100 | 150 | 200 | 250 |
|---|---|---|---|---|---|
| i(mA cm) | 2.66 | 8.91 | 29.9 | 100 | 335 |

  Calculate $i_0$

  ii) Calculate the EMF of the concentration cell consisting of zinc electrode, one immersed in a solution of 0.01 molality and the other solution in a solution of 0.1 molality at 25°C. The two solution are separated by a salt bridge. The mean activity coefficient of the electrolyte may be assumed to be unity.

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# M.Sc. - II
# PHYSICAL CHEMISTRY
## CHP-412 (A) : Material Chemistry and Catalysis
### (2019  Pattern) (Semester - IV)  (4 Credits)

*Time : 3 Hours]*                                       *[Max. Marks : 70*
*Instructions to the candidates:*
1) *Answer to the two sections should be written in Separate answer books.*
2) *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.*

## <u>Physico-Chemical Constants</u>

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

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

       i)      Define rectifier. Give its types.

       ii)     What is Langmuir-Blodgett film?

       iii)    What are quantum dots?

       iv)     Give two applications of hi-tech materials.

       v)      What is capacitor? Give its two applications.

    b)    Explain sol-gel method to prepare thin films.                              **[3]**


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

       i)      Explain the term MOCVD.

       ii)     Describe the term anyzotropy.

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

       i)      What are the applications of LB films?

       ii)     What is high critical temperature super conductors?


*Q3)* a)    Explain pairing and multigap structure in hi-tech material.               **[6]**

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

       i)      Discuss optical properties of solid devices material.

       ii)     What are the characteristics of 2-1-4 material.


*Q4)* a)    Describe the operation of a p-n-p transistor with the help of a neat sketch.**[6]**

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

       i)      What is sputtering? Give its types.

       ii)     Explain supper conductivity in cuprates.

## SECTION-II
## (Catalysis)

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

    i) Define inhibition and support.

    ii) Define poisoning.

    iii) How is a catalyst industrially useful.

    iv) Explain promoters with example.

    v) State two principles of green chemistry.

  b) Describe the factors which affects the activity of catalyst. **[3]**

*Q6)* a) Answer the following. **[6]**

    i) Discuss sol-gel method for preparing catalyst.

    ii) Explain a method to determine pore size.

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

    i) Discuss the precipitation method of preparation of catalyst.

    ii) Discuss the intermediate compound formation theory of catalyst.

*Q7)* a) Describe the thermal methods for catalyst characterization. **[6]**

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

    i) Explain catalyst deactivation.

    ii) Explain mercury porosity meter method to determine the size of pore.

*Q8)* a) Explain the mechanism of heterogeneous catalysis proposed by Langmuir and Hinshelwood. **[6]**

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

    i) Explain the types of catalysis.

    ii) How are organic pollutants degrated using photocatalyst.

**PA-3214**

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# M.Sc. - II
## PHYSICAL CHEMISTRY
### CHP-412 (B) : Biophysical Chemistry and Special Topics in Nuclear and Radiation Chemistry
(2019 Pattern) (Semester - IV) (Elective) (Option - B)

*Time : 3 Hours]*          *[Max. Marks : 70*
*Instructions to the candidates:*
1) *Answer to the 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 are 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      $N = 6.023 \times 10^{23} \text{ mol}^{-1}$
2) Boltzmann Constant      $k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
                             $= 1.38 \times 10^{-23} \text{ J K}^{-1} \text{ molecule}^{-1}$
3) Planck Constant      $h = 6.626 \times 10^{-16} \text{ erg s}$
                             $= 6.626 \times 10^{-34} \text{ J s}$
4) Electronic Charge      $e = 4.803 \times 10^{-10} \text{ esu}$
                             $= 1.602 \times 10^{-19} \text{ C}$
5) 1 eV      $= 23.06 \text{ k cal mol}^{-1}$
                             $= 1.602 \times 10^{-12} \text{ erg}$
                             $= 1.602 \times 10^{-19} \text{ J}$
                             $= 8065.5 \text{ cm}^{-1}$
6) Gas Constant      $R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
                             $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
                             $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7) Faraday Constant      $F = 96487 \text{ C equivalent}^{-1}$
8) Speed of light      $c = 2.997 \times 10^{10} \text{ cm s}^{-1}$
                             $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal      $= 4.187 \times 10^7 \text{ erg}$
                             $= 4.187 \text{ J}$
10) 1 amu      $= 1.673 \times 10^{-27} \text{ kg}$
11) Bohr Magneton      $\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$
12) Nuclear Magneton      $\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
13) Mass of an electron      $m_e = 9.11 \times 10^{-31} \text{ Kg}$

## SECTION-I

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

   i) State and explain Bragg's law.

   ii) Distinguish between active and passive transport.

   iii) Define electrophoresis & give its applications.

   iv) Give two function of proteins.

   v) Write Henderson's equation and explain the terms in it.

   b) Calculate $R_{rms}$ and $R_s$ for a linear polymeric chain containing 250 monomeric units each $45\overset{\circ}{A}$ long. **[3]**

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

   i) Distinguish between RNA and DNA.

   ii) What are biopolymer? State and explain their characteristics and application.

   b) Attempt the following.

   i) Derive the Michaelis-menten equation. **[3]**

   ii) Calculate the pH of a 2L solution containing 10 ml of 5m acetic acid and 10 ml of 1m sodium acetate. **[3]**

*Q3)* a) Discuss the methods to determine molecular weight of protein. **[6]**

   b) Attempt the following.

   i) Define and explain Circular Dichroism [C.D]. **[3]**

   ii) Evaluate Rmp for freely joined randomly coiled polymer chain in the number of bonds is 4000 and the bond distance $154 \times 10^{-12}$ m. **[3]**

*Q4)* a) Discuss the nerve impulse and it's conduction. **[6]**

   b) Attempt the following.

   i) Explain role of $Na^+/K^+$ pump. **[3]**

   ii) A polymer sample contain equal no. of molecule with molecular weight 15000 and 25000 calculate $\overline{m}n$ & $\overline{m}w$. **[3]**

5

# SECTION-II

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

   i) Explain term not atom and recoil atom.

   ii) Explain Bethe's notation with example.

   iii) Explain term nuclear star.

   iv) Write products formed in radiolysis of water.

   v) Enlist manmade sources of radiations.

   b) Half life period of a radio element is 24.3 min. How much it would be left after 30 min. If initial amount of radiactive element is 1gm? **[3]**
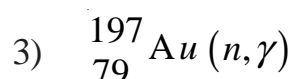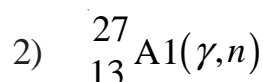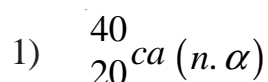
**Q6)** a) Attempt the following. **[6]**

   i) What is difference between somatic and genetic effect of radiation.

   ii) Write a note on radiation protection.

   b) Attempt the following.

   i) State possible radiolysis reaction for organic compounds. **[3]**

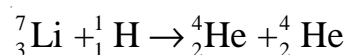   ii) Solve the following. **[3]**

   1) $^{40}_{20}ca\,(n.\alpha)$          2) $^{27}_{13}A1(\gamma,n)$

   3) $^{197}_{79}Au\,(n,\gamma)$

**Q7)** a) Explain construction and working van de accelerator. **[6]**

   b) Attempt the following.

   i) Write a note on solar nutrino problems. **[3]**

   ii) Evaluate Q value for reaction. **[3]**

   $^{7}_{3}Li + ^{1}_{1}H \rightarrow ^{4}_{2}He + ^{4}_{2}He$

   [Given 7L$i$=7.01822 amu $^{1}_{1}H = 1.00814$ amu, $^{4}_{2}He = 4.00387$ amu]

*Q8)* a)  What is condition required for choosing a radioactive nuclide a indicator for radiometric titration. **[6]**

b)  Attempt the following.
   i)  Draw and explain linear accelerator. **[3]**
   ii)  Calculate resolving time if system in microsecond from following data. **[3]**

| Sample | A | B | A+B |
|---|---|---|---|
| Count Rate | 3600 for 3 min | 2400 for 5min | 9900 for 6 min |

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**[5909]-54**

# M.Sc. (Part - II)
## INORGANIC CHEMISTRY
### CCTP-10 : CHI - 430 : Heterogeneous Catalysis and its Application
### (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 and calculator is allowed.*
   *5)*   *Answer to the two sections should be writtein in separate answer books.*

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

     a)   Explain in short promotor and poison with suitable example.

     b)   Which properties of zeolites makes them better heterogeneous catalysts.

     c)   Define chemisorption and physisorption.

     d)   Discuss in brief about active sites in heterogeneous catalysis.

   B)   Define zeolite? Give the classification of zeotlite.      **[3]**

*Q2)* A)   Answer <u>ANY ONE</u> of the following.          **[6]**

     a)   Discuss in detail any two methods for the preparation of heterogeneous catalyst.

     b)   Give an account of factors influencing on Zeolite synthesis.

   B)   Answer ANY TWO of the following.          **[6]**

     a)   What is supported metal catalyst? Enlist their advantages.

     b)   Discuss in brief. Types of chemical reactors.

     c)   Describe the method for preparation of Raney-Ni catalyst.

*P.T.O.*

*Q3)* A) Answer <u>ANY ONE</u> of the following. **[6]**
   a) Give an account of composition of zeolite framework structure.
   b) Discuss various methods of heterogenization of homogeneous transition metal complexes.

B) Write a note on : (Any Two). **[6]**
   a) MFI type of zeolite framework structure.
   b) Characterization of zeolite using powder XRD.
   c) Phase transfer catalysis.

## SECTION-II

*Q4)* A) Answer any <u>TWO OUT</u> of the following. **[8]**
   a) What is water-Gas shift reaction? Which catalyst used in it.
   b) What is F.C. alkylation reaction? Give reaction condition for it.
   c) Why $TiO_2$ is considered as good photo catalyst?
   d) How pyrophyllite clay is formed?

B) How do you convert alcohol to carboxylic acid? Which heterogeneous catalyst used there in? **[3]**

*Q5)* A) Answer <u>ANY ONE</u> of the following. **[6]**
   a) Discuss the use of zeolite as a hydro cracking catalyst.
   b) Discuss the role of heteropolyanions of $M_o$ and W in biodisel synthesis.

B) Answer <u>ANY TWO</u> of the following. **[6]**
   a) Discuss in brief : Application of intercalated clay as a catalyst.
   b) Discuss in short : Industrial application using electrocatalysis.
   c) How alkynes are converted to alkenes? Enlist the catalyst and reaction condition required for it.

*Q6)* A) Answer <u>ANY ONE</u> of the following. **[6]**
   a) What are perovskites? Explain their uses as a catalyst for pollution control.
   b) Draw the scheclite structure for $B_i M_o O_4$. Discuss their use as oxidation and ammoxidation catalyst.

B) Write a note on : (Any Two). **[6]**
   a) Semiconductor as photocatalyst.
   b) Menthanol synthesis using heterogeneous catalysis.
   c) Zeolite as a hydrogen transfer catalyst.

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**[5909]-55**

# M.Sc.-II

## INORGANIC CHEMISTRY

### CCTP-11-CHI-431 : Inorganic Nanomaterials : Properties Applications and Toxility

### (2019 Pattern) (Semester-IV)

*Time : 3 Hours]*          *[Max. Marks : 70*

*Instructions to the candidates:*

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

**SECTION-I**      **[35]**

**(Nano-Structural Materials and its Applications)**

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

     i) What are Nanomaterials?

     ii) State Moore's law.

     iii) What is Zero dimensional nanoparticles?

     iv) How natural nanoparticle differ from artificial nanoparticles?

   b) Explain the following size dependent properties of Nanomaterials.    **[3]**

     a) Colour      b) Magnetic property

*Q2)* a) Answer <u>any one</u> of the following.      **[6]**

     i) Explain in detail structural properties of nanoparticles.

     ii) Write the properties of carbon nanotubes.

   b) Answer <u>any two</u> of the following.      **[6]**

     i) What are nanocomposites? Explain coreshell nanoparticles.

     ii) Explain biological properties of Nanomaterials with suitable examples.

     iii) Explain application of nanomaterials in organic electronics.

*P.T.O.*

*Q3)* a) Answer <u>any one</u> of the following. [6]

      i) What is surface plasmon? Explain optical properties of Nanomaterials.

      ii) Explain in detail nanophotonics.

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

      i) Write the difference between dry and wet nanotechnology.

      ii) Explain in detial SWCNT'S.

      iii) Explain the computational nanotechnology in communication sector.

## SECTION-II [35]
### (Nanotoxicology and Biosafety)

*Q4)* a) Answer the following. [8]

      i) Define nanotoxicology.

      ii) What are the challenges of nanotoxicology.

      iii) What is bio-mimatic technology?

      iv) Write any two route of administration of nano-drug.

   b) Explain the following properties of nanotoxicology. [3]

      i) Size

      ii) Surface chemistry.

*Q5)* a) Answer <u>any one</u> of the following. [6]

      i) Explain any two physico-chemical properties of nanotoxicology.

      ii) Explain the mechanism of nanotoxicity.

   b) Answer <u>any two</u> of the following. [6]

      i) Explain toxic effect of silver nanoparticle.

      ii) Explain the properties of fecting transport of nanoparticles and their toxicity.

      iii) What is inflammation-mediated nanotoxicity?

*Q6)* a) Answer <u>any one</u> of the following. [6]

      i) Explain the mechanism of toxicity related to the cytotoxicity.

      ii) Explain toxicity test on small rodents.

   b) Answer <u>any two</u> of the following. [6]

      i) Explain in vitro toxicity assessment of nanoparticles.

      ii) What is aspect ratio of nanoparticle? Write any four point related to disposal of nanoparticles.

      iii) Explain any two epidemiological evidences of nanotoxicology.

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[5909]-56

# M.Sc. II (Inorganic Chemistry)
## CBOP-4 (T), CHI - 432A : MATERIAL SCIENCE
### (2019 Pattern) (Semester - IV) (4 Credits)

*Time : 3 Hours]*                                       *[Max. Marks : 70*

**Instructions to the candidates:**
1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Use of logarithm table and calculator is allowed.*
4) *Answer to the two section should be written in seperate answer book.*

## SECTION-I

**(Crystal (Structure) Defects, Magnetic & Super conducting Materials)**

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

  i)   What is point defects? Explain its types.

  ii)  Define.

     1)  Defect                          2)  Paramagnetism

  iii) What are dimagnetic materials?

  iv)  Explain classification of super conductors.

  b)   Draw the structure of HCP crystal structure & calculate the no. of atoms per unit cell in HCP.                                  **[3]**

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

  i)   State and explain the ficks first law and second law of diffusion.

  ii)  What is hysteresis loop? Explain types of hysteresis loop. Explain retentivity & corecivity.

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

  i)   Define:

     1)  Super conductivity.

     2)  Ferrites.

     3)  Critical temperature for super conductor.

  ii)  Write a short note on fullerene.

  iii) Explain the Josephen effect.

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

   i) Explain BCS theory of super conductivity.

   ii) Saturation magnetisation of FCC iron is 1800 kA/m². Calculate the net magnetic moment per iron atom in crystal. Given 1BM = $9.273 \times 10^{-2}$ A/m² and lattice parameter is 2.87A°.

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

   i) Write a note on meissner effect.

   ii) What is hard and soft magnet.

   iii) Explain "Effect of temperature on magnetic susceptibility value of ferromagnetic materials.

## SECTION-II

### (Ceramic, Composite Cementitious and Biomaterials)

*Q4)* a) Attempt the following. [8]

   i) What are piezoelectric materials? Explain with example.

   ii) What are ceramics? Give its applications.

   iii) Explain Bioceramics with example.

   iv) Define:

   1) Hydration process.

   2) Set retarder.

   b) What is high alumina cement ? Explain its properties and uses. [3]

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

   i) What are composite materials? Explain fiber for reinforced plastic composite materials with types, properties and uses.

   ii) Explain the different biomaterials involved in human body.

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

   i) Write a note on sol gel process.

   ii) What is glass transition temperature and melting temperature?

   iii) Write a note on Green concrete.

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

    i)   What is wood? Draw the cross section of wood. with its different parts. Give application of wood.

    ii)  What is cement? Explain different types of blended cement. Give its applications.

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

    i)   Define:

        1)   Macrodefect free cement.

        2)   Ophthalmology.

        3)   Biodegradable polymer.

    ii)  Give the full form of.

        1)   $C_2S$

        2)   IOL

        3)   PVC

    iii) Find the percentage moisture content of the following sample of wood from the given following data [met weight = 220 gm & Dry weight = 200 gm]

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**PA-3217**

**M.Sc. - II(Inorganic Chemistry)**
**CBOP-4, 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) *Figures to the right indicate full marks.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Answer to the two sections should be written in seperate answer book.*
5) *Use of logarithmic table calculator is allowed.*

## SECTION-I

### (Inorganic Chemistry Applications in Industry)

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

   i) What are the factors that affect the rate of corrosion.

   ii) Name the different sources of $So_2$ in environment.

   iii) Explain the need for personal protective equipment in combating hazards.

   iv) Why global warming occurs?

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

   Discuss various safety aspects in the refinery.

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

   i) Explain twelve principles of green chemistry.

   ii) Define corrosion inhibitor. Classify corrosion inhibitors write use of corrosion inhibitor.

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

   i) Name the common gases found in coal mine what is the explosive range?

   ii) Explain electroplating.

   iii) Explain electro deposition of Cu and Ni.

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

    i) Distinguish between chemical corrosion and electro chemical corrosion. Discuss about the use of inhibitors in corrosion control.

    ii) Explain hazard and its control in petrochemical industry and petrolium refineries.

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

    i) Sporting and military explosives.

    ii) Alloy plating.

    iii) Chemical storage-safety issues.

## SECTION-II
### (Inorganic Chemistry; Applications in Environment)

*Q4)* a) Answer the following. **[8]**

    i) Define BOD and COD. How BOD and COD determined from waste water?

    ii) Explain how microorganisms are responsible for cleaning of environment.

    iii) What are the best option for energy sources for 21st century? Explain in short.

    iv) How detergent and pesticides are responsible for water pollution?

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

  The coliform bacteria count is used to test water for what type of contamination? Do coliform bacteria cause disease? How do you treat water that contains pathogens?

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

    i) List four forms of biomass. What is the energy yield obtained from burning biomass? List the advantages and disadvantages of using biomass as a source of energy.

    ii) Differentiate between active and passive solar heating system.

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

    i) Explain in detail activated sludge process?

    ii) How primary, secondary and tertiary sewage treatment given to waste water?

    iii) Draw a schematic diagram of a phosphoric acid fuel cell (PAFC). What reaction occuring at the cathode and a node. Show overall reaction.

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

i)  How solar energy is the source of future energy? Will geothermal energy ever be a major source of energy wondwide? Explain.

ii)  What are the broad categories of water pollutant? List the trace element pollution in natural water with sources, effect and significance.

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

i)  Primary and secondary sludge.

ii)  Tidal power.

iii)  Industrial waste treatment.

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SEAT No. :

[Total No. of Pages : 7

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**M.Sc. - II**

**ORGANIC CHEMISTRY**

**CCTP-10 : CHO-450 : Chemistry of Natural Products**

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

*Time : 3 Hours]*                                                    *[Max. Marks : 70*

*Instructions to the candidates:*

1) *Q. 1 and Q. 5 are compulsory and carry 11 marks each.*

2) *Attempt any two questions from Q. 2 to Q. 4 and two questions from Q.6 to Q.8.*

3) *Answer to the two sections should be written in separate answer books.*

4) *Figures to the right indicate full marsk.*

## SECTION-I

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

    i)  Write the role of following reagents in the synthesis

        1)  NMP

        2)  TEM PO-OXONE

    ii)  Write a note on De-mayo Reaction.

    iii)  Write a retrosynthesis of longifolene by w.oppolzer approach.

    iv)  How will you prepare wieland miescher ketone from resorcinol?

    v)  Why the attempts of synthesis of longifolene by kuo, Money method from precursor Ⓐ was failed
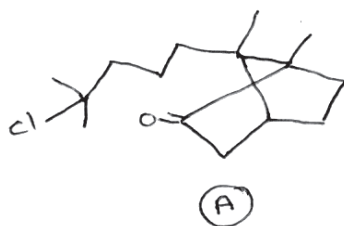


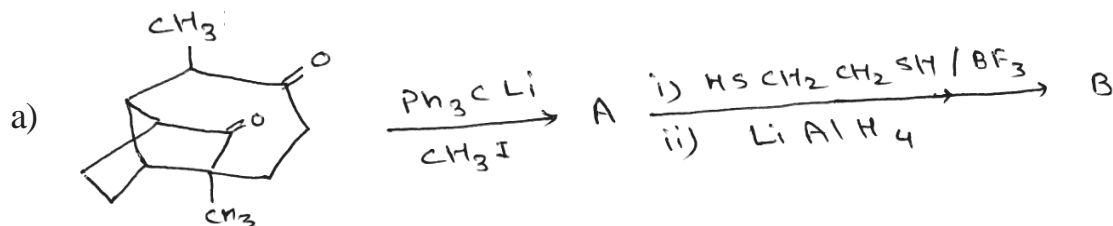*P.T.O.*

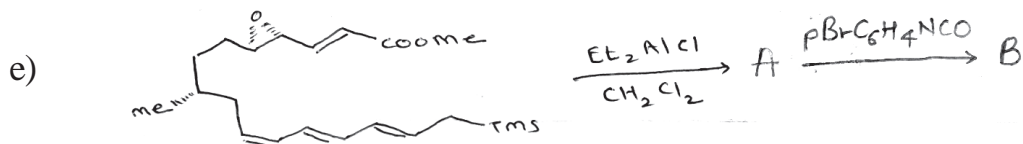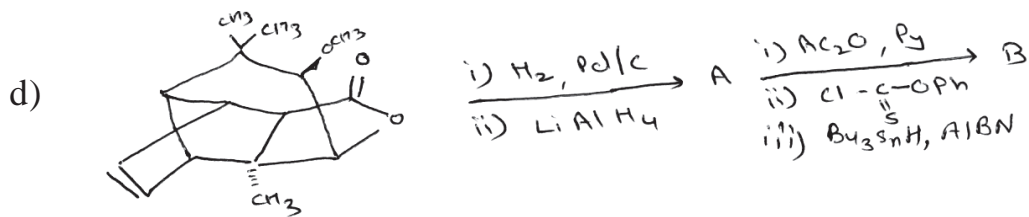b) Write the correct sequence of reagents for the following conversion. **[3]**
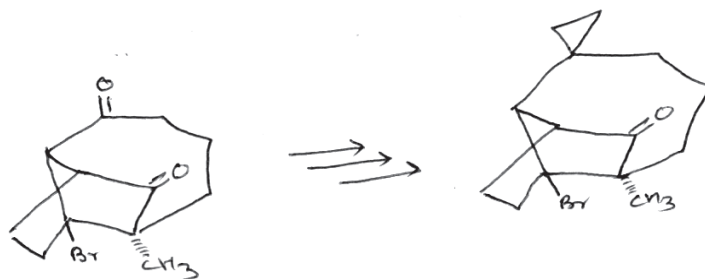


i) $CH_2 I_2$, $Et_2 Z_n$
ii) anny $FeCl_3$, Pyridine
iii) $NaI$, $Et_3 N/TMSCl$
iv) $Ph3 P=CH_2$
v) $H_2$, $Pd/C$, $EtOAC$
vi) $CH_3 CO_2 Na/CH_3OH$

*Q2)* Predict the products (any 4) **[12]**

a)

$$\xrightarrow[CH_3 I]{Ph_3 C Li} A \xrightarrow[ii) \ Li \ Al \ H_4]{i) \ HS \ CH_2 \ CH_2 \ SH \ / \ BF_3} B$$

b) Camphor $\xrightarrow{Br_2 | HBr, HOAc} A \xrightarrow[Cl SO_3 H]{Br_2} B$

c)

$$\xrightarrow{H_2, Pt| AcOH} A \xrightarrow{PCC} B$$

d)



i) H₂, Pd/c
ii) Li Al H₄ → A

i) Ac₂O, Py
ii) Cl-C-OPh (‖ O)
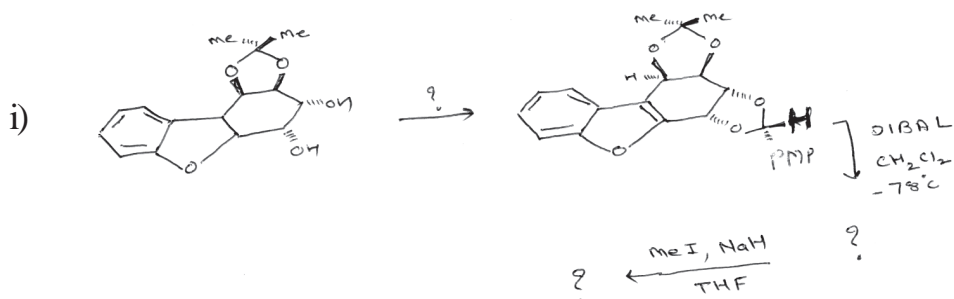iii) Bu₃SnH, AIBN → B

e)



Et₂AlCl / CH₂Cl₂ → A

pBrC₆H₄NCO → B
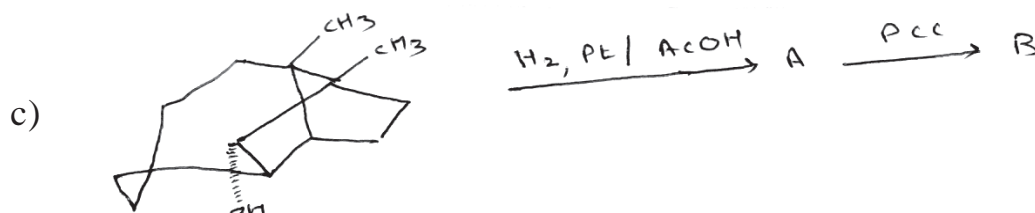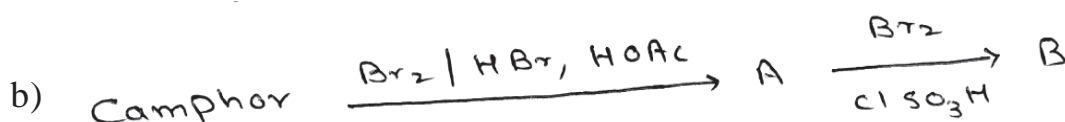
**Q3) a)** Write the missing reagents and intermediates in following conversions. Give mechanism for the same (any two) **[8]**

i)



? →

DIBAL CH₂Cl₂ -78°C

meI, NaH / THF ← ?

?

ii)



a) ?
b) ?
c) ? →

d) BrMg—OTBS
e) DMP

?

iii)



a) Allyl mgCl, THF
b) Aq. sat. NH₄Cl 25°C → ?

? →

?
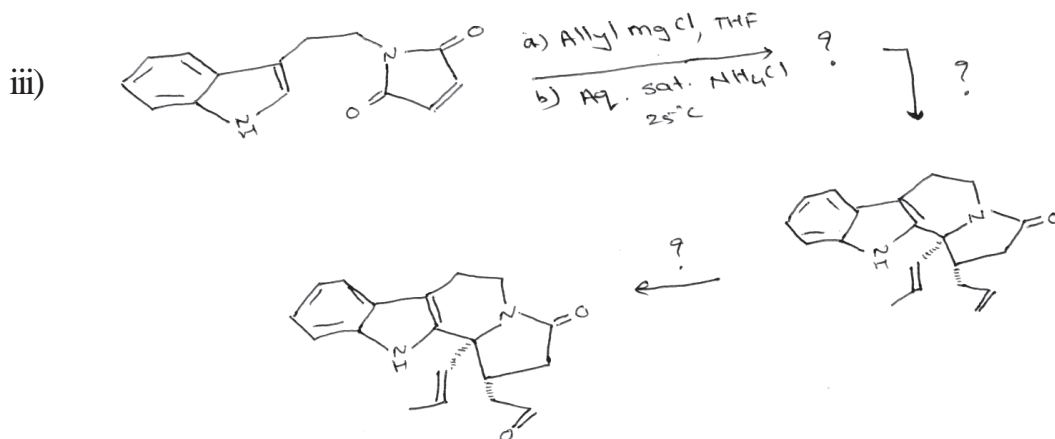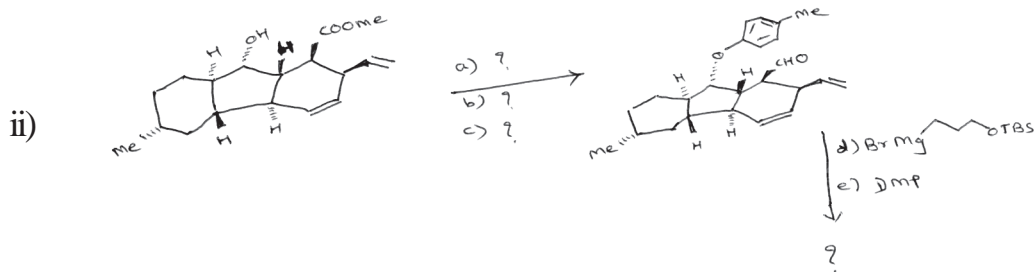
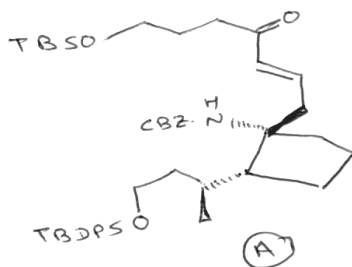b) Write the steps involved during the construction of Hirsutellone B from tricyclic core to sulfone **[4]**

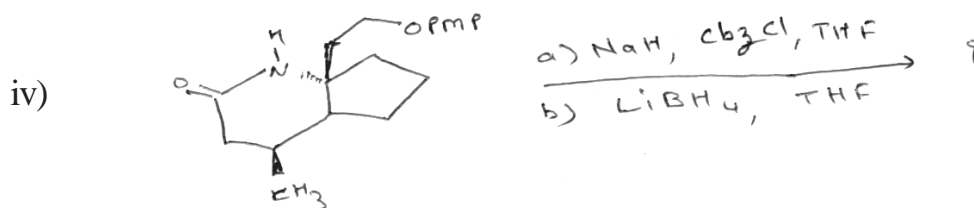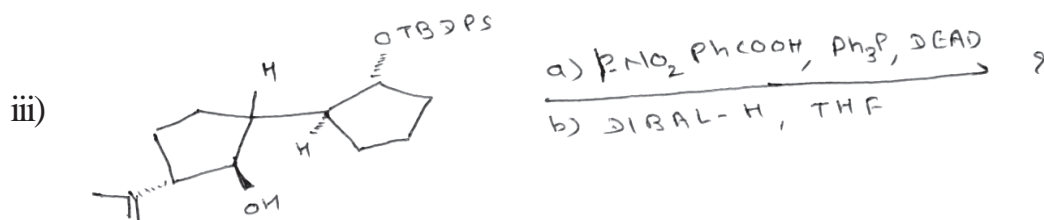**Q4)** Outline the steps involved in the following synthetic sequence. **[12]**
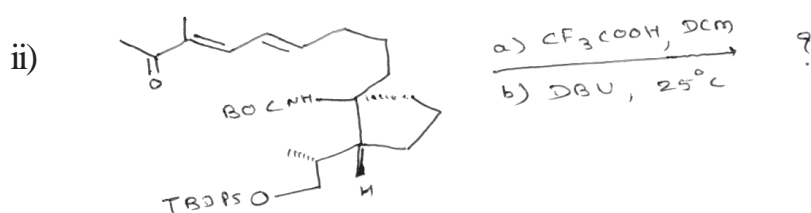
a) 

b) 

Hirsutellone B

c) 
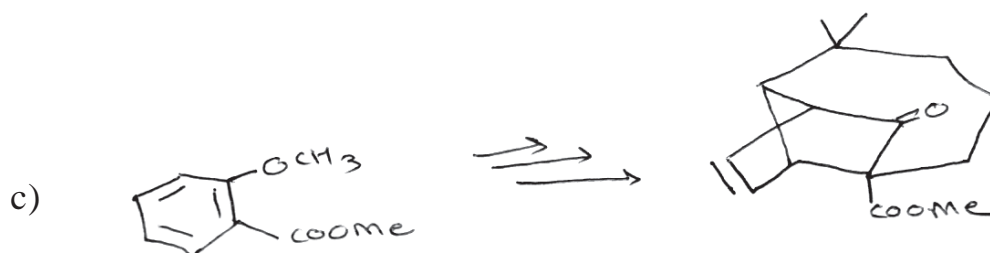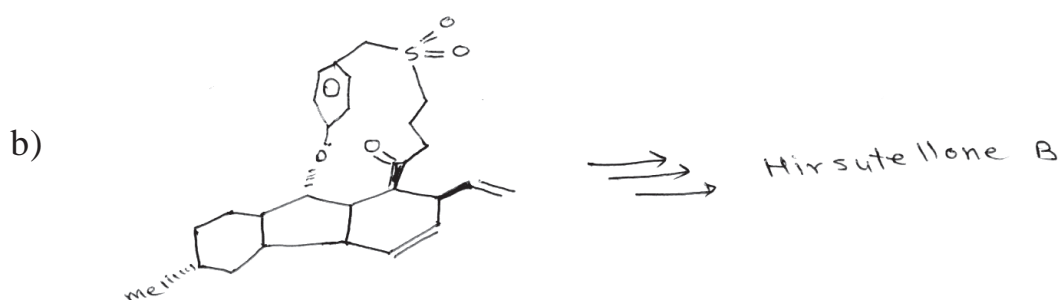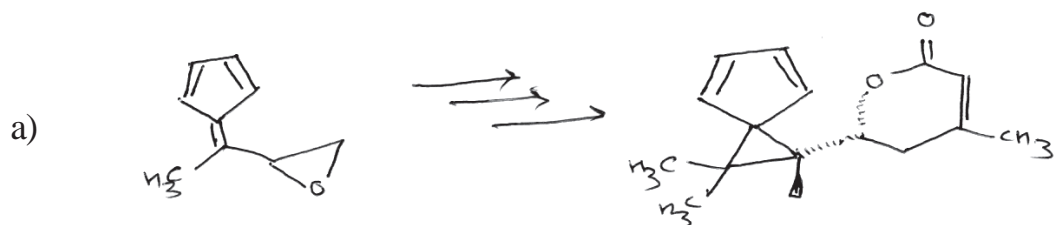
## SECTION-II

**Q5) a)** Solve the following (any 4) **[8]**

i) Draw the correct structure of pinnaic acid with exact stereochemistry.

ii) Write a note on cross olefin metathesis with reference to pinnaic acid total synthesis.

iii) Write the correct full form and use of following.
   1) PPTS
   2) SEMCl

iv) Which two important strategies were involved in the contruction of Ring-C of vannusal-B?

v) What is martin's sulfurane? Write its role in the total synthesis of originally assigned vannusal-B.

b) Write in detail the steps involved in the reaction of Ⓐ with H$_2$, Pd (OH)$_2$/C in THF with mechanism. **[3]**



**Q6) a)** Predict the product (any 3) **[9]**

i)



a) TBSCl, DBU, DCM

b) O$_3$, P$_y$ then
   Ph$_3$P    $-78 \rightarrow 25°C$

?

ii)



a) CF$_3$COOH, DCM

b) DBU, 25°C

?

iii)



a) P-NO$_2$ PhCOOH, Ph$_3$P, DEAD

b) DIBAL-H, THF

?

iv)



a) NaH, Cbz Cl, THF

b) LiBH$_4$, THF

?
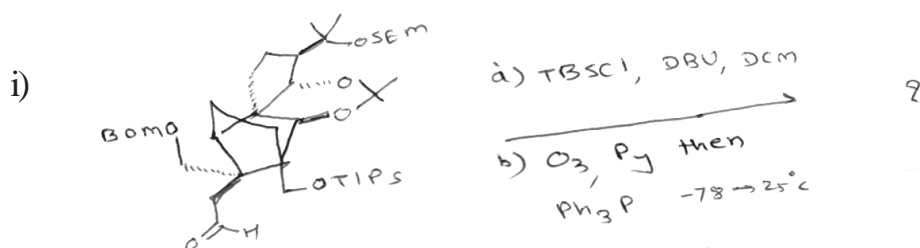
b) Answer the following. **[3]**

Explain the biosynthetic hypothesis that influenced the synthesis of (+3) C–21, epimer Ⓐ of

Originally assigned vannusal B
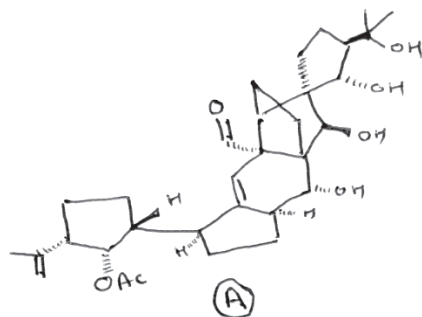


*Q7)* Write the correct reagents involved in the Following conversions and give mechanism of each step (any three) **[12]**

a) 

b) 

c) 

d)
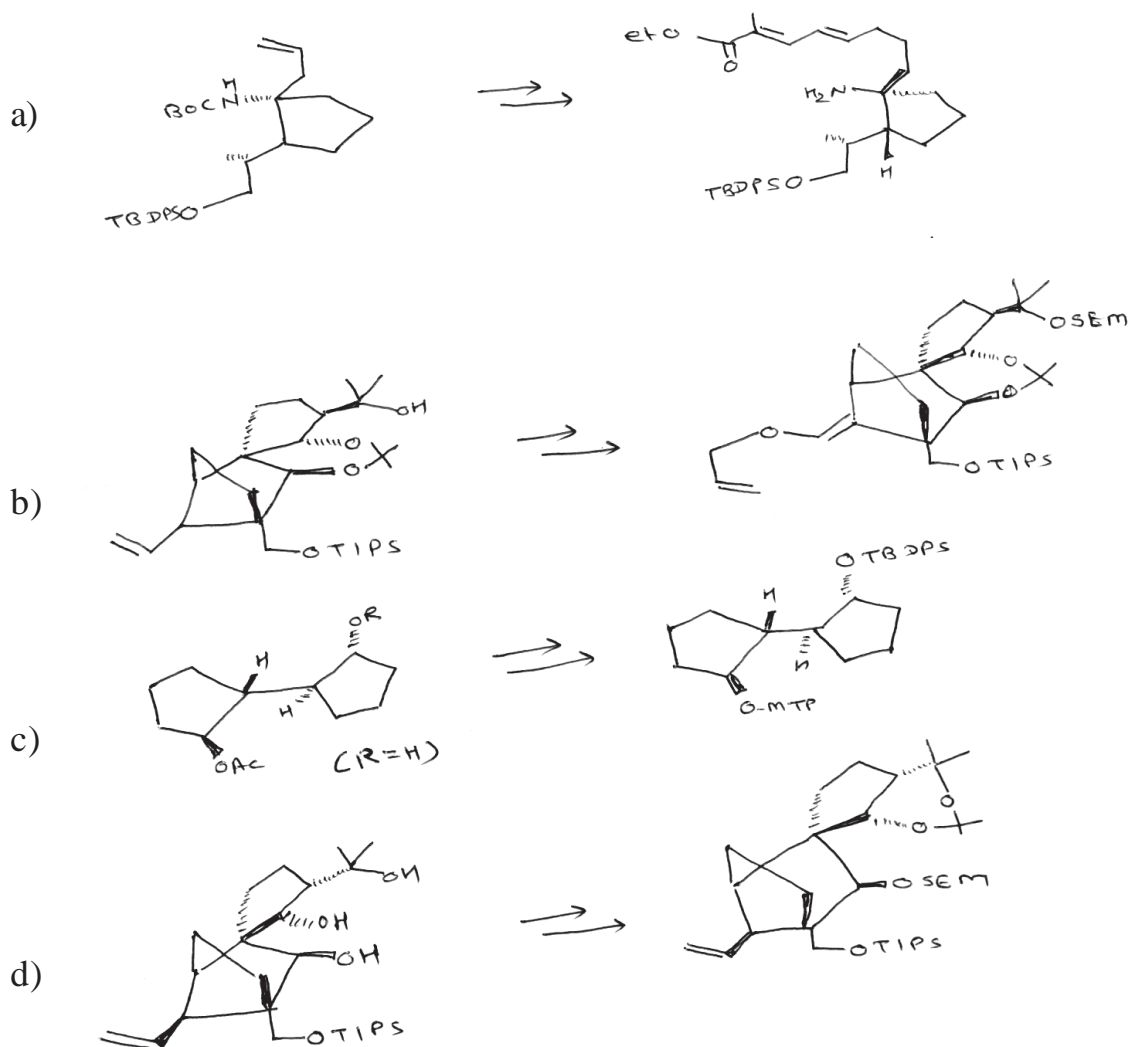
*Q8)* Solve the following. **[12]**

    a)    Explain the steps involved in the degradation study of pinnaic acid for the determination of configuration at C-17.

    b)    Discuss the spectroscopic evidences obtained from the comparison of NMR spectra of originally assigned structure with the natural isomer of vannusal B.

    c)    Write all the steps involved in the retrosynthesis of originally assigned structure of vannusal-B.

❖   ❖   ❖

**[5909]-58**

# M.Sc. - II (Organic Chemistry)
## ORGANOMETALLIC REAGENTS IN ORGANIC SYNTHESIS
### (2019 Pattern) (Semester - IV) (CCTP - II (CHO-451))

*Time : 3 Hours ]*                                                                         *[Max. Marks : 70*

*Instructions to the candidates:*
   *1)   Answer to the two sections should be written in separate books.*
   *2)   Question Nos. 1 & 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.*
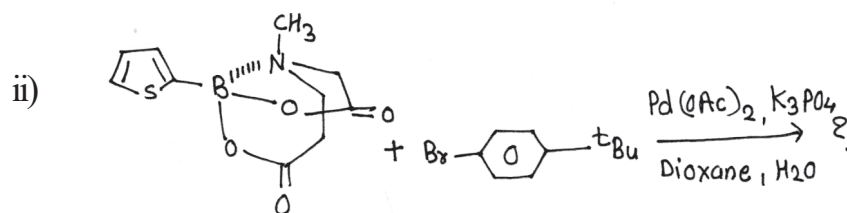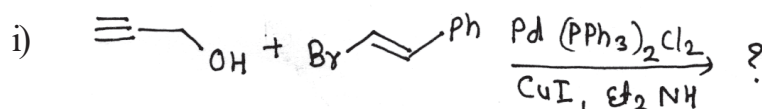   *4)   Figures to the right indicate full marks.*

## SECTION - I

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

   i)   Role of silane activators in Hiyama coupling

   ii)  C-C bond coupling reaction using Grignard reagent

   iii) In Julia - Lythoge reaction, benzothiazole sulphones (BT - Sulphone) are frequently used as a starting material.

   iv)  $RuO_4$ is used for the oxidation of primary alcohols.

   v)   Base catalysed peterson olefination reaction.

   b)   Write a note on Mizoroki - Heck Reaction.                                                   **[3]**

**Q2)** a)   Predict the product                                                                     **[6]**

   i)

   

   ii)

iii)  ① $\underset{2}{H}N-NH-Ts$ ② NaOMe, MeOH
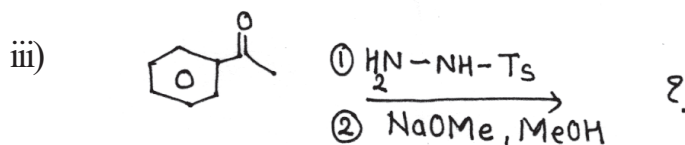
b) Suggest the mechanism. [6]

i) 

ii) 
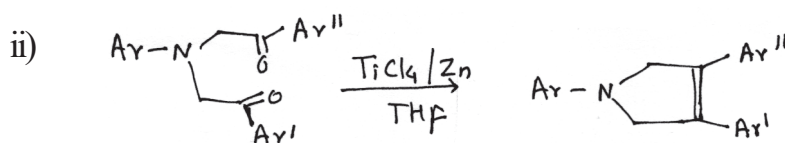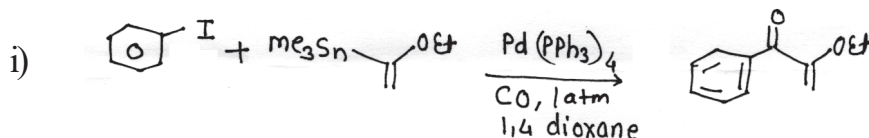
Q3) a) Answer the following. [8]

i) Irridium complexes - uses in organic synthesis.

ii) Predict the product & suggest mechanism.
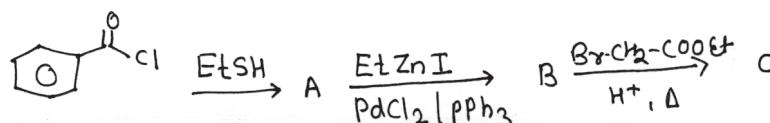


b) Calculate the amount of catalyst pdCl$_2$ required to convert lm mol of bromoanisole to p-methoxy ethyl cinnamate for the following reaction (Given M.W of PdCl$_2$ = 177.33 glmole) [4]
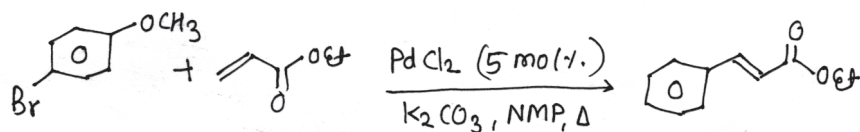


Q4) a) Write a note on [6]
i) Bamford stevens olefination reaction.
ii) Buchwald Hartwig Amination Reaction.

b) Attempt the following. [6]
i) Discuss Wadsworth - Emmon's modification.
ii) Write Oxo process with mechanism.

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

    i) Write the use of silane for the protection of alcohol.

    ii) What is the condition required for the reaction to undergo ring opening metathesis polymerization?

    iii) Why excess of reducing agent is added to carry out the click reaction using $CuSO_4.5H_2O$ as a catalyst.

    iv) Write the use of allyl borane in assymetric synthesis.

    v) What are multicomponent reactions? Enlist the principles involved in multicomponent reaction.

**b)** Predict the product and suggest the mechanism for the following reaction.

    [3]
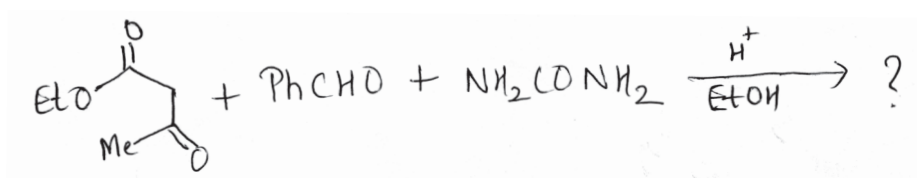


**Q6) a)** Suggest the mechanism for the following reactions. [6]

    i)



    ii)
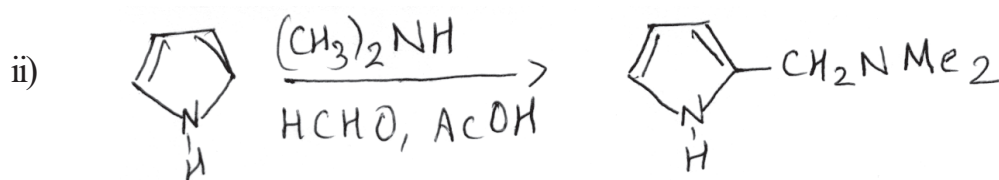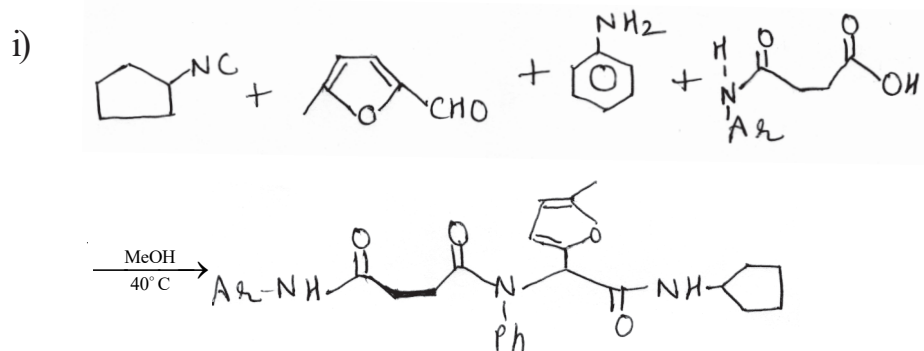


**b)** Predict the product/s of the following. [6]

    i)

ii)  $\xrightarrow{\text{Grubb's Catalyst}}$ A $\xrightarrow[\text{Zn}]{O_3}$ B

iii) $CH_3 - CH = CH_2 \xrightarrow{B_2H_6} A \xrightarrow[\text{NaOH}]{H_2O_2} B$
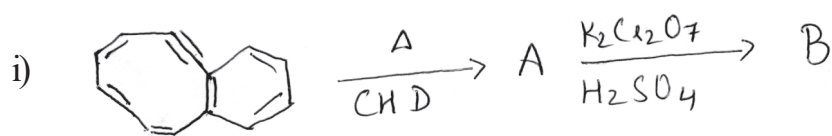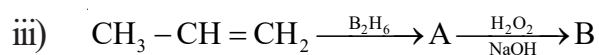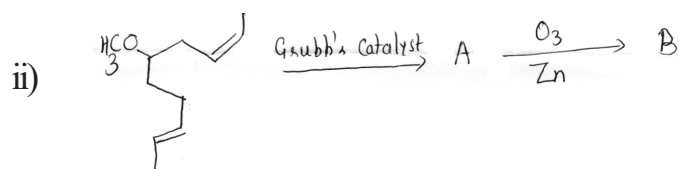
**Q7) a)** Write short notes on [6]

    i) Grubb's first generation catalyst

    ii) Isomerization of organoborane

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

    i)



    ii)



    iii) $CH_3COOH + CH_3CHO + C_2H_5NC \xrightarrow{H\oplus} ?$
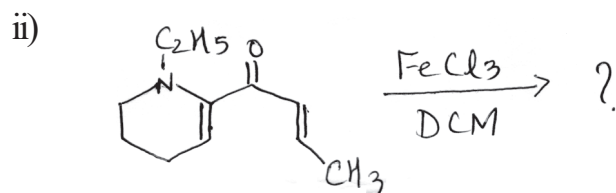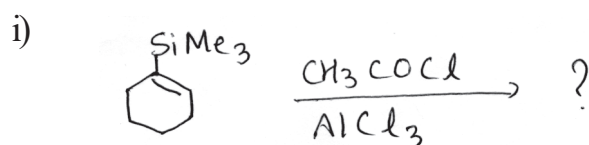
**Q8) a)** Solve the following. [6]

    i) Carry out the following conversion using organoborane.
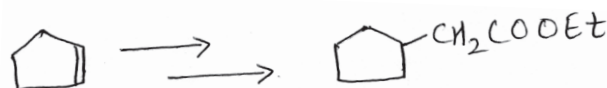


    ii) Predict the product and suggest the mechanism for the following reaction.

    $Ph\ CHO + CH_2 = CHCN \xrightarrow{DABCO} ?$
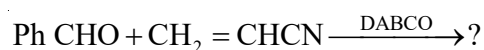
    b) Write short notes on - [6]
    i) Sharpless azide cycloaddition
    ii) 9BBN
    iii) Hydrosilylation

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SEAT No. :

[Total No. of Pages : 4

**[5909]-59**
# M.Sc. (Part - II)
## ORGANIC CHEMISTRY
### CBOP-4 CHO - 452 (A) : Concept and Application of Medicinal Chemistry
### (2019 Pattern) (Semester - IV)

*Time : 3 Hours]*          *[Max. Marks : 70*
*Instructions to the candidates:*
    *1)*    *Q.1 and Q.5 are compulsory and each carry 11 marks.*
    *2)*    *Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.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)    Answer the following.           **[8]**
       i)     Write Hansch equation and name the terms involved in it.
       ii)    Write biocatalytic role of proteins.
       iii)   Write biological functions of TPP.
       iv)   What are multitarget drugs.
    b)    Write note on sources of drugs.         **[3]**

*Q2)* a)    Solve the following. (Any two).       **[8]**
       i)     Explain pharmaco dynamics of drug.
       ii)    Write note on proton pump inhibitor.
       iii)   Explain drug development process.
    b)    Explain drug biotransformation.       **[4]**

*Q3)* a)    Solve the following (Any Two).       **[8]**
       i)     Explain principles of drug design.
       ii)    Explain functions of proteins in living beings.
       iii)   Explain the process of modern drug discovery.
    b)    Explain the drug metabolism process.     **[4]**

*Q4)* a)    Solve any two of the following.       **[8]**
       i)     Explain solution phase peptide synthesis.
       ii)    Explain drug receptor interactions.
       iii)   Explain therapeutic role of peptides.
    b)    Explain drug optimization strategies.     **[4]**

## SECTION-II

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

    i)  What is partition coefficient.

    ii)  Draw the structure of chloramphenicol and give its mode of action.

    iii)  What are tetracyclines? Give their applications.

    iv)  What is Lipinski rule of 5.

  b)  Explain : Acid sensitivity of penicillins.  **[3]**

*Q6)* a)  Solve any - 2.  **[8]**

    i)  What are sulphonamides? Explain their mode of action.

    ii)  Write note on : QSAR.

    iii)  Explain how acyclovir acts as prodrug. Justify its mode of action.

  b)  Explain the general physico-chemical parameters that need tobe considered in drug designing.  **[4]**

*Q7)* a)  Solve any - 2.  **[8]**

    i)  What are cepnacosporins? Explain their mode of action.

    ii)  Write note on : Polyene antibiotics.

    iii)  What are type I statins.

  b)  Explain 'SAR' with an example.  **[4]**

*Q8)* a)  Solve any - 2.  **[8]**

    i)  What are quinolones? Explain their mode of action.

    ii)  Explain : macrolides as protein synthesis inhibitors also give two examples.

    iii)  Draw the structure and give applications of.

       1)  Amphotrecin-B

       2)  Amantadine

  b)  Write note on: Stereochemistry and drug design.  **[4]**

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**PA-3220**

# M.Sc. (Part - II)
# ORGANIC CHEMISTRY
## CBOP-4 CHO - 452 (B) : Applied Organic Chemistry
## (2019 Pattern) (Semester - IV)

*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.*
3) *Answer to the two sections should be written in separate answer books.*
4) *Figures to the right indicate full marks.*

## SECTION-I

*Q1)* a) What is COFs? Explain types of COFs with examples. **[6]**

b) Explain the concept of molecular organic electroluminescent materials. **[5]**

*Q2)* Attempt any two of the following. **[12]**

a) Explain hole injection materials.

b) Explain electron transport and host materials.

c) Explain topology diagrams representing a general basis for COF design.

*Q3)* Attempt the following (Any two). **[12]**

a) Explain different methods for synthesis of COFs.

b) Give comparison of the advantages and disadvantages of the synthesis strategies of COFs.

c) Explain role of polymers in OLEDs.

*Q4)* a) Explain chemical and photo chemical properties of materials for OLEDs.**[6]**

b) Give the synthesis of SCOF-1 with $CuSO_4.5H_2O$. **[6]**

## SECTION-II

*Q5)* a)  Explain light induced switching.  **[6]**

b)  Explain application of supra molecular chemistry.  **[5]**

*Q6)* Attempt any two of following.  **[12]**

a)  Explain role of single molecule junction in the development of single molecule switches.

b)  Explain role of diodes in single molecule switches.

c)  Write a short note on molecular self assembly.

*Q7)* Attempt any two of following.  **[12]**

a)  Explain thought machines exploring Brownian motion.

b)  Write a short note on controlling motion in covalently bonded molecular systems.

c)  Write any two synthesis of super molecules with examples.

*Q8)* a)  Explain controlling motion in supra molecular systems in molecular machines.  **[6]**

b)  Explain self - assembled hybrid organic inorganic materials in self assembly and supra molecular chemistry.  **[6]**

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**[5909]-60**

# M.Sc. (Part - II) (Analytical Chemistry)
## CCTP-10, CHA-490 : ADVANCED ANALYTICAL SPECTROSCOPIC TECHNIQUES
### (2019 Pattern) (Semester - IV)

*Time : 3 Hours]* *[Max. Marks : 70*

*Instructions to the candidates:*

*1)* *Q. 1 and Q. 5 are compulsory.*

*2)* *Answer any two questions from Q.2 to 4 and solve any two questions from Q. 6 to 8.*

*3)* *Answers to two sections should be written on separate answer books.*

*4)* *Figures to right indicate full marks.*

*5)* *Use of logtable & calculators is allowed.*

### SECTION - I

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

    i) Give the principle for FES.

    ii) Draw the neat labelled diagram for direct current plasma.

    iii) Enlist the different mass analyzer's used in ICP-MS.

    iv) Give the importance of atomic fluorescence spectroscopy.

    v) Explain total sulphur analysers.

  b) Quinine in a 1.664 gm antimalarial tablet was dissolved in sufficient 0.10m HCl to give 500 ml of solution. A 20.00nl aliquot was then diluted to 100ml with the acid. The fluorescence intensity for the diluted sample at 347.5 nm provided a reading of 245 on an arbitary scale. A standard 100 ppm quinine solution registered 125 when measured under conditions identical to those for the diluted sample. Calculate the mass in milligram of quinine in the tablet. **[3]**

*P.T.O.*

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

     i)    Explain in detail the Instrumentation of AAS.

     ii)   What are the different interference in ICP-MS. Explain in detail.

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

     i)    How the resonant ionization spectroscopy is applicable for analysis of sample.

     ii)   Several standard solutions of cadmium chloride were prepared & the fluorescent radiance of each solution was measured with a photomultiplier tube at 228.8 nm. The fluorescent radiance of a sample solution was measured under the same experimental conditions. Determine the concentration C of the sample.

| $C \times 10^{-5}$ M | Relative fluorescent radiance |
|---|---|
| 2.50 | 13.6 |
| 5.00 | 30.2 |
| 7.50 | 45.3 |
| 10.00 | 60.7 |
| 12.50 | 75.4 |
| Sample | 50.5 |

*Q3)* a) What are the different mass analyzer used in ICP-MS? Explain any two in detail. **[6]**

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

     i)    How the Laser ionization spectroscopy is worked for analysis of sample?

     ii)   What are the different quantitative methods for analysis of sample by AAS.

*Q4)* a) Draw the schematic diagram of the inductive coupled plasma-mass spectrometer. Explain different component's of ICP-MS in detail. **[6]**

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

i) Explain Flame & Graphite furnace atomizer in AAS.

ii) If a particular photomultiplier tube contains eight dynodes & each dynode emits an average of 4.4 electrons for each impinging electron, calculate the amplification factor of the PM tube.

## SECTION - II

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

i) Define fluorescence

ii) What is triplet state?

iii) Draw the hyperfine splitted ESR spectrum of benzene free radical.

iv) Give any four applications of ESR spectroscopy.

v) What is the principle of Auger electron spectroscopy?

b) Quinine sulphate was analysed by flurometry. 0.1g tablet sample was extracted into 500ml 0.1 M HCl and fluorescence intensity was measured. It was 115.100 ppm quinine sulphate standard in 0.1m HCl showed fluorescence intensity 125. Calculate mg of quinine sulphate in 1.200g tablet. **[3]**

**Q6)** a) Answer the following : **[6]**

i) What is Phosphorescence? Give the difference between fluorescence and phosphorescence.

ii) With suitable example explain the effect of pH on fluorescence.

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

i) Write note on 'g' factor in ESR spectroscopy.

ii) What is free radical? How the splitting of lines take place if free radical contain atom with ½ nuclear spin?

*Q7)* a) Discuss the characteristics of the photoelectron and Auger electron spectra. **[6]**

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

   i) Explain selection rules for transition of electron in ESR spectroscopy.

   ii) With suitable example explain ESR spectrum of free radical containing a set of equivalent protons.

*Q8)* a) Explain with diagram instrumentation of fluorometer and spectroflurometer. **[6]**

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

   i) Chemiluminescence method for the estimation of gases.

   ii) Construction and working of electron gun in electron spectrometer.

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### [5909]-61
## M.Sc. (Semester - IV)
## ANALYTICAL CHEMISTRY
## CCTP-11 CHA-491 : Chemical Methods of Pharmaceutical Analysis
## (2019 Pattern) (4 Credits)

*Time : 3 Hours]*                                                   *[Max. Marks : 70*

*Instructions to the candidates :*
1) *Question 1 and 5 are compulsory.*
2) *Question 2 to 4 and 6 to 8 carry equal marks.*
3) *Solve any two questions from 2 to 4 and 6 to 8.*
4) *Figures to right indicate full marks.*
5) *Answers to two sections should be written on seprate answer sheets.*

### SECTION - I

**Q1)** a)   Solve any four of the following :                              **[8]**
   i)   Define 'Ointment'.
   ii)  Define 'Ear drops'.
   iii) Define 'Oral Powder'
   iv)  Define 'Injection'.
   v)   Define 'Disintegration test'.

b)   Solve the following :                                               **[3]**
5 gm of the sample was subjected to saponification with 50ml of alkoholic KOH and it was titrated against 0.5 N HCl with phenolpthalein indicator it required 10ml of it. If the blank value of alcoholic KOH was 50ml of 0.5N HCl calculate the saponification value of oil.

**Q2)** a)   Explain in detail.                                             **[6]**
   i)   Limit test for chlorides.
   ii)  Test for uniformity of weight for tablets / capsules.

b)   Differentiate between the following :                              **[6]**
   i)   Soft capsules and hard capsules.
   ii)  Gel and creame.

*P.T.O.*

*Q3)* a) Define 'Iodine value'? Explain in detail method of estimation of Iodine value. **[6]**

b) Write a note on : **[6]**

   i) Zone of Potency.

   ii) Standard reference material used for antimicrobial assay.

*Q4)* a) Explain in brief tube assay for growth promoting substances. **[6]**

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

   i) Explain in brief Dissolution test.

   ii) Explain in detail turbidometric method in microbial assay.

## SECTION - II

*Q5)* a) Solve any 4 of the following : **[8]**

   i) What is Excipient.

   ii) Development of new drugs.

   iii) Give documentation requirement for marketing authorization.

   iv) Why identification test are performed.

   v) What is medicinal product.

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

Tablet containing fluoxetine hydrochloride each equivalent to 20mg fluoxetine are to be analysed 20 capsules are collected and the total mass is 3.950 gm calculate average content of each capsule.

*Q6)* a) Explain in detail. **[6]**

   i) Explain assay of omeprazole by aqueous acid base titration.

   ii) Explain in detail test for chloride and sulphates.

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

   i) Explain the assay of paracetamol by titrimetric method using ceric ammonium sulphate.

   ii) State the principle of TLC. Explain identification of metrifonate by TLC.

**[5909]-61**                                     2

*Q7)* a) What are related substances? Give detail account of determination of related substances in omeprazole according to LC method. **[6]**

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

i) What is appearance of solution. Explain the determination of appearance of solution for Ibuprofen.

ii) 0.1487 g of sample of famous fumarate is dissolved according to the procedure and titrated with 0.0996M cerium sulphate. End point of the titration is observed at 8.81ml the molar mass of famous fumarate in 169.9 gm. Calculate percent parity of sample.

*Q8)* a) Assay Fentanyl in Fentanyl citrate injection by LC method with respect to sample and standard preparation chromatographic condition. Give procedure and equation for calculation. **[6]**

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

i) Write a note on Identification of optical rotation.

ii) 0.2099 g of sample of ephedrine is dissolved in 5ml of ethanol and added to 20ml of 0.10 24M Hd. This solution is titrated with 0.0998m NaOH. The end point observed at 7.75 ml The molar mass of ephedrine is 165.2 g/mole calculate percentage content of ephedrine in sample.

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**PA-3223**

**[5909]-62**

# M.Sc. (Part - II)
# ANALYTICAL CHEMISTRY
## CBOP-4, CHA-492 : (A) Laboratory Automation and Environmental Analytical Chemistry
### (2019 Pattern)  (Semester - IV)

*Time : 3 Hours]*        *[Max. Marks : 70*

*Instructions to the candidates:*

1) *Answers to the Two sections should be written on separate answer books.*

2) *Figures to the right indicate full marks.*

3) *Use of logtable and calculator is allowed.*

### SECTION - I

*Instructions :*

1) *Question 1 is compulsory.*

2) *From question 2 to 4 solve any two.*

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

     i)     What is control loop? Give the types.

     ii)    What is automatic titration?

     iii)   Enlist different types of analysers.

     iv)   What are the advantages of Automation?

     v)    State any four criteria for sensor.

   b)    Give an account of Laminar-H filter for extraction of low molecular weight components during sampling.      **[3]**

*P.T.O.*

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

      i)    Role of biosensors in analysis.

      ii)   Advantages and disadvantages of automation.

  b)  Explain the following : [6]

      i)    Batch and continuous flow analysis.

      ii)   Parallel integration

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

      i)    Optical sensors

      ii)   Discrete sample analyser

  b)  Attempt the following : [6]

      i)    Objectives of automation in analytical chemistry.

      ii)   Flow Injection analysis for reproducible sampling.

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

      i)    Miniaturized analytical system.

      ii)   Voltametric chemical sensors.

  b)  Explain the following : [6]

      i)    What is biosensor? Explain methods of immobilization.

      ii)   Define microfabrication. Explain glass micromatching.

## SECTION - II

*Instructions :*

  1)  *Question No. 5 is compulsory.*

  2)  *Question No. 6 to 8 solve any two questions.*

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

      i)    Give two health hazards of carbon monoxide.

      ii)   Define microwave assisted digestion.

      iii)  What is TOC?

      iv)  Which are the radionuclides present as water pollutants?

      v)   Give examples of metalloid pollutants.

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

A 30 ml of sewage water sample was refluxed with 10 ml of 0.25 N $K_2Cr_2O_7$ solution. The untreated dichromate requires 8.0 ml of 0.1 N FAS. 10 ml of dichromate solution and 25 ml of distilled water, under same condition as sample required 35 ml of 0.1 N FAS. Calculate the COD of the sewage sample.

**Q6) a)** Explain in detail : **[6]**

i) How is sampling carried out for the air samples? Explain

ii) Explain the process of Eutrophication and it's disadvantages.

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

i) What are detergents and detergent builders? Why are detergent builders added to detergents?

ii) 100 ml waste water sample is taken and titrated against standard acid having normality 0.11 N. It gave a burette reading of 24 ml, using phenolphthalein indicator. Determine the alkalinity of this sample.

**Q7) a)** Discuss the determination of sulphur dioxide any one analytical technique. **[6]**

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

i) Give specific examples of following classes : of water pollutants

1) Heavy metals

2) Trace elements

3) Metalloids

ii) Discuss colorimetric method for estimation of phosphate from waste water.

*Q8)* a)    What is dry ashing and wet digestion? Discuss different types of acid digestion processes.    **[6]**

b)   i)    How are the following parameters estimated in water samples? **[3]**

1)   Odour

2)   Colour

ii)   50 ml of standard hard water requires 45 ml of EDTA solution for titration. 50 ml hard water sample requires 18 ml of same EDTA solution. Calculate the hardness if 1 ml standard hard water contains 1.2 mg of $CaCO_2$ eq.    **[3]**

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**PA-3223**

**[5909]-62**

# M.Sc. (Part - II)
# ANALYTICAL CHEMISTRY
## CBOP-4, CHA-492 : (B) Analytical Chemistry of Agriculture, Polymer and Detergents.
### (2019 Pattern)  (Semester - IV) (4 Credits)

*Time : 3 Hours]*          *[Max. Marks : 70*

*Instructions to the candidates:*

*1) Question 1 and 5 compulsory.*

*2) Question 2 to 4 and 6 to 8 carry equal marks.*

*3) Solve any two questions from 2 to 4.*

*4) Figures to the right indicate full marks.*

*5) Answers to the two sections should be written on separate answer sheets.*

## SECTION - I

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

     i) Give loss on ignition method for determination of organic matter.

     ii) Enlist the clean-up techniques used for pesticides on environment.

     iii) Give methods for determination of moisture and neutralising value of lime material.

     iv) Give effects of excessive use of pesticides on environment.

     v) What is mean by sub-sampling.

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

     From 0.250 gm of sample, calcium was precipitated as calcium oxalate. The solution obtained after dissolution of the precipitate of calcium oxalate required 26 ml of 0.05 N $kMnO_4$ solution for titration. Calculate percentage of calcium and calcium oxalate (Atomic mass of Ca = 40, C = 12, D = 16)

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

   i)   Define Herbicides and explain in detail analytical method for substituted phenyl urea herbicides.

   ii)  Explain in detail Kjeldhal's method for determination of Nitrogen.

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

   i)   Explain cation exchange capacity & give the method for determination of cation exchange capacity.

   ii)  Orthophosphate was determined by weighing as ammonium phosphomolybdate $(NH_4)_2PO_4$. $12MoO_3$. Calculate percentage of phosphorus and $P_2O_5$. If 1.673 gm of precipitate was obtained from 0.328 gm of sample.

   (Given : At. wt Mo = 95.94, P = 30.97 gm)

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

   i)   Give method for determination of water soluble phosphorus.

   ii)  Give analytical procedure for estimation of dithiocarbamate in fungicides.

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

   i)   Give analytical method for measurement of calcium and magnesium by atomic absorption method.

   ii)  Explain analytical method for determination of total nitrogen in presence of nitrate and organic nitrogen.

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

   i)   Give analytical method for determination of phthalimide fungicides.

   ii)  0.485 gm of soil was analysed for nitrogen content by Kjeldhal's method. The evolved $NH_3$ 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 16.4 ml. Calculate percentage of nitrogen in given sample of soil.

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

   i)   Give analytical method for determination of water soluble potassium.

   ii)  Write analytical method for determination of extractable sulphur.

## SECTION - II

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

     i)     State basic types of stress measurements.

     ii)    Define Iodine value

     iii)   Define cationic surfactant

     iv)   Explain the term Elastomers with suitable example.

     v)    Define biodegradable polymers.

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

The intrinsic viscosities of solutions of polystyrene in toluene is 180 $cm^3/am$ at 25°C. Determine the molecular weight of this polymer. The Mark - Houwink - Sakurada constants for this system are

$K = 3.60 \times 10^{-2}$ l $gm^{-1}$ and a = 0.64.

**Q6)** a) Explain in detail from the following : **[6]**

     i)     Explain Raman spectroscopy for characterize the structural properties of polymers.

     ii)    Explain the use of NMR spectroscopy for characterize the structural properties of polymers.

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

     i)     Describe how to characterize the mechanical properties of polymers using tensile test.

     ii)    The density and associated data for two polypropylene samples are listed below in table. Determine the density of a sample having 74.6% crystallinity.

Density and crystallinity data for two polypropylene samples

| $\rho$ (g $cm^{-3}$) density | Crystallinity (%) |
|:---:|:---:|
| 0.904 | 62.8 |
| 0.895 | 54.4 |

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

    i) Describe determination of acid value, ester value and saponification value.

    ii) Describe para toluidine precipitation method for analysis of anionics.

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

    i) What is principles of potentiometric titration. Explain acid-base titrations potentiometrically using glass electrod.

    ii) Explain determination of mean molecular weight of alkane monosulphate for analysis of anionics surfactants.


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

    i) Discuss the use of UV-visible spectroscopy for identification of polymers.

    ii) Discuss various chromatographic techniques for identification of polymer samples.

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

    i) Explain ultracentrifugation method for the determination of molecular weights of polymer samples.

    ii) The data shown below in table were obtained for the molecular weight distribution of sample of polymer. Determine the weight average molecular weight of this material.

Molecular weight distribution of a sample of polymer.

| Mean $M_i$ kg/mol | $W_i$ |
|---|---|
| 14 | 0.147 |
| 26 | 0.818 |
| 38 | 0.167 |
| 50 | 0.293 |
| 62 | 0.234 |
| 74 | 0.155 |
| 86 | 0.054 |

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