

Total No. of Questions : 6]

SEAT No. :

P1339

[Total No. of Pages : 4

[5123]-11

M.Sc.

PHYSICAL CHEMISTRY

CH - 110 : Physical Chemistry - I

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following. **[15]**

- a) Explain Einsteins photoelectric effect. How does it support Panck's hypothesis of quantization of energy?
- b) Derive time independent Schrödinger wave equation.
- c) Obtain the workdone in a reversible adiabatic expansion of an ideal gas.
- d) Explain exact and inexact differentials.
- e) What is meant by thermodynamic equilibrium? Discuss the equilibrium between a liquid and its vapour and hence deduce Clausius- Clapeyron equation.

**Q2)** Attempt any three of the following. **[15]**

- a) Derive the Gibbs-Duhem equation. What are its applications.
- b) Write the combined mathematical statement of first and second law of thermodynamics. What are inadequacies of the first law?
- c) Waht is partial molar quantity? Explain any one method to determine partial molar quantity.
- d) Explain the terms osmosis and reverse osmosis. Give applications of each.
- e) Derive the Gibbs - Helmholtz equation. What is temperature coefficient of a reaction?

**Q3)** Solve any two of the following. **[10]**

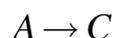
- a) What is the degeneracy of the level for which the total energy
  - i)  $14h^2/8ma^2$  and
  - ii)  $21h^2/8ma^2$

- b) What is the standard deviation in the velocity of an electron if the uncertainty in its position is 100pm?
- c) Calculate the kinetic energy of an electrons emitted from a potassium surface ( $\phi = 564nm$ ). The irradiation wavelength is 410nm.

### SECTION - II

**Q4)** Attempt any three of the following. **[15]**

- a) What is steady state approximation? Apply steady state approximation to enzyme catalyzed reactions to obtain Michaelis. Menton equation.
- b) Enlist the methods to study kinetics of fast reaction. Discuss any one in detail.
- c) Discuss any two methods to determine order of a reaction.
- d) Show that for a parallel reaction,  $A \rightarrow B$



the ratio of concentration of products remain constant at any time during the course of reaction.

- e) Explain diffusion controlled and activation controlled reaction in solution phase.

**Q5)** Attempt any three of the following. **[15]**

- a) Explain the mechanism of explosive reaction with reference to  $2H_2 + O_2 \rightarrow 2H_2O$ .
- b) Formulate thermodynamics of activated state using the Eyring equation
- c) Derive the expression for total partition function for a molecule.
- d) Explain stirling approximation and thermodynamic probability. Obtain the condition for maximum probability.
- e) Discuss Fermi-Dirac statistics.

**Q6)** Solve any two of the following.

**[10]**

- a) For a reaction  $A \rightarrow \text{products}$ , rate is directly proportional to  $[A]$ . It was observed that 90% of react it reacts in 1.2 h. calculate the rate constant and the half life period for this reaction.
- b) The moment of inertia for a rigid diatomic is  $5 \times 10^{-47} \text{ kgm}^2$ . Calculate its rotational partition function at  $25^\circ\text{C}$ .
- c) Half life period of a first order reaction is 20 minutes. Show that the reaction is not 100% complete even after 6 half lives.



Total No. of Questions : 6]

SEAT No. :

P3582

[Total No. of Pages : 5

[5123]-12

M.Sc. (Semester - I)

CHEMISTRY

CH - 130 : Molecular Symmetry and Chemistry of P -block Elements  
(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

**SECTION - I**

Q1) Attempt any three of the following : [15]

- a) Assign appropriate point group for any two of the following :
  - i) Benzene
  - ii) Trans - H<sub>2</sub>O<sub>2</sub>
  - iii) H<sub>3</sub>BO<sub>3</sub>
- b) Using Great orthogonality Theorem derive the character table for C<sub>2v</sub> point group Given : The classes for the point group are E, C<sub>2</sub>, σ<sub>v</sub><sup>xz</sup>, σ<sub>v</sub><sup>yz</sup>.
- c) Sketch and describe all symmetry operations of B<sub>2</sub>H<sub>6</sub> molecule.
- d) What are symmetry elements and symmetry operations? Explain all possible axes of symmetry in SF<sub>6</sub>.
- e) Using matrix multiplication as well as schematic representation give the product of C<sub>2</sub><sup>(z)</sup> × σ<sub>v</sub><sup>xz</sup>.

**P.T.O.**

Q2) Attempt any three of the following :

[15]

- a) Which irreducible representations of  $C_{4v}$  point group form the basis of the following reducible representation.

$C_{4v}$	E	$2C_4$	$C_2$	$2\sigma_v$	$2\sigma_d$
$\overline{red}$	1	-1	1	-1	1

Given : Character table for  $C_{4v}$ .

$C_{4v}$	E	$2C_4$	$C_2$	$2\sigma_v$	$2\sigma_d$
$A_1$	1	1	1	1	1
$A_2$	1	1	1	-1	-1
$B_1$	1	-1	1	1	-1
$B_2$	1	-1	1	-1	1
E	2	0	-2	0	0

- b) Label the following irreducible representations with appropriate Mulliken symbols stating the rules.

	E	$2C_3$	$3C_2$	i	$2S_6$	$3\sigma_d$
$\overline{1}$	1	1	1	1	1	1
$\overline{2}$	1	1	-1	1	1	-1
$\overline{3}$	2	-1	0	2	-1	0
$\overline{4}$	1	1	1	-1	-1	-1
$\overline{5}$	2	-1	0	-2	1	0

- c) Find out the normalized SALC using projection operator of  $A'_1$  irreducible representation on  $\sigma_1$  orbital of the following molecule.

Given :



ii) 
$$\hat{P} = \frac{1}{h} \sum_R \chi(R) R^1$$

iii)

$D_{3n}$	E	$2C_3$	$3C_2$	$\sigma_n$	$2S_3$	$3\sigma_v$
$A'_1$	1	1	1	1	1	1

- d) List all the symmetry elements for water molecule and show that they form a mathematical point group.
- e) On the basis of symmetry, what is the criterion for the molecule to be optically active? Which of the following molecules is/are optically active?
- i)  $\text{CHClF}_2$
- ii)  $\text{BF}_3$

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

- a) Explain with suitable examples the following symmetry elements and symmetry operations :
- i) Center of inversion and inversion
- ii) Principal axis and proper rotation.
- b) Define the following :
- i) Unit cell
- ii) Bravais lattice
- iii) Glide plane
- iv) Miller indices
- v) Screw axis
- c) What are the point groups possible for a linear molecule? Explain in detail giving suitable examples.

## SECTION - II

**Q4)** Attempt any three of the following : **[15]**

- a) Give classification of binary compounds of hydrogen.
- b) Give synthesis and structures of xenon fluorides.
- c) Explain the separation of alkali metals by using crown ethers.
- d) What are interhalogen compound? Write the important reactions of interhalogen compounds.
- e) Given an account of compounds of carbon with nitrogen.

**Q5)** Attempt any three of the following : **[15]**

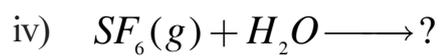
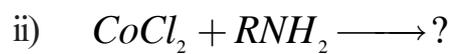
- a) Write a note on reaction of  $\text{RMgX}$ .
- b) Write a note on zeolites as molecular sieves.
- c) What are aluminosilicates? Explain.
- d) Write a detailed account on phosphazenes.
- e) Give characteristic reactions of dihydrogen.

**Q6)** a) Draw the structures of following (any five) : **[5]**

- i)  $\text{S}_4\text{N}_4\text{F}_4$
- ii)  $\text{N}_2\text{O}_5$
- iii)  $\text{IF}_7$
- iv)  $[\text{B}_6\text{H}_6]^{2-}$
- v)  $\text{P}_4\text{O}_{10}$
- vi)  $\text{B}_3\text{N}_3\text{H}_6$

b) Complete the following reactions (any five) :

[5]



Total No. of Questions : 6]

SEAT No. :

P1340

[Total No. of Pages : 4

[5123]-13

M.Sc. (Part - I) (Semester - I)

ORGANIC CHEMISTRY

CH - 150 : Organic Reaction Mechanism and Stereochemistry  
(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

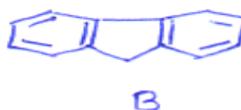
Instructions to the candidates:

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

SECTION - I

Q1) Attempt any four of the following. [16]

- a) Reaction of n-propyl bromide with toluene in presence of  $AlBr_3$  gives 4-methyl cumene. Explain
- b) Which of the following is stronger acid? Why?



- c) Differentiate between protic and aprotic solvents
- d) N,N - Dimethyl aniline reacts much faster in aromatic electrophilic reactions than 2,6-N,N-Tetramethyl aniline. Explain
- e) Ethyl cinnamate undergoes electrophilic substitution mainly at meta position. Explain.

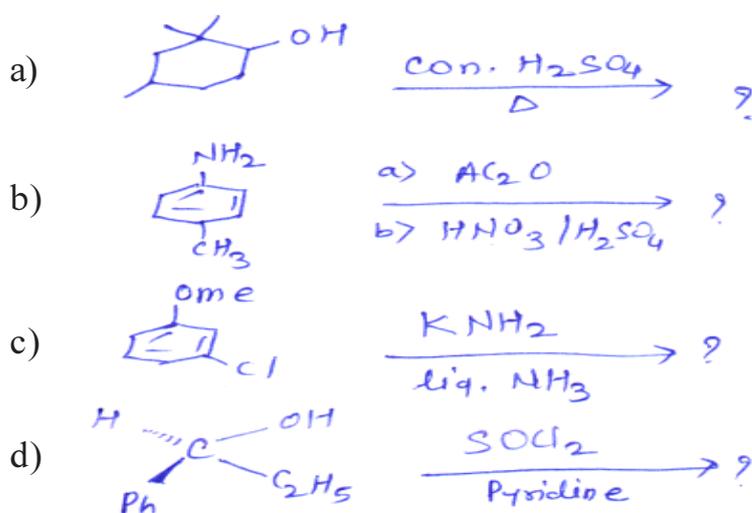
Q2) Write short notes on any three of the following. [12]

- a) Phase Transfer catalyst
- b) SET mechanism
- c) IPSO - substitution
- d) Ambident Nucleophiles

P.T.O.

Q3) Predict the products with mechanism (any three)

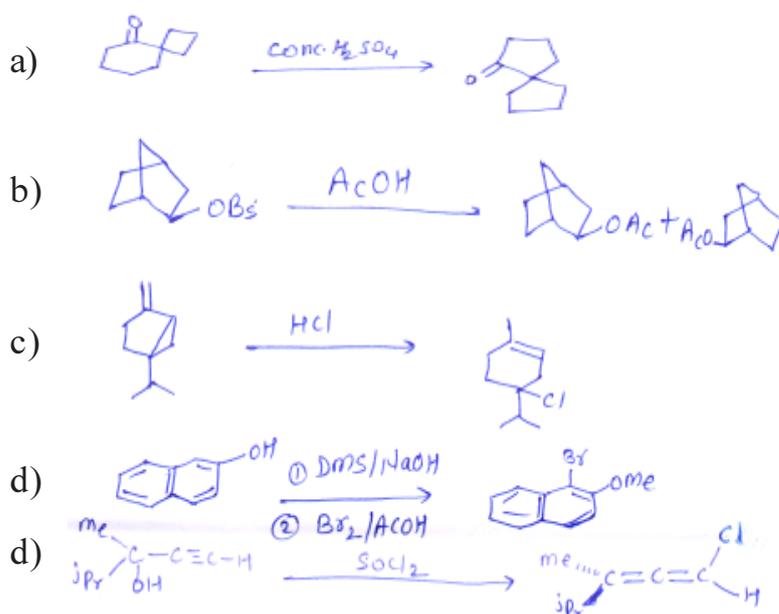
[12]



### SECTION - II

Q4) Suggest mechanism for any four of the following.

[12]



Q5) Attempt any eight of the following.

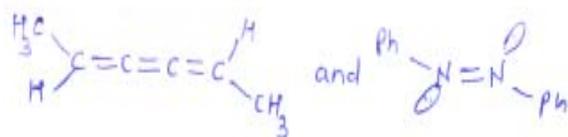
[16]

a) Which of the following compound is optically active? Justify

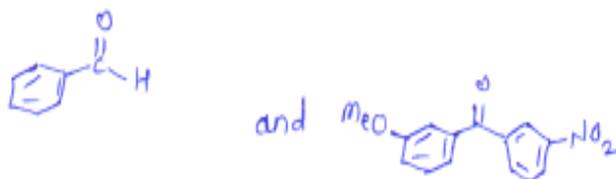


b) Cyclopentadienyl an ion is aromatic. Explain

c) Assign E/Z to the following.



d) Assign si and Re faces in the following compounds.



e) Convert Fischer to Newman for the following structure



f) Identify aromatic, anti aromatic and non aromatic amongst the following.



g) Which of the following compound is optically active



h) Identify chiral carbons and find total No. of stereo isomers in the following compounds.



i) Pyrrole is stronger acid than pyrrolidine. Explain

**Q6)** Attempt any four of the following.

**[12]**

- a) Which of the following is a stronger base? Why



- b) With the help of suitable example explain Non Classical carbocation
- c) Explain stereo selective and stereo specific reactions with suitable example.
- d) The proportion of gauche conformation of z-hydroxy ethanethiol is more than expected. Explain.
- e) Write a shortnote on 'Prochiral relationship'.



Total No. of Questions : 6]

SEAT No. :

P1341

[Total No. of Pages : 3

[5123]-21

M.Sc - I (Semester - II)

CH - 210 : PHYSICAL CHEMISTRY - II

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following. **[15]**

- a) Obtain the expression for moment of inertia for rigid diatomic molecule.
- b) Explain the terms Resolving power and signal to noise ratio.
- c) Explain the different factors affecting intensity of spectral transitions.
- d) Distinguish between harmonic and anharmonic oscillator with respect to energy, selection rule and zero point energy.
- e) Describe the P.Q.R. Branches of vibrational spectra of a diatomic molecule with a suitable example.

**Q2)** Attempt any two of the following. **[15]**

- a) Explain the applications of Mössbauer spectroscopy.
- b) Write a note on predissociation spectra.
- c) Discuss Fortrant diagram.
- d) Distinguish between Quantum and classical theory of Raman effect.
- e) Sketch and explain the polarizability ellipsoids for CO<sub>2</sub> molecule.

**Q3)** Solve any two of the following. **[10]**

- a) The rotational constant for <sup>79</sup>Br <sup>19</sup>F is 0.35717 cm<sup>-1</sup>. What is the value of J for which the most intense line will be seen at 300k?
- b) The life time of an excited species is 100Ps. Estimate the separation between the spectral lines corresponding to the excitation transition.
- c) The equilibrium vibration frequency of the iodine molecule is 215 cm<sup>-1</sup> and the anharmonicity constant  $x_e$  is 0.003. What is the intensity of the hot band for  $\gamma = 1 \rightarrow \gamma = 2$ , relative to the fundamental  $\gamma = 0 \rightarrow \gamma = 1$ , if the temperature is 300k.

## SECTION - II

**Q4)** Attempt any three of the following. **[15]**

- a) Discuss the four factor formula used in reactor technology.
- b) Explain the terms half life, average life and  $\delta$ -ray track
- c) Explain isotope separation method for plutonium.
- d) Write a note on compton scattering.
- e) Describe principle, construction, working and limitations of G. M. Counter.

**Q5)** Attempt any three of the following. **[15]**

- a) What are the different modes of interaction of gamma rays with matter?
- b) How does the solubility of a sparingly soluble salt be determined using radio-isotopes. Explain with suitable example.
- c) What is design parameter? Classify the reactors on the basis of fuel and moderator.
- d) Give the preparation of  $^{35}\text{S}$  and  $^{22}\text{Na}$  isotopes.
- e) Write a note on Fricke desimeter.

**Q6)** Solve any two of the following. **[10]**

- a) It is known that 1gm of  $^{226}\text{Ra}$  emits  $11.6 \times 10^{17}$  atoms of radon per year. Given the half-life period of Ra to be 1600y. Calculate the value of the Avogadro's constant.
- b) Given the electron absorption coefficient to be 0.211 b/electron for 1 MeV, r - radiation. Calculate the molecular, mass and linear absorption coefficient for water [Given,  $\rho = 1.0 \text{ gm cm}^{-3}$  for  $\text{H}_2\text{O}$ ]
- c) 0.1gm of Mn sample was irradiated in a Neutron flux of  $10^7 \text{ n. cm}^{-2} \text{ s}^{-1}$ , for 30 minutes. What will be its activity at the end of the irradiation.



Total No. of Questions : 6]

SEAT No. :

P1342

[Total No. of Pages : 4

[5123]-22

**M.Sc. (Semester - II)**  
**INORGANIC CHEMISTRY - II**

**CH - 230 : Molecular Symmetry and Chemistry of Pblock Elements**  
**(2008 Pattern) (Part - I)**

*Time : 3 Hours]*

*[Max. Marks : 80*

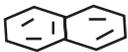
*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Attempt any three of the following:

**[15]**

- a) Give stereo graphic projection of  $D_{3h}$  and  $C_{2h}$  point groups. Justify your answer.
- b) Explain with suitable examples following symmetry elements and symmetry operations
  - i) Centre of inversion and inversion
  - ii) Principal axis and proper rotation.
- c) Assign any two of the following molecules into appropriate point group.
  - i)  $NH_3$
  - ii)  $H_3BO_3$
  - iii) 
- d) What are the conditions of a mathematical group? Explain them with help of trans  $H_2O_2$ .
- e) Prepare group multiplication table for water molecule.

**P.T.O.**

**Q2)** Attempt any three of the following:

[15]

- a) Using matrix multiplication method find the product of:
- $i \times i$
  - $C_2^y \times \sigma_{xy}$
- b) For the  $PCl_5$  molecule, find out reducible representation for which sigma bonds form the basis and find out which of the orbitals from the p atom will be offered for sigma bonding (character table given below)

$D_{3h}$	E	$2C_3$	$3C_2$	$\sigma_h$	$2S_3$	$3\sigma_v$	
$A_1'$	1	1	1	1	1	1	$x^2+y^2z^2$
$A_2'$	1	1	-1	1	1	-1	Rz
$E'$	2	-1	0	2	-1	0	$(x,y) (x^2-y^2,xy)$
$A_1''$	1	1	1	-1	-1	-1	
$A_2''$	1	1	-1	-1	-1	1	Z
$E''$	2	-1	0	-2	1	0	Rx,Ry xz,yz

- c) using great orthogonality theorem, derive the character table for  $C_{2h}$  point group. Assign the irreducible representation with appropriate mulliken symbols. Justify it.
- d) Sketch and explain all the symmetry elements for  $C_5H_5^-$  ion.
- e) Write all possible isomers of  $Ma_2b_2C_2$  complex where M is the central atom and b and c are monodentate ligands state which isomer is optically active. Justify your answer on basis of symmetry criterion for optical activity.

**Q3)** Attempt any two of the following:

[10]

- a) Find out the normalized SALC using projection operator of  $B_{19}$  irreducible representation which operates on  $\sigma_1$  orbital of  $[AuCl_4]^{2-}$  ion

$D_{4h}$	E	$2C_4$	$C_2$	$2C_2'$	$2C_2''$	i	$2S_4$	$\sigma_h$	$2\sigma_v$	$2\sigma_d$
$B_{19}$	1	-1	1	1	-1	1	-1	1	1	-1

- b) Define the terms with examples
- Crystal lattice
  - Unit cell
  - Miller indices
  - Weiss indices
  - Space lattice
- c) Write the characters of the representations of the following direct product and determine the set of irreducible representations which comprise them for the point group T<sub>d</sub>. Direct product T<sub>1</sub> x E  
(Given : Character table for T<sub>d</sub> point group)

T <sub>d</sub>	E	8C <sub>3</sub>	3C <sub>2</sub>	6S <sub>4</sub>	6σ <sub>d</sub>		
A <sub>1</sub>	1	1	1	1	1		$x^2+y^2+z^2$
A <sub>2</sub>	1	1	1	-1	-1		
E	2	-1	2	0	0		$2z^2-x^2-y^2, x^2-y^2$
T <sub>1</sub>	3	0	-1	1	-1	R <sub>x</sub> , R <sub>y</sub> , R <sub>z</sub>	
T <sub>2</sub>	3	0	-1	-1	1		$xy, xz, yz$

### SECTION - II

**Q4)** Attempt any three of the following: **[15]**

- Give the characteristic reactions of dihydrogen.
- Explain the alkali metal solution in ammonia used as a good reducing agent.
- Write short note on fixation of Nitrogen.
- Give an account of electron rich compounds
- Write a short note on aluminosilicates

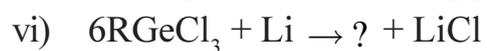
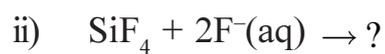
**Q5)** Write short notes on (any three) **[15]**

- Molecular sieves
- Pseudohalogens
- Nitrogen oxyanions
- preparation of fluorides of xenon
- Borazine

**Q6) a) Draw any five structures: [5]**



**b) Complete any five reactions [5]**



**[5123]-22A**  
**M.Sc. (Part - I) (Semester - II)**  
**CHEMISTRY**  
**CH - 230 : Inorganic Chemistry - II**

*Time : 3 Hours]**[Max. Marks : 80**Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and calculators is allowed.*
- 6) *Given atomic Numbers; Gd = 64, Pm = 61, Ho=67, Cr = 24, Cu = 29.*

**SECTION - I**

**Q1)** Attempt any three of the following : **[15]**

- a) Classify the following configurations as A, E or T in complexes having oh symmetry. Some of these configurations represent excited states.
 

i) $(t_{2g})^4 (eg)^2$	ii) $(t_{2g})^6$ ,
iii) $(t_{2g})^3 (eg)^3$ ,	iv) $t_{2g}^5$ ,
v) $eg^2$ .	
- b) For each of the following free ion terms, determine the values of  $L$ ,  $M_L$ ,  $S$ , &  $M_S$  :
 

i) $3_G$	ii) $3_F$
----------	-----------
- c) Give the full spectroscopic symbol for the ground state term of the following ions.
 

i) $Gd^{3+}$	ii) $Pm^{3+}$
iii) $HO^{3+}$	iv) $Cr^{3+}$
v) $Cu^{2+}$	
- d) Calculate the degeneracy of the following configurations/ions/terms.
 

i) $2.{}^2B_{1g}$	ii) ${}^3T_{2g}$
iii) $f'd^1$	iv) ${}^6I$
v) $(t_{2g})^2(eg)^2$	

**P.T.O.**

- e) Explain the following
- $\text{KMnO}_4$  shows intense purple colour while  $[\text{Mn}(\text{H}_2\text{O})_6]\text{SO}_4$  Shows faint pink colour.
  - Explain  $[\text{FeF}_6]^{3-}$  is Colourless while  $[\text{Fe}(\text{CN})_6]^{3-}$  is red in colour

**Q2) Attempt any three of the following : [15]**

- Give the splitting of ground state term of  $[\text{CoF}_6]^{4-}$  and correlate the transitions in terms of Racah Parameter, B and crystal field parameter  $\Delta O$ .
- Explain which of the following complexes show orbital contribution of magnetic moment. Justify your answer.
  - $(\text{NH}_4)_2[\text{Co}(\text{SO}_4)_2] \cdot 6\text{H}_2\text{O}$
  - $\text{K}_2[\text{Cu}(\text{SO}_4)_2] \cdot 6\text{H}_2\text{O}$
- Arrange the following transitions in octahedral complex according to increasing intensity. Justify your answer.
  - $A_{2g} \rightarrow A_{2g}$
  - $A_{2g} \rightarrow A_{2u}$
  - $A_{2u} \rightarrow T_{2g}$
- Write note on : Chemi luminiscence
- How would you account for the magnetic moment of the following complexes.
  - $\text{Ba}[\text{MnF}_6], \mu = 3.80\text{BM}$
  - $\text{Cs}[\text{Ti}(\text{SO}_4)_2] \cdot 12\text{H}_2\text{O}, \mu = 1.84\text{BM}$

**Q3) Answer any one of the following : [10]**

- Construct correlation diagram for  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$  complex ion on the basis of crystal field theory.
  - R.S. terms of the free  $\text{V}^{3+}$  ion are  $3F, 1D, 3P, 1G$  and  $1S$  in the order of increasing energy.

- ii) In weak octa hedral field the R. S. terms split into the following group theoretical terms :

$$3_F = {}^3T_{1g} + {}^3T_{2g} + {}^3A_{2g}$$

$$1_D = {}^1T_{2g} + {}^1E_g$$

$$3p = {}^3T_{1g}$$

$$1_G = {}^1T_{1g} + {}^1T_{2g} + {}^1E_g + {}^1A_{1g}$$

$$1_s = {}^1A_{1g}$$

OR

- b) i) Hexa aquo nicke (II) complexe shows three absorption band at 1050nm, 650nm and 400nm. Calculate nephelauxetic parameter B and spectrochemical parameter  $D_9$ .

Comment on nature of M-L bonding.

$$\text{Given } B_0 = 1030 \text{ cm}^{-1}$$

- ii) For tetrahedral comkplex of cobalt (II)  $\mu_{\text{eff}} = 4.87$  B.M. Calculate  $\gamma_2$  transition for this complex if the spin orbit coupling constant,  $\lambda$  equals to  $-190\text{cm}^{-1}$ .

### Section - II

**Q4)** Answer any three of the following: **[15]**

- Show the scheme depicting the steps in the ATP dependent export of  $3\text{Na}^+$  and simultaneous import of  $2\text{k}^+$  by the  $\text{Na}^+\text{k}^+$  ATPase.
- What are the possible pathways of absorption of metals by cells.
- Comment on the natural selection of elements used in bioinorganic chemistry.

- d) Describe the mechanism for cleavage of Hg – C bonds at the active site of organomercurilyase involved in mercury detoxification.
- e) How does the ligand exchange rates affects the rate of biological reaction.

**Q5) Write short notes on any three: [15]**

- a) Irving - william series.
- b) Zinc fingers.
- c) Cis - platin as anticancer drng.
- d) Cytochrome P – 450.
- e) Concept of model compounds.

**Q6) Draw structures of any five. [10]**

- a) Enterobactin.
- b) ATP
- c) Cardiolyte.
- d) Rubredoxin.
- e) Porphyrin.
- f) Guanine.

## DIRECT PRODUCTS

1. Groups of the form  $G \times i$  or  $G \times \sigma_h$  :  
 The  $g, u$  or  $' , "$  additions to the IR symbols in these groups satisfy  
 $g \times g = u \times u = g, g \times u = u, ' x' = " x" = ', ' x" = "$ .
2. Products of the form  $A \times A, B \times B, A \times B$  :  
 For all groups :  
 Letter symbols :  $A \times A = A, B \times B = A, A \times B = B$ .  
 Subscripts :  $1 \times 1 = 1, 2 \times 2 = 1, 1 \times 2 = 2$   
 except for the B representations of  $D_2$  and  $D_{2h}$  where  
 $B \times B = B$  and  $1 \times 2 = 3, 2 \times 3 = 1, 3 \times 1 = 2$ .
3. Products of the form :  $A \times E, B \times E$  :
  - (a) For all groups :  $A \times E_k = E_k$  irrespective of the suffix on A.
  - (b) For all groups except  $D_{6d}, D_{4d}, S_8$  :  
 $B \times E_1 = E_2, B \times E_2 = E_1$   
 irrespective of the suffix on B. (If the group has only one E representative put  $E_1 = E_2 = E$ .)
  - (c) For  $D_{6d}$  :  
 $B \times E_1 = E_5, B \times E_2 = E_4, B \times E_3 = E_3, B \times E_4 = E_2, B \times E_5 = E_1$   
 irrespective of the suffix on B.
  - (d) For  $D_{4d}, S_8$  :  
 $B \times E_1 = E_3, B \times E_2 = E_2, B \times E_3 = E_1$   
 irrespective of the suffix on B.
4. Products of the form  $E \times E$  :  
 (For groups which have A, B or E symbols without suffixes put  $A_1 = A_2 = A$ , etc. in the equations below )
  - (a) For  $O_h, O, T_d, D_{6h}, D_6, C_{6v}, C_{6h}, C_6, S_6, D_{3d}, D_{3h}, D_3, C_{3v}, C_{3h}, C_3$  :  
 $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2; E_1 \times E_2 = B_1 + B_2 + E_1$ .
  - (b) For  $D_{4h}, D_4, C_{4v}, C_{4h}, C_4, S_4, D_{2d}$  :  
 $E \times E = A_1 + A_2 + B_1 + B_2$ .
  - (c) For  $D_{6d}$  :  
 $E_1 \times E_1 = E_5 \times E_5 = A_1 + A_2 + E_2,$   
 $E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + E_4,$   
 $E_3 \times E_3 = A_1 + A_2 + B_1 + B_2,$   
 $E_1 \times E_2 = E_4 \times E_3 = E_1 + E_3, E_1 \times E_3 = E_3 \times E_3 = E_2 + E_4,$   
 $E_1 \times E_4 = E_2 \times E_3 = E_3 + E_5, E_2 \times E_3 = E_3 \times E_4 = E_1 + E_3,$   
 $E_1 \times E_5 = B_1 + B_2 + E_4, E_2 \times E_4 = B_1 + B_2 + E_2.$

(d)  $D_{3a}, D_{3b}, D_3, C_{3a}, C_{3b}, C_3$  :

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

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

(e) For  $D_{6a}, S_4$ .

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

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

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

5. Products involving the T (or F) representations of  $O_h, O$  and  $T_d$  :

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

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

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

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

6. The complete results 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	$A_1 + A_2 + E$	$T_1 + T_2$	$T_1 + T_2$
$T_1$	$T_1$	$T_2$	$T_1 + T_2$	$A_1 + E + T_1 + T_2$	$A_2 + E + T_1 + T_2$
$T_2$	$T_2$	$T_1$	$T_1 + T_2$	$A_2 + E + T_1 + T_2$	$A_1 + E + T_1 + T_2$

# CORRELATION TABLE FOR GROUP $O_h$

$O_h$	$O$	$T_d$	$D_{4h}$	$D_{2d}$	$C_{4v}$	$C_{3v}$	$D_{3d}$	$D_3$	$C_{2v}$
$A_{1g}$	$A_1$	$A_1$	$A_{1g}$	$A_1$	$A_1$	$A_1$	$A_{1g}$	$A_1$	$A_g$
$A_{2g}$	$A_2$	$A_2$	$B_{1g}$	$B_1$	$B_1$	$A_2$	$A_{2g}$	$A_2$	$B_g$
$E_g$	$E$	$E$	$A_{1g} + B_{1g}$	$A_1 + B_1$	$A_1 + B_1$	$A_1 + A_2$	$E_g$	$E$	$A_g + B_g$
$T_{1g}$	$T_1$	$T_1$	$A_{2g} + E_g$	$A_2 + E$	$A_2 + E$	$A_1 + B_1 + B_2$	$A_{2g} + E_g$	$A_2 + E$	$A_g + 2B_g$
$T_{2g}$	$T_2$	$T_2$	$B_{2g} + E_g$	$B_2 + E$	$B_2 + E$	$A_1 + B_1 + B_2$	$A_{2g} + E_g$	$A_1 + E$	$2A_g + B_g$
$A_{1u}$	$A_1$	$A_2$	$A_{1u}$	$B_1$	$A_2$	$A_2$	$A_{1u}$	$A_1$	$A_u$
$A_{2u}$	$A_2$	$A_1$	$B_{1u}$	$A_1$	$B_2$	$A_1$	$A_{2u}$	$A_2$	$B_u$
$E_u$	$E$	$E$	$A_{1u} + B_{1u}$	$A_1 + B_1$	$A_2 + B_2$	$A_1 + A_2$	$E_u$	$E$	$A_u + B_u$
$T_{1u}$	$T_1$	$T_2$	$A_{2u} + E_u$	$B_2 + E$	$A_1 + E$	$A_1 + B_1 + B_2$	$A_{2u} + E_u$	$A_2 + E$	$A_u + 2B_u$
$T_{2u}$	$T_2$	$T_1$	$B_{2u} + E_u$	$A_2 + E$	$B_1 + E$	$A_2 + B_1 + B_2$	$A_{2u} + E_u$	$A_1 + E$	$2A_u + B_u$

Character Table for  $O$  rotational group

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



[5123]-23

M.Sc. I Year (Semester - II)

ORGANIC CHEMISTRY

CH - 250 : Synthetic Organic Chemistry and Spectroscopy  
(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instruction to the candidates:

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

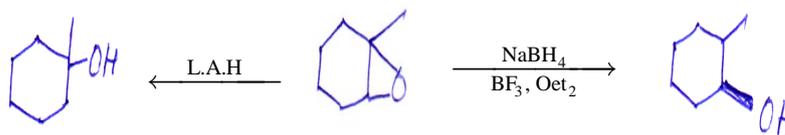
SECTION - I

Q1) a) Answer any four of the following. [16]

- i) For cis hydroxylation of alkene,  $O_5O_4$  is used while for trans hydroxylation reagent is peracid.
- ii) In the following reaction, 'A' is converted preferably to 'B' via Wittig reaction and not via Grignard reaction. Explain.



- iii) N,N - dimethyl benzamide does not undergo Hoffmann rearrangement whereas Benzamide does.
- iv) Explain the selectivity of the following reagent in the following reaction.



- v) In sommelet rearrangement the product is formed from the less stable ylide

P.T.O.

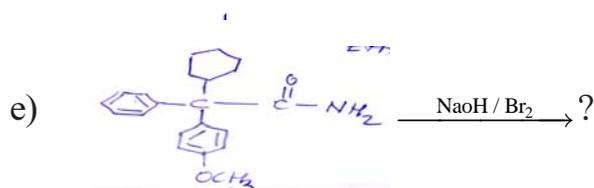
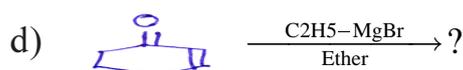
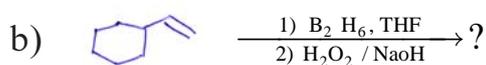
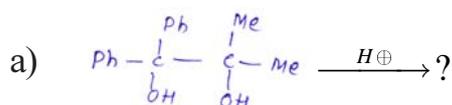
Q2) Attempt any three of the following:

[12]

- Write short note on "Claisen Rearrangement".
- Write short note on organozinc rearrangement.
- Explain Birch reduction with example.
- Explain in details : Jone's oxidation.

Q3) Predict the product/s and suggest the mechanism of any four of the following.

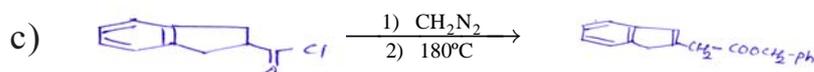
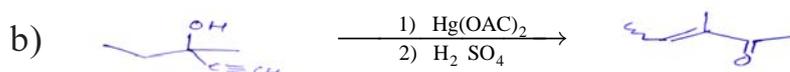
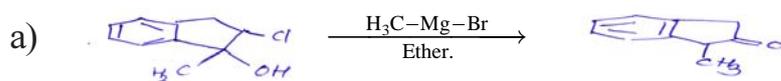
[12]



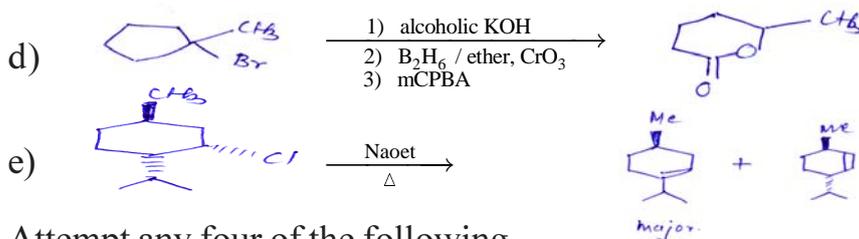
### SECTION - II

Q4) Suggest the mechanism for any four of the following.

[12]



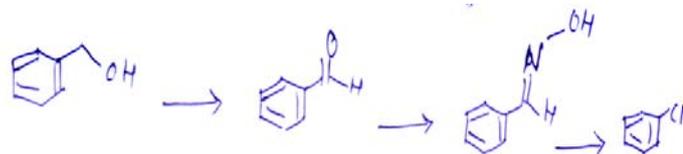
Collidine  
PhCH<sub>2</sub>OH



**Q5)** Attempt any four of the following.

**[16]**

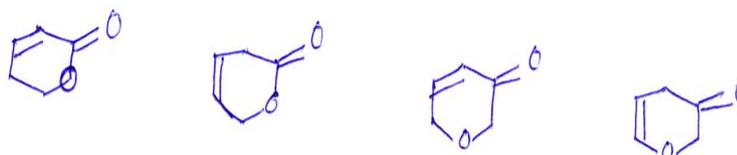
- a) How will you monitor the following reaction sequence by Ir. Suggest the reagents.



- b) Calculate the  $\lambda_{\max}$  for following, show your calculation.



- c) Phenol on reaction with NaOH shows bathochromic shift while aniline with reaction with acid shows hypsochromic shift.
- d) Arrange the following compounds in the decreasing order of their carbonyl frequencies in IR.



- e) Write a short note on diamagnetic anisotropy.

**Q6)** Deduce the structures of any three of the following compounds using spectral data and justify your answer. **[12]**

- a) M.F.  $C_8H_8O_2$   
 UV : 260nm ( $\epsilon = 13,000$ )  
 IR : 3200-2600 (b), 1710, 1630, 1590, 1495  $cm^{-1}$   
 PMR : 5.65  $\delta$  (d, 14H<sub>2</sub>, 1H)  
 6.60  $\delta$  (d, 14H<sub>2</sub>, 1H)

7.35  $\delta$ (t, 8H<sub>2</sub>, 2H)  
7.52  $\delta$ (m, 1H)  
7.70  $\delta$ (d,d, 8 and 2Hz, 2H)  
12.30  $\delta$ (bs, 1H)

- b) M.F : C<sub>5</sub>H<sub>11</sub> Br  
UV : Featureless above 210 nm  
IR : Nothing significant  
PMR : 1.02  $\delta$  (d, J=6 Hz, 24mm)  
1.65  $\delta$  (m, 4.4mm)  
1.85  $\delta$  (m, 8.3mm)  
3.4  $\delta$  (t, J=6Hz, 8.2mm)
- c) MF = C<sub>5</sub>H<sub>4</sub>O<sub>2</sub>  
IR = 2700, 1670 cm<sup>-1</sup>  
PMR =  $\delta$  6.03 (1H, dd, J= 5 Hz and 2Hz)  
7.28 (1H, d, J = 5 Hz)  
7.72 (1H, d, J = 2Hz)  
9.07 (1H, S)
- d) M.F : C<sub>7</sub>H<sub>4</sub>O<sub>3</sub> NCl  
UV : 255 ( $\epsilon$ = 12000)  
IR : 1770, 1530 1330, 850 cm<sup>-1</sup>  
PMR :  $\delta$ =8.03 (2H, d, J = 8Hz)  
8.13 (2H, d, J = 8Hz)



Total No. of Questions : 5]

SEAT No. :

P1344

[Total No. of Pages : 3

[5123]-31

M.Sc.

PHYSICAL CHEMISTRY

CH-310 : Quantum Chemistry & Solid State Chemistry

(New)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any four of the following. **[20]**

- a) Show that hermitian operators have real eigen values.
- b) Deduce the quantum mechanical operator for linear momentum.
- c) Evaluate  $\left[ z^3, \frac{d}{dz} \right]$
- d) State and prove the variation theorem.
- e) Discuss the Application of the variation to the ground state of helium atom.
- f) Compare perturbation method with the variation method.

**Q2)** Attempt any four of the following. **[20]**

- a) Obtain the secular determinant for benzene and find the energies of the first three orbitals.
- b) Explain the mnemonic model used to determine the energy levels of polycyclic annulenes.
- c) Deduce the secular determinant and hence the H.M.O.'s for naphthalene
- d) Explain the term REPE. Give its significance with an example.
- e) Find the levels of a 3p term and give its degeneracy.
- f) Explain what are regular and inverted multiplets.

## SECTION - II

**Q3)** Attempt any three of the following. **[15]**

- a) Explain the term piezoelectricity. Give its applications.
- b) Discuss the rectifying contact metalsemiconductor junction.
- c) What are Frenkel and schottky defects? How do they affect the density of a crystal?
- d) Distinguish between elastic and plastic deformations
- e) How are crystals grown from melt? Explain the verneuil method of crystal growth.

**Q4)** Attempt any three of the following.

**[15]**

- a) Explain the experiment used to determine the nature of carriers in a silver chloride crystal.
- b) Write a note on optical properties of semiconductors.
- c) Explain photoelectromagnetic effect.
- d) Discuss the addition reaction in the solid - solid type of reactions giving a suitable example.
- e) Discuss  $\alpha - t$  plots for the decomposition of a single solid.

**Q5)** Solve any two of the following.

**[10]**

- a) Determine the total length of all the dislocations in a  $1\text{mm}^3$  crystal if the dislocation density is  $10^6/\text{cm}^2$
- b) Calculate the number of donor electrons in the conduction band in a semiconductor crystal at  $25^\circ\text{C}$ . [ $E_0 = 0.56\text{ eV}$ ,  $E_d = 0.708\text{ eV}$ ]
- c) Calculate the fermi energy of a crystal in eV which has  $10^{19}$  electrons per  $\text{cm}^3$ .



Total No. of Questions : 6]

SEAT No. :

P1345

[Total No. of Pages : 3

[5123]-32

M.Sc. (Semester - III)

PHYSICAL CHEMISTRY

CH - 311 : Nuclear and Radiation Chemistry

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following. **[15]**

- a) Discuss the theory of nuclear fission
- b) Give an account of neutron evaporation and spallation.
- c) Draw and explain fission fragment mass distribution curve
- d) Write a note on critical size of a nuclear reactor
- e) Describe Natural reactor at OKIO

**Q2)** Attempt any three of the following. **[15]**

- a) Discuss the salient features of shell model
- b) What are the various forms of nuclear potential?
- c) Derive Breit-Wigner formula
- d) Discuss the postulates of compound Nucleus theory
- e) Write various thermo nuclear reactions.

**Q3)** Solve any two of the following. **[10]**

- a) How many fissions per sec are required to produce 200 watt power?  
Given : 1 fission generates 200 Mev energy.
- b) Calculate neutron & proton separation energy for  $^{23}\text{Na}$   
Given mass of p = 1.0078, n = 1.0087,  $^{23}\text{Na}=22.98777$ ,  $^{22}\text{Na}=21.994435$ amu
- c)  $^{24}\text{Mg}$  is bomnarded with 8Mev deuterons. Calculate energy of deuterons scattered at  $90^\circ$

## SECTION - II

**Q4)** Attempt any three of the following. **[15]**

- a) Discuss the working of scintillation counter
- b) Enlist various natural and manmade sources of radiations
- c) What precautions should be taken while working in a radiation lab?
- d) Define maximum permissible dose. Which points are to be considered while applying this dose.
- e) Discuss the use of ion beam analysis technique in studying surface analysis

**Q5)** Attempt any three of the following. **[15]**

- a) Draw and discuss the working of van de Graff generator.
- b) Write a note on fricke dosimetry
- c) Explain mechanism of annealing after Szilard-chalmer's reaction
- d) Discuss the principle of PIXE technique.
- e) Write a note on High purity Germanium Detector

**Q6)** Solve any two of the following. **[10]**

- a) Find out the dose due to 300mci  $^{60}\text{Co}$  at a distance of 3 meters. Given: gamma energy = 1170 and 1330 KeV.
- b) Find out the dose absorbed due to ethanol when kept in gamma source for 3 hours.

Given :  $Z/A$  of Fricke solution = 0.553, dose absorbed by Fricke Solution at same position = 50 Gy/min

- c) Find out thickness of lead needed to reduce the activities from 50,000 cpm to 5,000 cpm. Given  $Zn - Pb = 82$   $A$  of  $Pb = 207$  density of  $Pb = 11.35\text{g/cm}^3$



Total No. of Questions : 6]

SEAT No. :

P1346

[Total No. of Pages : 4

[5123]-33

M.Sc.

PHYSICAL CHEMISTRY

CH - 312 : Advanced Instrumental Methods of Analysis (New)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following. **[15]**

- a) Describe the electron probe x-ray microanalysis (EPXMA) technique used for the analysis of surfaces.
- b) Draw a neat labelled diagram of the apparatus used for x-ray absorption. Discuss the advantages and disadvantages of using radioactive sources instead of x - ray tubes.
- c) Draw a neat labelled diagram of an energy dispersive instrument used in x-ray fluorescence and discuss the types of samples used for analysis.
- d) Explain 'excitation function' with a suitable example.
- e) Define cross section of reaction and explain its types.

**Q2)** Attempt any three of the following. **[15]**

- a) What are the criteria for selecting an activation reaction in NAA?
- b) Describe briefly the electron bombardment ionization method used in mass spectrometry with a neat labelled diagram.
- c) Discuss the applications of mass spectrometry.
- d) Describe the magnetic field analyzer used in ESCA and state its disadvantages.
- e) Discuss the types of samples and sample preparation methods used in ESCA.

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

- a) The accelerating potential in an x-ray tube was 20.0 kv. Calculate the short-wavelength cut off.
- b) The work function of a spectrometer is 50 eV. The binding energy of the emitted electron is 1070 eV. If the kinetic energy of the  $\bar{e}$  is 1.77 eV, find wavelength of incident x-ray energy.

- c) What weight of an alloy should be taken which contains 1.00% gold if the irradiation period is 12 hr in a neutron flux of  $1.8 \times 10^7 \text{ n cm}^{-2} \text{ s}^{-1}$  and the desired activity after a cooling period of 6hr is 500 cpm?

Given :  $r = 100\%$ ,  $\sigma = 98.86$ ,  $t_{1/2}$  of  $^{198}\text{Au} = 2.69 \text{ d}$  and counting efficiency = 20%

### SECTION - II

**Q4)** Attempt any three of the following. **[15]**

- a) What is Plasma? Explain briefly the principle underlying inductively coupled plasma atomic emission spectroscopy.
- b) Write a note on applications of ICP emission spectroscopy.
- c) What is basic difference between DSC and DTA. Explain briefly any one type of DSC instrument.
- d) Describe in brief components of TGA apparatus.
- e) Draw and explain the block diagram of components of apparatus that is used for chemiluminescence.

**Q5)** Attempt any three of the following. **[15]**

- a) Describe with suitable energy level diagram, energy transitions that occur during absorption and luminescence in the uv-visible region within a molecule.
- b) What is polarizable electrode? Describe different electrodes used in voltammetry
- c) What is voltammetric analysis? Describe different excitation signals used in voltammetry.
- d) Discuss briefly the current voltage relationship in coulometry.
- e) What is potentiostat? Explain the working of potentiostat.

**Q6)** Solve any two of the following.

**[10]**

- a) Calculate the time required for constant current of 0.750 A to deposit 0.270 g of Co(II) as an element on cathode. Assume 100% current efficiency.
- b) A 0.6025 g sample was dissolved and the  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions present were precipitated as  $\text{MgC}_2\text{O}_4\text{H}_2\text{O}$  and  $\text{Ca}_2\text{C}_2\text{O}_4\text{H}_2\text{O}$ . The oxalates were then heated in a thermogravimetric apparatus leaves residue that weighed 0.5713 g in the range of 320 to 390°C and 0.4673 g in the range of 580°C to 620°C. Calculate the percentage of Ca and Mg in the sample (Given atomic weights : Ca = 40, Mg = 24, O = 16, C = 12, H = 1)
- c) Calculate the magnetic flux density required to focus an ion with M/Z 215 on the exit slit of a magnetic analyzer in which the accelerating potential is 6490 V and the radius of curvature of the ionic beam at the exit slit is 23.0 cm.



Total No. of Questions : 5]

SEAT No. :

P1347

[Total No. of Pages : 3

[5123]-34

M.Sc.

PHYSICAL CHEMISTRY

CH - 314 : Polymer Chemistry (New)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following. **[15]**

- a) Describe the typical examples of addition elimination mechanism of condensation polymerization.
- b) Define the following terms degree of polymerization, configuration, heterochain polymer, repeat unit
- c) Derive the copolymer equation, stating the assumption used.
- d) Distinguish between thermoplastic and thermosetting polymer.
- e) Discuss the mechanism of anionic polymerization.

**Q2)** Attempt any three of the following. **[15]**

- a) What is glass transition temperature? Describe any one method of its determination.
- b) Explain Random co-polymer of polyethylene and polypropylene is amorphous while polyethylene is crystalline.
- c) What is co-polymerization? Give the advantages of co-polymers over homopolymers.
- d) Explain how mechanical properties can be used in physical testing of polymers.
- e) Discuss the Flory-krigbaum theory for dilute polymer solution.

**Q3)** Solve any two of the following. **[10]**

- a) The extent of reaction for condensation polymerization is 0.99 calculate  $\bar{X}_n$ ,  $\bar{X}_w$  and polydispersity index.
- b) Determine the average molecular weight of the sample from following data for a sample of cellulose acetate.

C (g/100ml)	0	0.114	0.351	0.703
n (millipoise)	3.16	4.06	6.64	13.02

Given that  $K = 1.87 \times 10^{-5}$  and  $\alpha = 1.03$  for this system.

- c) 53 gm of acrylonitrile co-polymerised with 10.4 gm of styrene. Find the composition of the polymer formed instantaneously if the monomer reactivity ratios of acrylonitrile and styrene are 0.04 and 0.40 respectively [Atomic weight C = 12, H = 1 and N = 14]

## SECTION - II

**Q4)** Attempt any four of the following. **[20]**

- a) What is DTA technique. Discuss the use of DTA technique in the analysis of polymer.
- b) Describe with a neat diagram the membrane osmometry method of determination molecular wt. of a polymer.
- c) Discuss the effect of irradiation exposure on block co-polymerization.
- d) Discuss the use of IR spectra for analysis of crystalline and amorphous polymers.
- e) Define the terms - relative viscosity, specific viscosity, reduced viscosity and intrinsic viscosity. Which molecular weight of a polymer is related with one of the above term? How?
- f) Write a note on the use of 'X'-rays in analysis of polymers.

**Q5)** Attempt any four of the following. **[20]**

- a) Describe 'end group analysis' for the determination of molecular weight of the polymer.
- b) Describe conduction mechanism of conducting polymer
- c) Discuss the viscoelasticity phenomenon and its mechanism in polymers.
- d) Compare the compression molding with injection molding.
- e) What is vulkanization? Give its chemistry.
- f) What are the different types of spinning methods. Describe any one spinning method with neat diagram.



Total No. of Questions : 4]

SEAT No. :

P1348

[Total No. of Pages : 3

[5123]-35

M.Sc.

PHYSICAL CHEMISTRY

CH - 315 : Special Topics in Physical Chemistry

(New)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** answer any four of the following. **[20]**

- a) What do you mean by ceramics? Explain the properties of ceramics.
- b) Discuss influence of oxygen medium on the properties of surface and ceramic grain boundaries in porous ceramics.
- c) Write a note on chemiresistors.
- d) Classify the sensors according to their purpose.
- e) Explain catalysis in dilute aqueous solution with a suitable example.
- f) Derive an expression of saturation kinetics.

**Q2)** Answer any four of the following. **[20]**

- a) Explain general and specific acid and base catalysis.
- b) Discuss catalysis in concentrated strong acid solutions.
- c) Write the mass balance on carbonate in a solution of 0.1M  $\text{H}_2\text{CO}_3$  and charge balance for 0.1 MHCN.
- d) Write proton condition for  $\text{NaHCO}_3$  and  $\text{Na}_2\text{CO}_3$ .
- e) Calculate pH and concentrations of all the species for 0.1 M  $\text{Na}_2\text{CO}_3$ .  
Given :  $k_{a_1} = 4.46 \times 10^{-7}$ ,  $k_{a_2} = 5.62 \times 10^{-11}$ .
- f) Draw a logarithmic concentration diagram for 0.1 M  $\text{CH}_3\text{COOH}$ .  
Given :  $\text{pK}_a = 4.75$ .

## SECTION - II

**Q3)** Attempt any four of the following. **[20]**

- a) Why do nanoparticles exhibit anomalous properties? State their properties.
- b) Write a note on atomic force microscope.
- c) Explain the phase diagram of sulphur.
- d) Describe different forms of smart composites.

- e) In a steam distillation experiment, the distillate contains 7.64 g organic liquid and 10 g water. Vapour pressure of two liquids are 48 mm and 712 mm Hg respectively at the boiling point. Calculate the molecular weight of the organic liquid.
- f) What do you mean by replicating nature? How is it applied to prepare smart materials?

**Q4)** Attempt any four of the following.

**[20]**

- a) Describe the phase diagram for water.
- b) What is the effect of change in solubility on the two phase region in phenol-water system?
- c) Derive Raoult's law.
- d) Give an account of fullerene.
- e) What are smart fibres? Discuss their applications.
- f) Give an account of the chemical methods of preparation of nano particles.



Total No. of Questions : 4]

SEAT No. :

P1349

[Total No. of Pages : 3

[5123]-36

M.Sc. (Part - II) (Semester - III)

INORGANIC CHEMISTRY

CH - 326 : Organometallic compounds of Transition metals &  
Homogeneous catalysis.

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) All questions are compulsory and carry equal marks.
- 2) Figures to the right indicate full marks.
- 3) Use of log table and calculators are allowed
- 4) At. No = Mn = 25, Fe = 26, Co = 27, Cr = 24, Ir = 77.

Q1) Answer the following (any four)

[20]

- a) In a metal carbonyl compound, one carbonyl ligand is replaced by a strong  $\pi$ -donor ligand. What will be effect on the carbonyl stretching frequency.
- b) Discuss the bonding interaction in metallocene
- c) Explain the metal-ligand interaction in metal-Nitrosyl
- d) Give the typical reactions of '(Cp)<sub>2</sub>TiCl<sub>2</sub>'
- e) What is EAN rule? Which of the following compounds obey EAN rule.
  - i) [Mn(CO)<sub>4</sub>(NO)]<sup>0</sup>
  - ii) [Cr(CO)<sub>4</sub>(PPh<sub>3</sub>)<sub>3</sub>]
  - iii) [IrBr<sub>2</sub>(CH<sub>3</sub>)(CO)(PPh<sub>3</sub>)]
  - iv) [Fe( $\eta^5$ -C<sub>5</sub>H<sub>5</sub>)<sub>2</sub>]
  - v) [CO( $\eta^5$ -C<sub>5</sub>H<sub>5</sub>)<sub>2</sub>]<sup>+</sup>

Q2) Attempt any four of the following

[20]

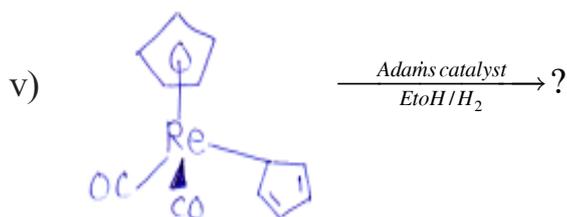
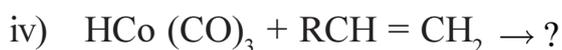
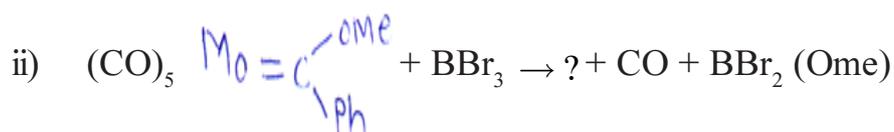
- a) "Co<sub>2</sub>(CO)<sub>8</sub> and Fe<sub>2</sub>(CO)<sub>9</sub> are considered as carbonyl deficient compounds. Explain
- b) Describe the bonding in metal-alkene compounds. with suitable example.

P.T.O.

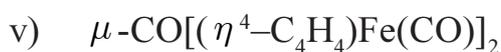
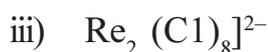
- c) What is the role of carbene complex in the olefin metathesis reaction?
- d) In a metal-alkyne complex  $\nu(C \equiv C)$  is observed at  $1850 \text{ Cm}^{-1}$ , while in the free alkyne  $\nu(C \equiv C)$  is observed approximately at  $2200 \text{ Cm}^{-1}$ .
- e) Explain giving appropriate examples the oxidative addition and reductive elimination reactions shown by organometallic compounds.

**Q3)** Attempt any four of the following **[20]**

- a) Explain the interdependence of inorganic & organometallic materials in the environment.
- b) Give a brief account of the preparative methods for organometallics compounds of transition metals.
- c) Write an account of methods of synthesis and properties of metal carbonyls.
- d) Complete the following reactions-



e) Draw the structures -



**Q4)** Write short notes on - any four

**[20]**

- a) Tolmans catalytic cycle
- b) Hydrogenation of alkenes
- c) Group IV organometallics in medicine
- d) Heck Reaction
- e) Suzuki coupling.



Total No. of Questions : 4]

SEAT No. :

P1350

[Total No. of Pages : 2

[5123]-37

**M.Sc. (Semester - III)**  
**INORGANIC CHEMISTRY**

**CH - 330 : Co-ordination Chemistry and Reaction Mechanism**

*Time : 3 Hours]*

*[Max. Marks : 80*

*Instructions to the candidates:*

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Use of logarithmic tables and calculator is allowed.*
- 4) *Atomic number Co=27.*

**Q1)** Attempt any four of the following :

**[20]**

- a) Draw the structure of the following
  - i) Diammine triaqua hydroxo chromium (III) nitrate
  - ii) Mer - dichlorotetracyano chromate (III)
  - iii) Tri- $\mu$  - carbonyl bis [tri carbonyl iron (O)]
  - iv) 1, 2, -  $\eta^3$  - allyl - 3,4,6 - triiodo - 5 trifluoro methyl platinate (IV)
  - v) quadro - Bis (dimethyl glyoximato) nickel (II)
- b) Explain tetragonal distortion in  $d^9$  system and find out driving force for distortion
- c) Explain splitting diagrams of Octahedral and Tetrahedral geometrics.
- d) What is meant by mixed valence complexes? How electron transfer rate depends upon bridged ligand? Give their biological applications.
- e) Explain the formation of  $[\text{Re}_2 \text{Cl}_8]^{2-}$  ion

**Q2)** Attempt any four of the following :

**[20]**

- a) Explain the structures of copper (II) acetate and  $\text{CO}_2 (\text{CO})_8$ .
- b) Explain ferromagnetism and antiferromagnetism with the help of different models.

**P.T.O.**

- c) In the complex like  $\text{Na}_4[\text{Co}(\text{NO}_2)_6]$   $\mu_{\text{obs}} = 1.88$  B.M. and  $\mu_{\text{cal}} = 1.73$  B.M. Explain
- d) Discuss the effect of  $\pi$  bonding on the value of  $\Delta$  in an octahedral complex with the ligands capable of forming the  $\pi$ -bonds.
- e) Discuss the terms
  - i) Magnetically dilute system
  - ii) Magnetically concentrated system.

**Q3)** Attempt any four of the following. **[20]**

- a) Write down the detailed mechanism of the reaction between  $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$  and  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  to form  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]^{2+}$
- b) Distinguish between the intimate and stoichiometric mechanisms of a reaction.
- c) Write a note on thermodynamic and kinetic stability of complexes.
- d) Explain the mechanism of base hydrolysis of  $[(\text{NH}_3)_5\text{Co}(\text{III})\text{Cl}]^{2+}$ .
- e) What is effect of chelation on rate of acid hydrolysis reaction of Co(III) complexes?

**Q4)** Answer any four of the following. **[20]**

- a) What is the effect shown by the following on associative, dissociative and interchange mechanisms
  - i) Size of the central metal atom
  - ii) -ve charge of leaving group
  - iii) -ve charge of entering group
- b) Explain in detail the effect of  $\pi$  - bonding on the rate of substitution reaction in octahedral complexes.
- c) Explain two electron transfer reactions.
- d) Discuss the solid state reactions with special reference to their kinetics and mechanism.
- e) Explain why  $[\text{PtCl}_4]^{2-}$  and  $[\text{Pt}(\text{NH}_3)\text{Cl}_3]^-$  should lose chloride ions 100 times faster than  $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$



Total No. of Questions : 4]

SEAT No. :

P1351

[Total No. of Pages : 2

[5123]-38

**M.Sc. II (Semester - III)**  
**INORGANIC CHEMISTRY**

**CH - 331 : Structural Methods in Inorganic chemistry**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Max. Marks : 80*

*Instructions to the candidates:*

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Use of calculators is allowed.*

**Q1)** Answer the following (any four)

**[20]**

- a) Draw the ESR-spectrum for  $^{13}\text{CH}_3$  radical. Explain
- b) Discuss the principle of NQR - spectroscopy.
- c) What is DTA? Draw the DTA curve for  $[\text{Mn}(\text{H}_2\text{PO}_2)]_2 \cdot \text{H}_2\text{O}$
- d) Discuss the redox mechanism of Ascorbic acid by using cyclic voltametry.
- e) Explain the mössbauer spectra of Fe(II) and Fe(III) having low spin and high spin complexes in octahedral geometry.

**Q2)** Answer the following (any four)

**[20]**

- a)  $^{31}\text{P}$ -NMR spectrum of  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  are recorded. How will you differentiate the structure of the compound on the basis of NMR.
- b) Calculate the percentage of  $\text{MgCO}_3$  and  $\text{CaCO}_3$  in 80mg of lime stone sample that exhibits thermogram showing weight of 60mg at  $500^\circ\text{C}$  and 36mg at  $900^\circ\text{C}$ .
- c) Draw a schematic diagram of DSC instrument and write note on the working of DSC instrument.
- d) Write the principle of X-ray diffraction.
- e) Write the advantages and disadvantages of SEM.

**P.T.O.**

**Q3) Answer the following (any four) [20]**

- a) Explain the effect of gaseous environment on the DTA curve.
- b) What are miller indices? Draw the miller indices for the faces having the intercepts as [100], [111] and [321]?
- c) What is chemical shift? Explain the factors affecting on chemical shift in case of mössbauer spectroscopy.
- d) Draw the mössbauer spectra for  $\text{Fe}_3(\text{CO})_{12}$  compound and explain.
- e) Explain the experimental procedure of CV with the help of neat labelled diagram.

**Q4) Answer the following (any four) [20]**

- a) Write the principle of XPS.
- b) Asymmetry parameter.
- c) Give applications of TEM
- d) Spin-spin coupling in NMR
- e) Limitations of NQR spectroscopy.



Total No. of Questions : 4]

SEAT No. :

P1352

[Total No. of Pages : 2

[5123] - 39

M.Sc. - II

INORGANIC CHEMISTRY

CH - 332 : Bioinorganic Chemistry : Inorganic Elements in  
the Chemistry of Life

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) All questions are compulsory.
- 2) All questions carry equal marks.
- 3) Neat diagrams must be drawn wherever necessary.

**Q1)** Answer the following (Any four) : **[20]**

- a) What is radio pharmaceutical agent? Why  $^{99m}\text{Tc}$  is used as a radio pharmaceutical agent.
- b) Which are the enzymes that contains Vit-B-12? Comment on their reactions.
- c) Explain the role of manganese in peroxidase enzyme.
- d) Explain the role of following metals in biology and Medicine.
  - i) Copper
  - ii) Zinc
  - iii) Cobalt
- e) "[Ru (Phen) $_3$ ] $^{2+}$  binds to DNA through major groove binding via intercalation, where as [Cu (Phen) $_3$ ] $^{2+}$  favours minor groove binding". Explain.

**Q2)** Attempt any four of the following : **[20]**

- a) Explain the role of gold compounds as anti arthritis agents.
- b) Explain the enzyme catalysed transformations of Catechol derivatives to light absorbing quinones. Which enzyme is required for the transformation? Name the metal present in the enzyme.
- c) Name the techniques used to study the binding of coordination compounds to DNA. Explain any one in detail.

P.T.O.

- d) Which is the enzyme found in Jack fruit ? Write a brief account of this enzyme.
- e) Which is the metal present in the enzyme Xanthene oxidase? Explain the main features and function of this enzyme.

**Q3)** Answer the following (Any four) : **[20]**

- a) Answer in brief.
  - i) Write the reactions catalysed by enzyme galactose oxidase and amine oxidase.
  - ii) Name the metals present in the following enzymes.
    - a) Peroxidase
    - b) Photosystem I
    - c) Tyrosinase
    - d) Carbonic anhydrase
- b) Explain the role of manganese in photosynthesis.
- c) Explain the mechanism of nitrate reduction. Which enzyme is responsible for this reduction.
- d) Which are the main copper proteins found in living systems? Explain their important structural features.
- e) What is meant by chemical nuclease? With the help of suitable examples explain their functions.

**Q4)** Write short notes on (Any four) : **[20]**

- a) Zinc enzymes.
- b) Anticancer drugs.
- c) MRI contrast agents.
- d) Reactions of Cobalamin.
- e) Blue and Nonblue Copper proteins.



Total No. of Questions : 6]

SEAT No. :

P1353

[Total No. of Pages : 3

[5123] - 40

M.Sc.-II

ORGANIC CHEMISTRY

CH - 350 : Organic Reaction Mechanism

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 80

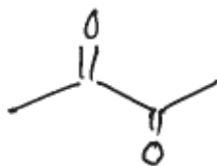
Instructions to the candidates :

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

SECTION - I

Q1) Attempt any four of the following : [12]

- a) For hydrolysis of  the values are :  
 $\rho = -1.31$ , P-Br  $\sigma = 0.23$  and P-NO<sub>2</sub>  $\sigma = 0.78$ . Justify.
- b) Predict the sign of Hammett constants for P-OCH<sub>3</sub>, P-NMe<sub>3</sub>, m-OH and m-NO<sub>2</sub>.
- c) Discuss thermodynamic implications of Linear Free Energy Relationship.
- d) Give evidences to support neighbouring group participation.
- e) Which of the following prefers enol form?



and



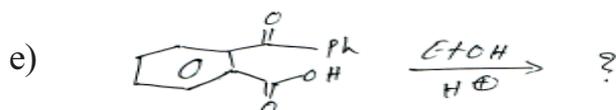
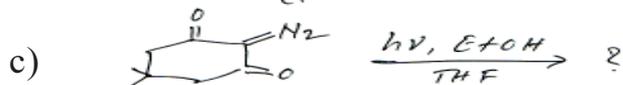
Q2) Write short notes on any three of the following. [12]

- a) Newmann's rule of six.
- b) Transannular rearrangement.
- c) Mannich Reaction.
- d) Reaction rate and free energy of activation.

P.T.O.

Q3) Predict the product with mechanism. (Any four)

[16]



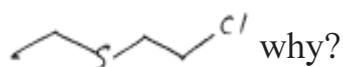
### SECTION - II

Q4) Explain any four of the following :

[12]

a) Explain umpolung chemistry with thiamine as d1 reagent.

b)  $n\text{-C}_4\text{Hg-Cl}$  reacts with  $\text{Na}^{\oplus} \text{Ome}^-$  in MeOH several times slower than



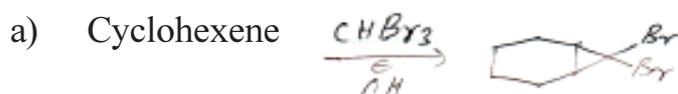
c) Reaction of benzaldehyde with ethylmethylketone gives different products in acidic and basic medium. Give reason.

d) Discuss oxidation of FAD in biological chemistry.

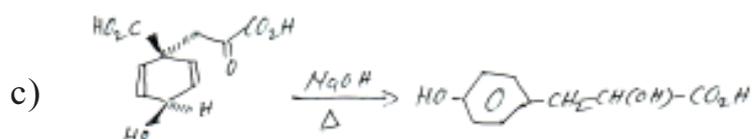
e) Explain any rearrangement which proceeds through carbene intermediate.

Q5) Suggest the mechanism (Any four) :

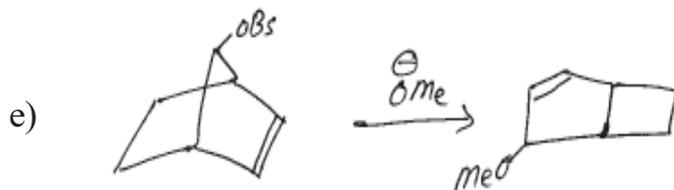
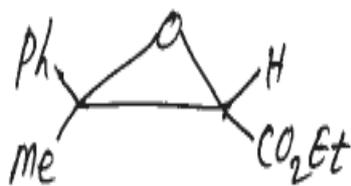
[16]



b) Acetone (Excess)  $\xrightarrow{\text{H}^+}$  1, 3, 5- trimethylbenzene



d) Acetophenone + ethylchloroacetate  $\xrightarrow{\ominus OEt}$



**Q6)** Answer any four of the following:

**[12]**

- Explain enol chemistry with lysine enamines.
- Which factors stabilize Carbanions?
- Substituents at  $\beta$  position reduces the rates of hydrolysis of AAC2 mechanism.
- Favorskii rearrangement proceeds through cyclopropanone as an Intermediate. Comment.
- Write short note on "Nitrene Reactions".

▽▽▽▽

[5123] - 41

M.Sc. II

## ORGANIC CHEMISTRY

CH - 351 : Spectroscopic Methods in Structure Determination  
(2008 Pattern)

Time : 3 Hour]

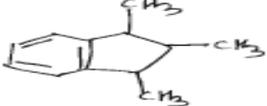
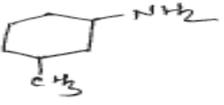
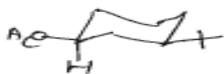
[Max. Marks : 80

Instructions to the candidates :

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

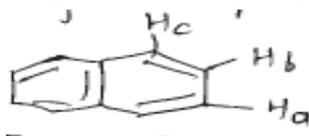
SECTION - I

Q1) a) Distinguish following pairs by the spectroscopic method indicated. [8]

- i)  and  (MS)
- ii)  and  (MS)
- iii)  and  (CMR)
- iv)  and  (PMR)
- v)  and  (PMR)

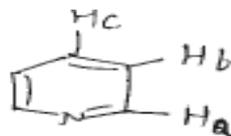
b) Explain any four of the following : [8]

- i) Explain the coupling constants observed in the following compounds.



$$J_{ab} = 6H_2$$

$$J_{bc} = 7.5 H_2$$



$$J_{ab} = 5 H_2$$

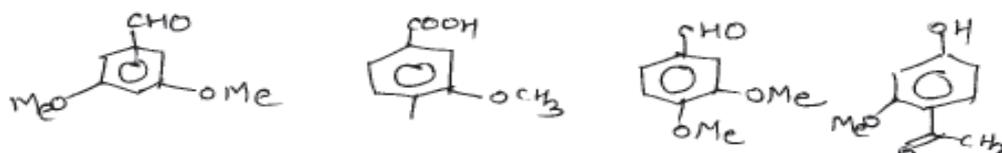
$$H_{bc} = 8 H_2$$

P.T.O.

- ii) In Ms, appearance of metastable ions signifies the formation of daughter ion from its parent ion in one step. Explain.
- iii) What will be line position in Hertz of a proton in 300 MHz, which shows chemical shift at 4.3 ppm in 60 MHz instrument.
- iv) Explain the factors affecting intensity of signals in PMR.
- v) Explain benefits of DEPT over off resonances in CMR.

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

- a) A compound shows MT at 84 and has a base peak at 56, what is its probable Molecular Formula? It exhibits only one signal in its PMR & CMR at 1.4 and 35 respectively. No significant peak is observed in IR spectrum. Deduce its structure
- b) Find the structure using the following spectral data.  
 MF : C<sub>7</sub> H<sub>12</sub> O  
 PMR : 1.08 (s, 6H), 2.21 (cl, 7H<sub>2</sub>, 2H) : 5.08 (d, 11.8 Hz, 1H), 5.11 (d, 15.5 Hz, 1H), 5.75 (ddt, 11.8, 15.5 and 7.2 Hz, 1H), 9.49 (s, 1H)  
 CMR : 21 (q), 41 (t), 45 (s), 118 (t), 133 (d), 206 (d).
- c) Using the spectral data, assign the correct structures from the ones shown below.



56 (q), 56.2 (q), 109 (d), 111 (d), 126 (d), 130 (s), 150 (s), 155 (s), 190 (d)

- d) Find the structure, using following spectral data.  
 MF : C<sub>7</sub> H<sub>9</sub> N  
 IR : 2250 cm<sup>-1</sup>  
 PMR : 1.9 (m, 2H), 2.35 (m, 4H), 3.10 (s, 2H), 5.75 (t, J = 3.4 Hz, 1H),  
 CMR : 19 (t), 23 (t), 32 (t), 34 (t), 117 (s), 129 (d), 132 (s).

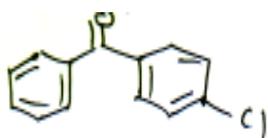
**Q3) Write short notes on (any three) [12]**

- a) Factors affecting geminal coupling.
- b) Use of cosy or HETCOR in structure determination.
- c) Lanthanide shift Reagent.
- d) Various analyzers used in MS

## SECTION - II

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

- i) The exact mass of a compound is 60.06884. The probable molecular formula are  $C_3H_8O$ ,  $C_2H_4O_2$  and  $C_2H_8N_2$ . Find which molecular formula is correct for above compound. (Exact masses are C = 12.01115; H = 1.00794; N = 14.0067 ; O = 15.9994)
- ii) What are the benefits of CIMS and MALDI over EIMS? Discuss.
- iii) Give the genesis of the ions of



m/e 218, 216, 141, 139, 105, 77.

- iv)  $Ph-CH_2-CO-CH_2-CH_2-CH_3$  exhibits the following ions Give the genesis and explain.

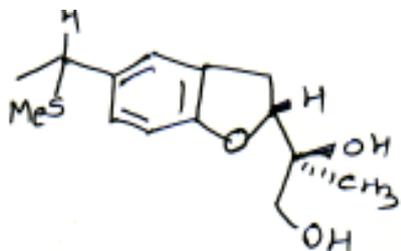
71 – 100%, 91 – 53%, 119 – 2%, 77 – 22%, 43 – 29%

- v) The mass spectra of a compound show the following ions. Find a structure consistent with the data.

m/e : 114 (34), 113 (7), 112 (100), 78 (3.5), 77 (50), 51 (14), 56 (12), 39 (8).

- b) Draw schematic diagram of mass spectrometer and explain the working of ionization chamber of EIMS. **[4]**

**Q5) a)** Assign the chemical shifts to the various Protons in the following structure. Explain your assignments. **[8]**



1.48 (s, 3H), 1.52 (d S = 7.5 H<sub>2</sub>, 3H),

1.88 (s, 3H), 3.2 (d, J = gH<sub>2</sub>, 2H), 3.75

(q, J = 7.5 H<sub>2</sub>, 1H), 3.88 (d, J = 10H<sub>2</sub>, 1H),

J = (10H<sub>2</sub>, 1H) 4.05 (d, J = 10 H<sub>2</sub>, 1H), 5.18 (t, J = gH<sub>2</sub>, 1H), 6.65 (d, S = 8H<sub>2</sub>, 1H), 7.02 (dd, S = 8 & 2 H<sub>2</sub>, 1H), 7.10(d, J = 2 H<sub>2</sub>, 1H)

- b) A compound  $C_3H_5ClO$  exhibits the following NMR data. Arrive at a structure consistent with the data. [8]

PMR : 2.7 (dd,  $J = 2.5$  &  $4.8$  Hz, 1H), 2.9(t,  $J = 4.8$  Hz, 1H), 3.25 (m, 1H), 3.54 (dd,  $J = 6$  &  $12$  Hz, 1H) 3.7 (dd,  $J = 5$  &  $12$  Hz, 1H)

CMR : 51 (d), 46 (t), 43 (t),

COSY : 2.7 with 2.9 & 3.25;

2.9 with 2.7 & 3.25;

3.25 with 2.7, 2.9, 3.54, 3.7;

3.54 with 3.25, 3.7,

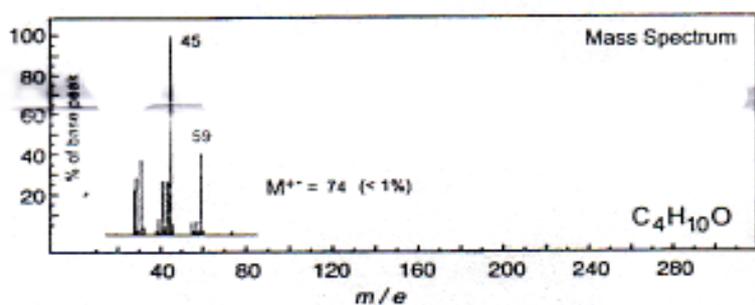
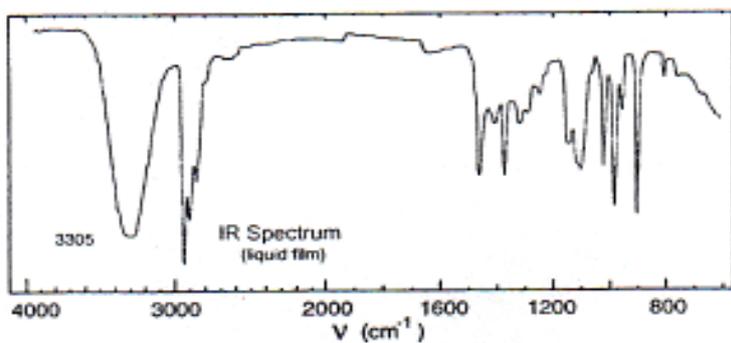
3.7 with 3.25, 3.54.

HETCOR : 43 with 3.54 & 3.7;

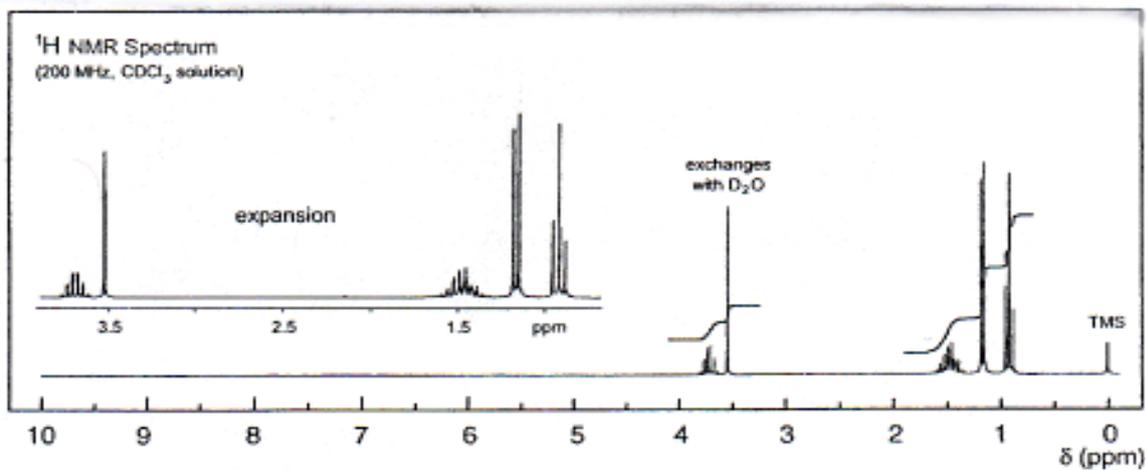
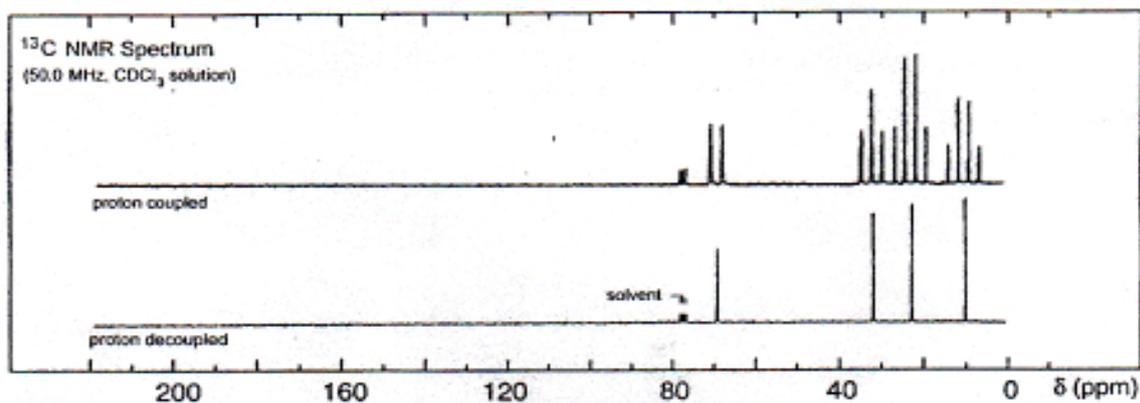
46 with 2.7 & 2.9;

51 with 3.25.

**Q6)** You are provided with spectra of a compound on the next page. Analyze these spectra and arrive at a structure with the data. Justify your structure. [12]



No significant UV absorption above 220 nm



▽▽▽▽

Total No. of Questions : 6]

SEAT No. :

P1355

[Total No. of Pages : 6

[5123] - 42

M.Sc.

ORGANIC CHEMISTRY

CH - 352 : Organic Stereo chemistry

(2008 Pattern) (Paper - VI)

Time : 3 Hour]

[Max. Marks : 80

Instructions to the candidates :

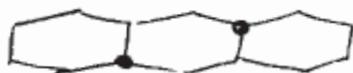
- 1) All questions are compulsory.
- 2) Figures to the write indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

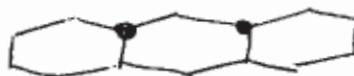
Q1) Answer any four of the following :

[16]

- a) Pka for Trans-4-t-butylcyclohexane carboxylic acid is 7.79 while for cis-4-t-butyl cyclohexane carboxylic acid is 8.23. Compare the Pka values and comment on the relative Strengths of both of them.
- b) Trans-9-methyldecalin is more stable than cis isomer by 3.35 KJ/mole. Explain.
- c) Draw conformational structures of Compound (I) and (II). Discuss their stability.



Compound (I)

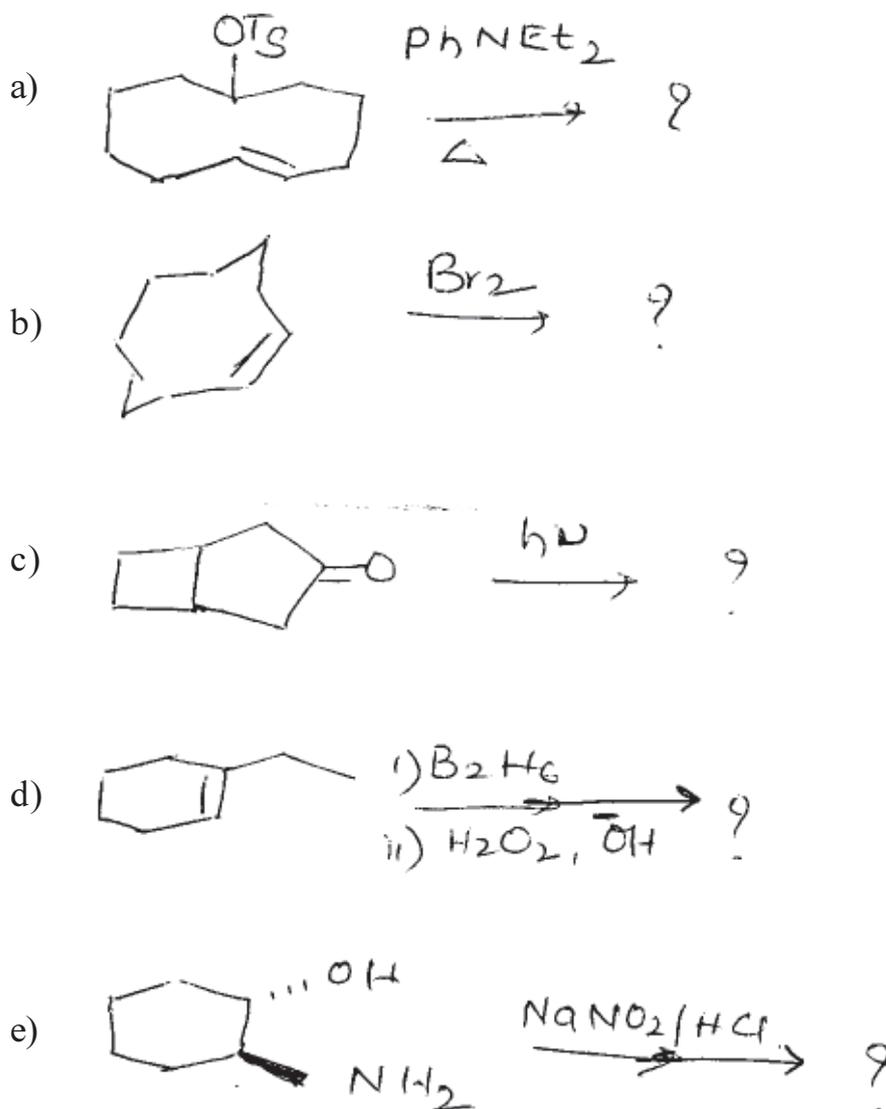


Compound (II)

- d) Draw the most stable conformation of 1,2,2,6,6-pentamethyl-4-hydroxyl-4-phenylpiperidine Justify your answer.
- e) Describe the properties of racemic modifications.

P.T.O.

Q2) Predict the product/s in any four of the following. Explain the stereochemical principles involved. [12]



Q3) Write short notes on any three of the following :

[12]

- Isobornyl chloride rearrangement.
- Van Arkel rule.
- Chromic acid oxidation of steroid alcohols.
- Transannular interactions.

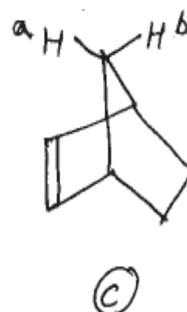
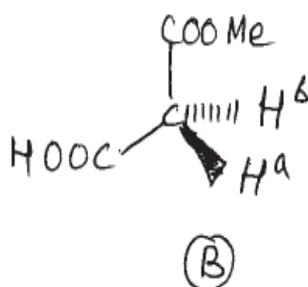
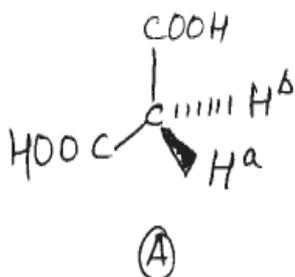
## SECTION - II

**Q4)** Answer any three of the following. **[12]**

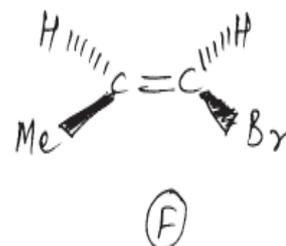
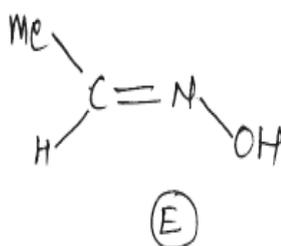
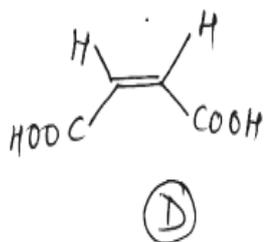
- a) How relative configuration in quinine at  $C_8$  and  $C_9$  is deduced by comparison with ephidrine.
- b) On the basis of Coupling constant explain the stereochemistry of laetone fusion into enhydrin.
- c) Give experimental evidences to establish the relative configuration at  $C_5$  and  $C_6$  in morphine.
- d) Find the relative configuration at  $C_6$ -OH and  $C_{13}$ - $C_{15}$  bond in. Codeine and in isocodeine. Give the chemical evidence.

**Q5)** Answer the following questions (Any four) : **[12]**

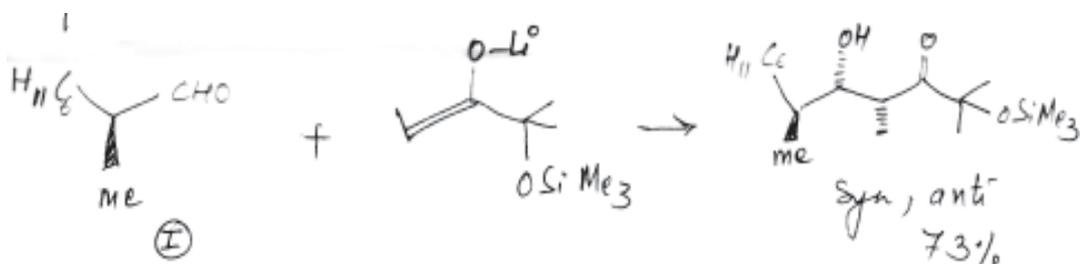
- a) In the following molecules. A, B, C, indicates whether the hydrogens marked  $H^a$ ,  $H^b$  are homotopic, enantiotopic or diastereotopic.



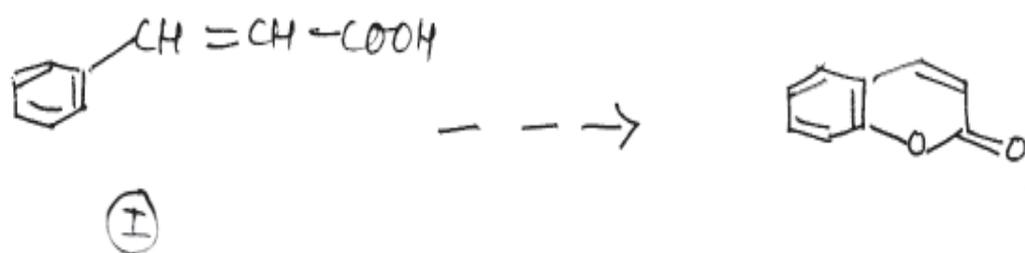
- b) Assign Re/Si configuration to the top faces, as drawn of each  $SP^2$  hybridized carbon and nitrogen in compound D, E, F.



- c) Reaction of S-2 cyclohexyl propionaldehyde (I) gives a 3 -  $\alpha$  - OH configured product preferentially. Explain.

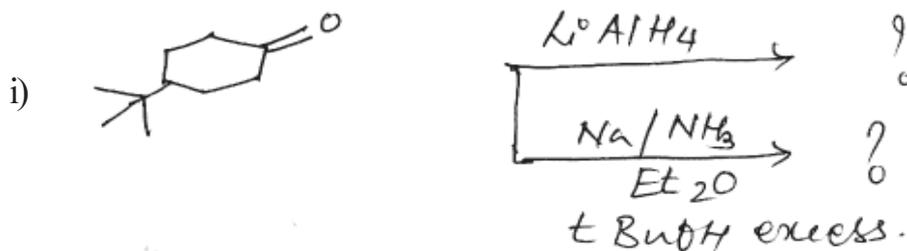


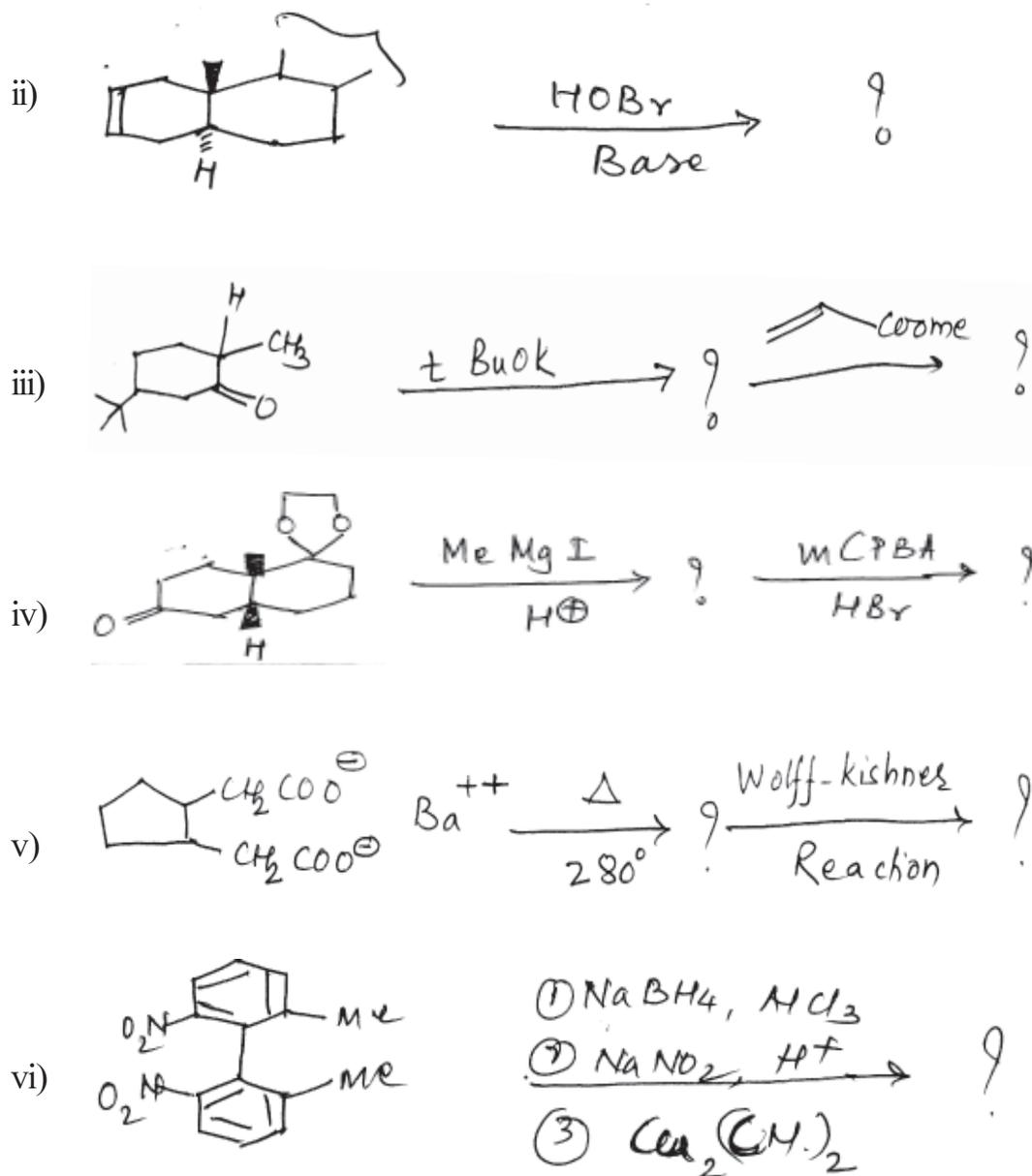
- d) The isomeric Coumarinic acid (I) Show two isomer one of the isomer cyclise easily compar to others isomer. Explain with mechanism.



- e) Write a note on Cram's rule with example.

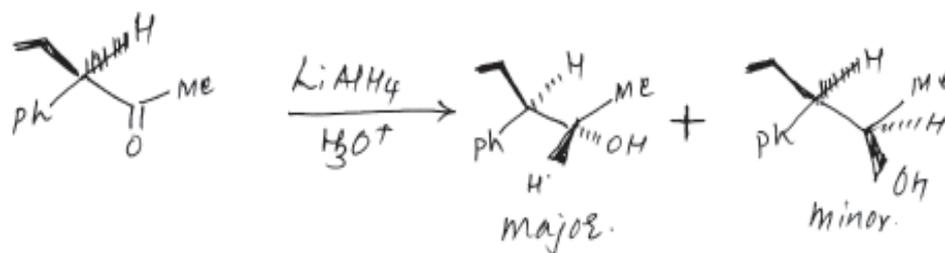
- Q6) a) Predict the products in the following Reactions. Explain the stereochemistry and mechanism in details. (any five) [10]



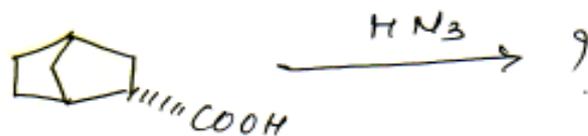


b) Answer the following (any two): [6]

i) Using Felkin rule, Explain the following transformation.

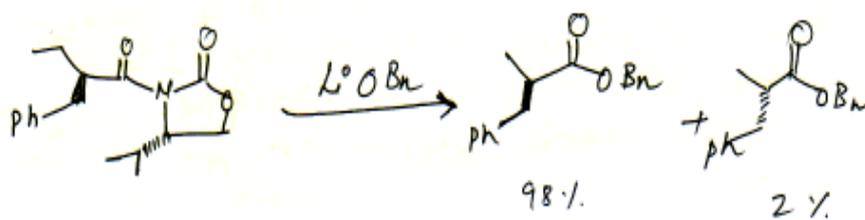


- ii) (-) endo-norbornane Carboxylic acid on reaction with  $\text{HN}_3$  gives (+) endo-Norbornyl amine. Explain the mechanism. Stereochemical principle of this reaction.



(-) endo-Norbornane  
Carboxylic acid

- iii) Explain the term enantiomeric excess. Calculate ee of the following major product.



▽▽▽▽

Total No. of Questions : 6]

SEAT No. :

P1356

[Total No. of Pages : 4

[5123] - 43

M.Sc. (ORGANIC CHEMISTRY)

CH - 353 : Free Radicals, Photochemistry and Pericyclic  
Reactions and their Applications  
(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 80

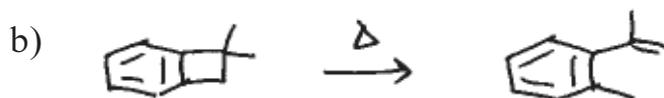
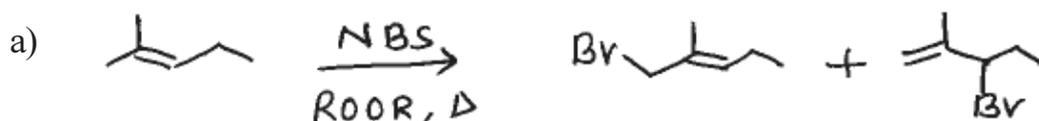
Instructions to the candidates :

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

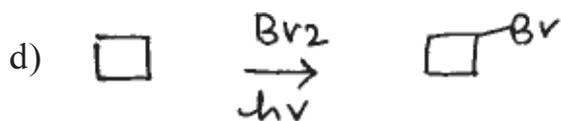
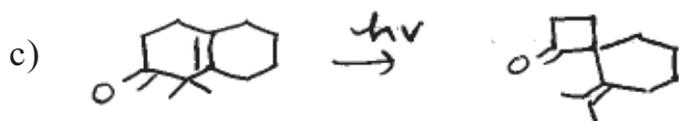
SECTION - I

- Q1) a) Write short notes on any two of the following. [8]
- i) Role of AIBN in Radical chemistry.
  - ii) Photosensitisation.
  - iii) Autoxidation.
- b) Explain any two of the following. [8]
- i) Di- $\pi$  methane Rearrangement and its mechanism.
  - ii) Nourish type I cleavage with proper example.
  - iii) In the free Radical addition of  $\text{CCl}_4$  to styrene much telomer is formed.

- Q2) Suggest the mechanism in any four of the following. [12]

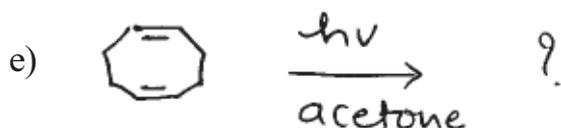
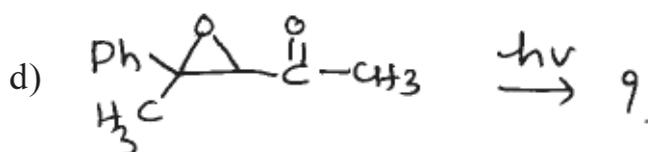
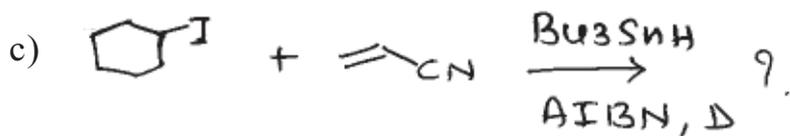
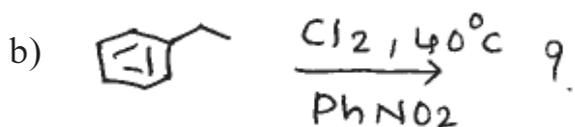
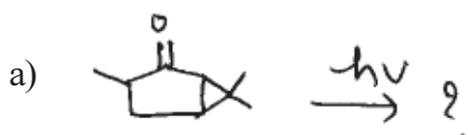


P.T.O.



Q3) Predict the products in any four of the following.

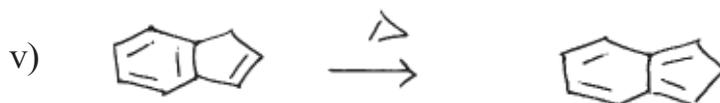
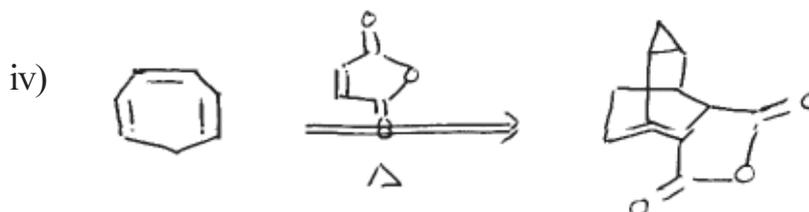
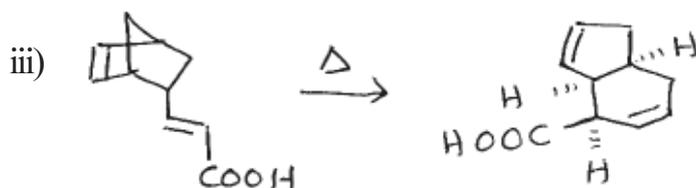
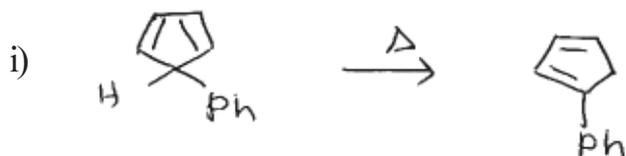
[12]



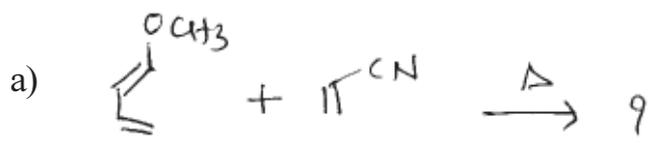
**SECTION - II**

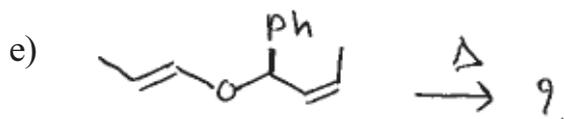
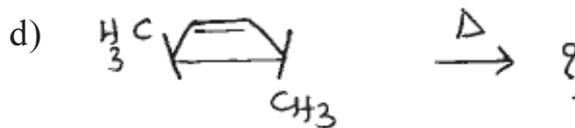
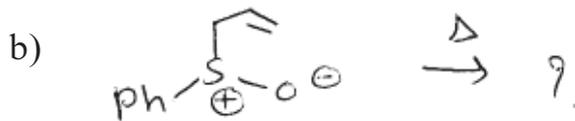
**Q4) a)** With the help of FMO method, show that [2+2] cycloaddition reaction is photochemically allowed process. **[4]**

**b)** Suggest the mechanism for any four of the following. **[12]**



**Q5) Predict the products in any four of the following. [12]**



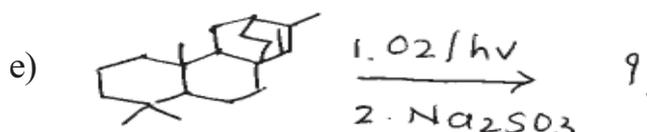
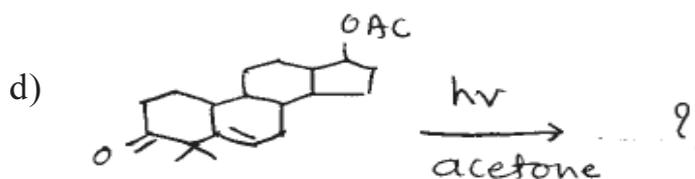
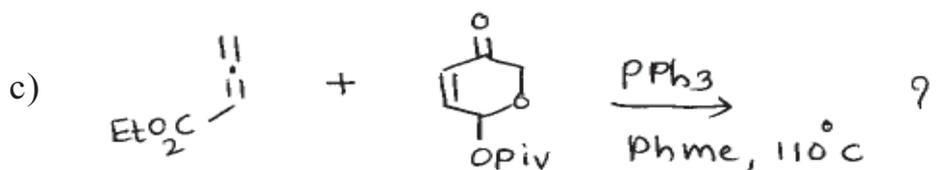


Q6) Answer any four of the following.

[12]

a) Which of the following types of cycloadditions would you predict to proceed easily upon heating.

b) [1, 3] Sigmatropic shift of hydrogen is thermally forbidden but photochemically allowed. Explain.



▽▽▽▽

Total No. of Questions : 4]

SEAT No. :

P1357

[Total No. of Pages : 3

[5123] - 44

M.Sc. II (Semester - III)

ANALYTICAL CHEMISTRY

CH - 390 : Electroanalytical and Current Analytical  
Methods in Industries

(2008 Pattern) (Paper - V)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) All questions are compulsory and carry equal marks.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Use of logarithmic tables, non programmable calculator is allowed.
- 4) Answer to the two sections should be written in separate answer books.

**SECTION - I**

Q1) Attempt any four of the following :

[20]

- a) Discuss the analytical applications of anodic stripping voltametry.
- b) Describe construction and working of DME used in polarographic analysis. Mention advantages and disadvantages of DME.
- c) What is coulometry? Describe the method of separation of nickal and cobalt by controlled potential coulometry.
- d) Calculate the diffusion current of Aluminium metal ion in solution having concentration 3.5 mm, if drop time was measured at the rate of 3.51 sec perdrop. The mercury flow rate was 1.68 mg per sec (Given : diffusion coefficient of Aluminium metal Ion is  $6.8 \times 10^{-6} \text{ cm}^2/\text{s}$ ).
- e) A 120 mg of alloy sample is treated with 100 ml  $\text{H}_2 \text{SO}_4$  Solution to dissolve iron as Fe (II) The 25 ml 0.1 N Ce (III) and sample solution is placed in electrolysis cell for coulometra titration. A constant current of 28.5 mA is used and end point is reached in 420 sec calculate the percentage of Fe in alloy.

P.T.O.

**Q2)** Attempt any four of the following : **[20]**

- a) Describe the potential ramp that is used in square wave polarography. Mention difference between pulse Polarography and square wave polarography.
- b) Draw a labelled polarographic curve. Explain role of maximum suppressor and bubbling of nitrogen gas through the solution in polarographic analysis.
- c) What are the different pulse methods in voltametry? Explain why pulse methods are better than direct methods.
- d) Explain the technique of the amperometry. Draw its experimental set up, Mention its important applications.
- e) Determine half-wave potential ( $E_{1/2}$ ) of Ag/Ag NO<sub>3</sub> electrode having electrode potential - 2.24 volt at 25°C, the current generated by the rate of mass transported by diffusion is 1.98 μA (Given : cathodic diffusion current,  $i_{d,c} = 11.3 \mu\text{A}$ ).

### **SECTION - II**

**Q3)** Attempt any four of the following : **[20]**

- a) Explain the principle of neutron activation analysis. Discuss the comparator method for determination of trace metals from sample.
- b) Explain the principle of radio-metric titration. How it is used to perform complexometric titration?
- c) Explain the principle of Isotope dilution analysis. Discuss the technique of inverse isotope dilution analysis.
- d) A one litre mixture of halide was to be analysed for its iodide content. 2 ml of labelled iodide with activity 5000 counts per 2 min was added to the mixture. After mixing 3 ml of pure iodide was separated which have the activity 5850 counts per 15 min. Calculate the iodide content of the mixture.
- e) What weight of the Arsenic sample should be taken if irradiation period is 24 h, with a neutron flux  $10^7 \text{ n cm}^{-2} \text{ s}^{-1}$ ? A counting rate of 500 dpm is desirable after a cooling period of 10 h.

Arsenic-76 has a half life of 26.4h, Arsenic 75, the target isotope has a natural abundance of 100% and thermal neutron cross section of 43b.

**Q4)** Attempt any four of the following.

**[20]**

- a) Write a note on electro chemical Sensors.
- b) Explain the principle of turbidometric analysis. Describe the standard addition method for the estimation of chloride from water sample by turbidity measurements.
- c) Explain how thermometric titrations differ from classical acid-base titrations. Discuss the advantages of thermometric titrations.
- d) Describe thermogravimetric method for the simultaneous determination of calcium and magnesium from the sample of dolomite.
- e) A thermogram of magnesium compound showed a loss of 91 mg from total 175 mg used for analysis. Identity the compound either as MgO, Mg CO<sub>3</sub> or Mg C<sub>2</sub> O<sub>4</sub>. (At. Wt : - Mg = 24, C = 12, O = 16).



Total No. of Questions : 4]

SEAT No. :

P1358

[Total No. of Pages : 3

[5123] - 45

M.Sc. II (Semester - III)

ANALYTICAL CHEMISTRY

CH - 391 : Environmental and Analysis of Industrial Materials  
(2008 Pattern) (New Course)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) Answer to the two sections should be written in separate answer books.
- 2) All questions are compulsory and carry equal marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic tables, non programmable calculator is allowed.

**SECTION - I**

Q1) Attempt any four of the following :

[20]

- a) Explain the term mixed fertilizer. Describe a method used for estimation of nitrogen from fertilizer.
- b) What are colouring constituents of glass? How iron is estimated from coloured glass?
- c) Explain in detail the use of 8-hydroxyquinoline to estimate aluminium in deodorants and antiperspirants.
- d) What are explosives? How is moisture determined by Karl fischer titration?
- e) A Sample of face powder weighing 2.550 gm was dissolved in acid and the solution was diluted to 250 ml. An aliquot of 50 ml solution was analysed for  $\text{SO}_4^{2-}$  and gave 0.310 gm of  $\text{Ba SO}_4$ . Calculate the percentage of sulphate and sulphur from given sample.

[Given : At-wts :- Ba = 137, S = 32, O = 16]

P.T.O.

**Q2)** Attempt any four of the following :

**[20]**

- a) How Unsulphonated and unsulphated materials are extracted and estimated from Sample of detergent?
- b) Define the terms :-
  - i) Pigment
  - ii) Vehicle
  - iii) Varnish
  - iv) Flash point
  - v) Binder
- c) Explain the term deodorant. Discuss the analytical procedure to determine sulphate from it.
- d) From 0.290 gm of sample containing calcium was dissolved in acid and calcium was precipitated as Calcium oxalate. The precipitate was dissolved in dil-  $\text{H}_2\text{SO}_4$  solution and the solution is diluted to 100 ml. An aliquot of 10 ml was titrated with 0.025 N  $\text{KMnO}_4$  and gave burette reading 7.1 ml. Calculate the percentage of calcium in the given sample.  
[Given At. wts :- Ca = 40.08, O = 16, Mn = 54.93, K = 39]
- e) 0.2 gm of yellow-chrome pigment was disintegrated and soluble chromate was extracted with  $\text{H}_2\text{SO}_4$ . The solution was diluted to 100 ml. An aliquot of 10 ml required 11.5 ml of 0.05 N  $\text{Na}_2\text{S}_2\text{O}_3$  Solution in iodometric titration. Calculate the percentage of chromium and  $\text{CrO}_3$  in the given sample.  
[Given At. wts :- Cr = 52, O = 16]

## **SECTION - II**

**Q3)** Attempt any four of the following :

**[20]**

- a) What are major and minor constituents of the brass? Explain analytical procedure for estimation of copper from brass sample.
- b) Enlist the constituents of dolomite ore. How is magnesium estimated from dolomite ore?

- c) Outline the analytical procedure for the determination of any one of the following :-
- Aluminium from Bauxite ore.
  - Titanium from Ilmenite ore.
- d) 0.140 gm of bauxite ore was disintegrated by suitable method. After removal of impurities the filtrate containing  $\text{Al}^{3+}$  ions was diluted to 100 ml. An aliquot of 25 ml required 27 ml of 0.0098 M EDTA solution for complete reaction. Calculate percentage of  $\text{Al}_2\text{O}_3$ .
- [Given At. wt Al = 26.98]
- e) 1.00 gm sample of ilmenite ore was dissolved in conc.  $\text{H}_2\text{SO}_4$ . After removal of insoluble matter filtrate was diluted to 250 ml. An aliquot of 100 ml is used to precipitate Ti and Fe. The precipitate on ignition gave 0.421 gm of mixed oxide of Ti and Fe. A 25 ml of stock solution was titrated against 0.1 N  $\text{K}_2\text{Cr}_2\text{O}_7$  solution and burette reading was 8.3 ml. Calculate percentage of  $\text{TiO}_2$  and  $\text{Fe}_2\text{O}_3$  in sample.
- [Given At. wt. Fe = 55.85, Ti = 47.90, O = 16]

**Q4)** Attempt any four of the following : **[20]**

- Write a brief note on estimation of mercury from a sample of waste water.
- Explain the term COD and BOD. Give experimental procedure for the estimation of COD from given water sample.
- Explain the methods used to remove the suspended particulate matter.
- Write note on any one :-
  - Activated sludge process.
  - Cyclone separator
- Explain in brief (any one) :
  - Generation and control of  $\text{SO}_x$ .
  - Safety measures in industries.

▽▽▽▽

Total No. of Questions : 4]

SEAT No. :

P1359

[Total No. of Pages : 3

[5123] - 46

M.Sc. II

ANALYTICAL CHEMISTRY

CH - 392 : Advanced Analytical Techniques

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory and carry equal marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of non-programmable calculator/logarithmic table is allowed.
- 5) Use of graph paper is allowed.

**SECTION - I**

Q1) Attempt any four of the following :

[20]

- a) State and explain the Ohm's law. Explain with suitable example how this law is useful in circuit analysis.
- b) Draw the circuit symbols of the following and explain it's meaning and give applications :
  - i) Light emitting diode
  - ii) Photoresistor
  - iii) Transistors
  - iv) Amplifiers
- c) Explain the scope of microprocessor control and computers in analytical Laboratories.
- d) Four resistances  $4\Omega$ ,  $6\Omega$ ,  $24\Omega$ , and  $8\Omega$  are joined in parallel and current of 45 A is fed through them. Calculate the current flowing through each resistor.
- e) How long must a 0.245 amp. current flow in order to plate 0.600g of Copper from Cu (II) Sulfate.

P.T.O.

**Q2)** Attempt any four of the following :

**[20]**

- a) Draw the block diagram showing the communication lines between the analyst, the computer and analytical apparatus. Explain the function of each component.
- b) Explain the role of microprocessor control in X-ray spectrometer.
- c) Write a critical note on scope of microprocessor control in liquid chromatography.
- d) Explain discrete sample analyzer technique in detail.
- e) What is the value of resistor which should be connected with  $60\text{ K}\Omega$  to reduce its value to  $15\text{ K}\Omega$ .

### **SECTION - II**

**Q3)** Attempt any four of the following :

**[20]**

- a) Explain the standard addition method in AAS with a suitable example.
- b) Explain the role of supercritical fluid chromatography as an analytical tool in pharmaceutical analysis.
- c) Give a brief account of Radioimmunoassay with special reference to principle and application.
- d) Write a critical note on Resonance ionisation spectroscopy.
- e) 5 ml sample of blood was treated with trichloroacetic acid to precipitate proteins. After centrifugation, the resulting solution was brought to  $\text{pH}_3$  and extracted with 2ml portion of methyl isobutyl ketone containing the organic lead complexing agent. The extract was aspirated directly into an air acetylene flame and yields absorbance 0.510 at 283.3 nm. 5 ml of aliquot of standard solution containing 0.400 ppm and 0.600 ppm of lead were treated in the same way yielding an absorbance of 0.404 and 0.517. Calculate ppm of lead in blood sample.

Q4) Attempt any four of the following.

[20]

- a) Explain the following terms with respect to AAS.
  - i) Sputtering
  - ii) Spectral interference and its correction method
  - iii) Releasing agent
- b) Explain the type of transition tunable laser. Classify medium pumping and controlling mechanism.
- c) Explain the principle, instrumentation and applications of Radiobioassay.
- d) Compare supercritical fluid chromatography with gas chromatography and liquid chromatography. Also compare supercritical fluid chromatography with other column methods.
- e) The copper in an aqueous sample was determined by atomic absorption flame spectrophotometry. First 10.0 ml of the unknown were pipetted into five 500ml volumetric flasks. Various volumes of each standard containing 14.4 ppm Copper were added to the flasks and solutions were then diluted to volume.

Unknown ml	Standard ml	Absorbance
10.0	0.0	0.208
10.0	10.0	0.301
10.0	20.0	0.385
10.0	30.0	0.470
10.0	40.0	0.559

Calculate the Copper concentration in ppm in the sample by calculation as well as by graph.

▽▽▽▽

Total No. of Questions : 4]

SEAT No. :

P1360

[Total No. of Pages : 2

[5123] - 47

M.Sc. II

ANALYTICAL CHEMISTRY

CH - 380 : Pharmaceutical Analysis

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) All questions are compulsory and carry equal marks.
- 2) Answers to the two sections should be written in separate answer books.
- 3) Use of Logarithmic table/non-programmable calculator is allowed.

**SECTION - I**

**Q1)** Attempt any four of the following : **[20]**

- a) Describe in brief the sources of imparities in raw materials.
- b) What is limit test? Describe limit test for sulphate and chloride ions.
- c) Explain the steps involved in the investigation of new drug.
- d) Discuss the test for haemolysins.
- e) 0.78g of ibuprofen ( $C_{13}H_{18}O_2$ ) was dissolved in 10 ml ethanol and solution was diluted upto 100 ml. 25 ml of above diluted solution was titrated with 0.098N sodium hydroxide solution. The burette reading recorded was 9.5 ml. calculate the percentage of ibuprofen in the given sample.

**Q2)** Answer any four of the following : **[20]**

- a) What is karl-Fischer reagent? Give the procedure for determination of water content from the pharmaceutical product.
- b) Define the term ask value and give its applications. How sulfated ask in aspivin is determined?
- c) What is microbial limit test? Explain the culture media and give composition of casein soyabean digest agar medium.

**P.T.O.**

- d) Explain the cup-plate method for microbial assay of antibiotics.
- e) A pharmaceutical sample containing 0.14g of  $\beta$ -naphthol was dissolved in 30 ml ethylene diamine and titrated with 0.09 N potassium methoxide (in methanol) using o-nitroaniline indicator. The burette reading was 6.9 ml. Determine the percentage of  $\beta$ -naphthol in the sample.

### SECTION - II

**Q3)** Attempt any four of the following : **[20]**

- a) Describe in detail disintegration test for tablets.
- b) Give the advantages and disadvantages of aerosols.
- c) What are capsules? Differentiate between hard and soft capsules. Give brief assay of rifampicin.
- d) What are ointments? Explain different types of bases used for the preparation of ointments.
- e) In an assay of Local anaesthetic, 0.31 g of benzocaine ( $C_9H_{11}NO_2$ ) dissolved in the mixture of 20 ml concentrated hydrochloric acid and 40 ml distilled water. The solution was cooled to  $5^\circ C$  and was titrated with 0.1 m sodium nitrite using acviflavin indicator. The burette reading was 15.9 ml. Calculate the percentage of benzocaine in the sample.

**Q4)** Answer any four of the following. **[20]**

- a) Explain the role of binders and additives in tablet preparation.
- b) What are creams? Explain different types of creams with suitable examples.
- c) Give an account of steam sterilization.
- d) Explain the role of FDA in pharmaceutical industries.
- e) 0.95 g of aspivin ( $C_9H_8O_4$ ) sample was dissolved in 25 ml water to which 50 ml 0.5 N sodium hydronite was added. The mixture was boiled in water bath for 15 minutes. On cooling, the solution was back titrated with 0.5 N hydrochloric acid solution. The titre reading was 30 ml. The blank titration reading was 49 ml. Calculate the percentage of aspivin in the sample.



Total No. of Questions : 4]

SEAT No. :

P1361

[Total No. of Pages : 2

[5123] - 48

M.Sc. - II

ANALYTICAL CHEMISTRY

CH - 381 : Medicinal Chemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates :

- 1) Answers to the two sections should be written in separate answer books.
- 2) All questions are compulsory and carry equal marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of logarithmic tables, non-programmable calculators is allowed.

**SECTION - I**

**Q1)** Attempt any four of the following : **[20]**

- a) What are the factors affecting bioactivity? Explain the concept of pro-drug and soft-drug.
- b) Explain in detail the relationship between free-Wilson and Hansch-analysis.
- c) Write a short note on immunological assay of drugs.
- d) What is a drug receptor? Discuss the elementary treatment of drug receptor interactions.
- e) Define :
  - i) Pharmacophoric API.
  - ii) Isosterism.
  - iii) Bio-isosteris.

**Q2)** Attempt any four of the following : **[20]**

- a) What is a drug? Give the classification of drugs on the basis of therapeutic action.
- b) Enlist the theories of drug activity. Discuss any two theories.

**P.T.O.**

- c) Define the following parameters :
  - i) Lipophilicity
  - ii) Electronic ionization constant
- d) Write a short note on uses of pharmacokinetics in drug development process.
- e) Discuss important features of drug absorption, disposition and elimination.

## SECTION - II

**Q3)** Attempt any four of the following : **[20]**

- a) Give an account of carcinolytic antibiotics and mitotic Inhibitors of Uracil and mechlorithamine.
- b) Give the methods of synthesis :
  - i) Sorbitrate.
  - ii) Amyl-nitrate.
- c) Discuss the mode of action of Sulphonamides or Ciprofloxacin.
- d) Write a short note on stereochemical aspects of psychotropic drugs.
- e) Define :
  - i) Neurotransmitters.
  - ii) Neuroleptics.
  - iii) Antidepressants.

**Q4)** Attempt any four of the following. **[20]**

- a) Define antibiotics. Give an account of lactamrings antibiotics inhibiting protein synthesis.
- b) Give the process of synthesis of :-
  - i) Barbiturates.
  - ii) Oxazepam.
- c) Discuss the use of hormones and natural products as antineoplastic agents.
- d) Explain the salient features of novel drug delivery system.
- e) Discuss the action of any two cardiovascular drugs.

▽▽▽▽

Total No. of Questions : 6]

SEAT No. :

P1362

[Total No. of Pages : 3

[5123]-51

M.Sc. (Semester - IV)

PHYSICAL CHEMISTRY

CH - 410 : Molecular Structure and Spectroscopy

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following : **[15]**

- a) Discuss in brief the classical mechanical approach of NMR Spectroscopy theory.
- b) Define the terms : Saturation, Nuclear spin, chemical shift and nuclear resonance in NMR.
- c) Distinguish between ESR and NMR spectroscopy.
- d) Describe the essential components of NMR instrument with a suitable block diagram.
- e) What is NQR group frequencies? Explain their use in molecular structure determination.

**Q2)** Attempt any three of the following : **[15]**

- a) Why is ESR spectrum recorded in the first derivative mode?
- b) What is Mc Connell relationship? Explain the terms involved their in Discuss its applications.
- c) What is g-value? Discuss the factors affecting g-value.
- d) Discuss the applications of ESR spectroscopy.
- e) Explain the basic principle of PAS.

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

- a) Predict the nature of ESR spectra of  $^{14}\text{NH}_3$  and  $^{15}\text{NH}_3$ .  
Given :  $^{14}\text{N}$ ,  $I = 1$ ,  $A = 20$  G (for  $^{14}\text{N-H}$ )  
 $^{15}\text{N}$ ,  $I = \frac{1}{2}$ ,  $A = 6$  G (for  $^{15}\text{N-H}$ )  
 $^1\text{H}$   $I = \frac{1}{2}$ .
- b) Calculate the NMR frequency of  $^{35}\text{Cl}$  in magnetic field of intensity 1.89T.  
[Given :  $I = \frac{3}{2}$ ,  $\mu = 1.06$  in units of  $\beta_n$ ]
- c) A free electron resonates at 9.5 GHz at a magnetic field strength 0.33 T. At what frequency will resonance occur if the magnetic field is 1.6 T.

## SECTION - II

**Q4)** Attempt any three of the following : **[15]**

- a) Draw a neat labelled diagram of an X-ray Powder camera. Show that for a powder camera of radius 57.296 mm,  $1^\circ$  is equal to 1 mm.
- b) How is the fourier synthesis used to determine a Unit cell?
- c) Give a brief account of Braggs method used in the elucidation of crystal structure.
- d) Write an account of diffraction of electrons by gases with reference to Wierl equation.
- e) State the essential characteristics of the instrumentation for X-ray diffraction.

**Q5)** Attempt any three of the following : **[15]**

- a) Derive the Van-vleck formula for magnetic susceptibility.
- b) Distinguish between diamagnetism and paramagnetism.
- c) What are the advantages and disadvantages of Faraday method over Govy method?
- d) Describe the experimental setup of neutron diffracton technique with a suitable diagram.
- e) Define the terms : magnetic yield, pole strength, intensity of magnetization and susceptibility.

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

- a) Calculate the glancing angle.  
Given :  $d = 400 \text{ Pm}$ ,  $\lambda = 154 \text{ Pm}$ ,  $h = 1$
- b) Calculate the radius of an atom having FCC structure. The mass and density of an atom are 63.5 and  $8.94 \text{ g cm}^{-3}$  respectively
- c) Calculate the volume and mass susceptibilities of complex salt with five unpaired electron at  $25^\circ\text{C}$   
[Given : density =  $1.85 \text{ g cm}^{-3}$ , molar mass =  $228 \text{ g mol}^{-1}$ .]



Total No. of Questions : 6]

SEAT No. :

P1363

[Total No. of Pages : 4

[5123]-52

M.Sc. (Semester - IV)

PHYSICAL CHEMISTRY

CH - 411 : Surface Chemistry and Electro-Chemistry

(2008 Pattern)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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

P.T.O.

## SECTION - I

**Q1)** Attempt any three of the following : **[15]**

- a) Derive Gibbs adsorption equation.
- b) Explain the wetting phenomenon using Young equation.
- c) Describe with a neat sketch, the volumetric method for the study of gas adsorption.
- d) Discuss briefly the localised bond approach for chemisorption.
- e) Give a critical comparison of various models used to explain multilayer adsorption.

**Q2)** Attempt any three of the following : **[15]**

- a) What are zeolites? Explain with examples how zeolites act as molecular sieves.
- b) What is hysteresis of adsorption? How has the phenomenon been explained by Zsigmondy's theory?
- c) Explain the method of naming the catalyst and the catalyst structure. What is catalyst deactivation?
- d) What is specific surface area of solid? Discuss various methods used to determine it.
- e) Write a note on heterogeneous catalysis.

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

- a) The following table gives the volume of nitrogen (reduced to 0°C and 1 bar) adsorbed per gram of active carbon at 0°C at a series of pressures,

P/Pa	524	1731	3058	4534	7497
V/cm <sup>3</sup> g <sup>-1</sup>	0.987	3.04	5.08	7.04	10.31

Plot the data according to Langmuir isotherm and determine the constants.

- b) A fatty acid forms a surface film on water that obeys, the two dimensional perfect gas law. If the lowering of the surface tension is  $10 \times 10^{-3} \text{ Nm}^{-1}$  at  $25^\circ\text{C}$ , what is the surface excess concentration and the surface area per adsorbed molecule?
- c) The pressures of nitrogen required to cause the adsorption of  $1.0 \text{ cm}^3 \text{ g}^{-1}$  of gas on carbon black are 24 Pa at 77.5K and 290 Pa at 90.1 K. Calculate the enthalpy of adsorption using the Clausius Clapeyron equation.

### SECTION - II

**Q4)** Answer any three of the following : **[15]**

- a) Define true and potential electrolyte.
- b) Define the term flux and enlist the names of types of fluxes.
- c) Write Butler-Volmer equation and explain the terms involved in it.
- d) Discuss the Stern theory of electrical double layer.
- e) Define the terms :
- i) Outer potential
  - ii) Surface potential
  - iii) Inner potential
  - iv) Electrochemical potential

**Q5)** Answer any three of the following : **[15]**

- a) What are primary cells? Describe in detail one example of primary cell.
- b) Assuming the expression for charge density, derive an expression for thickness of ionic atmosphere.
- c) Derive the Fick's first law for steady-state diffusion.
- d) Discuss the principles involved in the methods of preventing corrosion.
- e) Write a note on electrosynthesis.

**Q6)** Solve any two of the following :

**[10]**

- a) Calculate the constants A and B in Debye - Huckel equation for solvent with dielectric constant 2-6 at 25°C.
- b) The diffusion coefficients of  $K^+$  and  $Cl^-$  ion in 0.02 M KCl solution at 25°C were measured as  $D_{Na^+} = 1.25 \times 10^{-9} \text{ m}^2 \text{ s}^{-1}$  and  $D_{Cl^-} = 0.29 \times 10^{-9} \text{ m}^2 \text{ s}^{-1}$  calculate the equivalent conductance of solution.
- c) The exchange current density at Pt /  $H_2$  (g) /  $H^+$  (aq) electrode at 280 K is  $0.80 \text{ mA cm}^{-2}$ . What current flows through a standard electrode of total surface area  $5 \text{ cm}^2$ . When overvoltage is 5 mv (given  $\alpha$  or  $\beta = 0.5$ )?

▽▽▽▽

Total No. of Questions : 4]

SEAT No. :

**P1364**

[Total No. of Pages : 3

[5123] -53

**M.Sc. PHYSICAL CHEMISTRY**

**CH-414: BioPhysical Chemistry & Related Technology (Old)  
(2015 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

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

**Physico - Chemical Constants**

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

**P.T.O**

### **SECTION -I**

**Q1)** Attempt any four of the following: [20]

- a) Why is the phosphoanhydride bond called a high energy bond?
- b) What is primordial soap? Explain the terms 'tenany' and 'chaperones'.
- c) Differentiate between Rmp, R9 and Rrms.
- d) Explain the functions of chaperones in protein folding.
- e) What are the strategies followed to study the chemical processes in cell biology?
- f) Calculate Rrms for a polymer having 280 monomers and 450 nm long.

**Q2)** Attempt any four of the following. [20]

- a) What are good and poor solvents for macromolecule? What is the measure of the effectiveness of a solvent?
- b) Explain the role of ATP to fuel cell process.
- c) Deduce the Henderson-Hassalbalch equation.
- d) Write a note on channel proteins.
- e) Explain the effect of directionality on the strength of H-bond.
- f) Discuss the role of  $ca^{++}$  in muscle contraction.

### **SECTION -II**

**Q3)** Attempt any four of the following [20]

- a) Explain reversible enzyme inhibition with examples.
- b) Draw and explain the graph showing various events of action potential.
- c) What is all or none law? Explain.
- d) Define the terms:
  - i) endocytosis
  - ii) antiport
  - iii) axolemma
  - iv) synapse and
  - v) afferent nerves
- e) What is passive transport? How is it facilitated by membrane proteins?
- f) What are biopolymers? State their characteristics and applications with examples.

**Q4)** Attempt any four of the following

**[20]**

- a) Discuss the biological significance of Donnan membrane equilibrium.
- b) Write a note on: Helix-cell transition.
- c) Describe the instrumentation used for measuring optical rotatory dispersion.
- d) What are micelles and bilayers? Differentiate between them.
- e) What is electrophoresis? State its types, explain any one.
- f) State the principle of x-ray diffraction. How is it used to determine molecular weight of an asymmetric macromolecule?



Total No. of Questions : 5]

SEAT No. :

P1365

[Total No. of Pages : 3

[5123] -54

M.Sc. (Semester - IV)

PHYSICAL CHEMISTRY

CH -415: Special Topics in Nuclear and Radiation Chemistry (Old)  
(2008 Pattern)

Time : 3 Hours]

[Maximum Marks : 80

Instructions to the candidates:

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

Physico - Chemical Constants

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7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9. 1 cal		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10. 1 amu		=	$1.673 \times 10^{-27} \text{ kg}$
11. Bohr magneton	$\beta_e$	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	$\beta_n$	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	$m_e$	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O

## SECTION -I

**Q1)** Attempt any three of the following: **[15]**

- a) Give an account of technecium generator.
- b) Discuss the principle of position emission Tomography technique which radioisotopes are used in this technique?
- c) Describe the method of separation of hydrogen isotopes.
- d) What are the advantages of using gamma radiation for food preservation. Which radiation sources are used for this purpose?

**Q2)** Attempt any three of the following. **[15]**

- a) Explain the terms Cosmochemistry, fall and find, s and p process.
- b) What is maximum permissible dose? Which point are to be considered. while applying this dose?
- c) Classify the radio active waste as per AERB guidelines.
- d) Give an account of neutrino problem.

**Q3)** Solve any two of the following **[10]**

- a) Find out the thickness of lead needed to decrease an activity from 50,000cpm to 10,000 cpm.  
Given:  $e\mu = 0.211$  b/electron 2 of pb = 82, A of pb = 207, density of pb= 11.35 g/cm<sup>3</sup>
- b) Technicium generator is louted with 99 mb with an activity of 20,000cpm. find out the activity of 99mtc extraucted after 6 hours of loading .  
Given:  $t_{1/2}$  of 99mo = 66h,  $t_{1/2}$  of 99m tc =6h extraction efficiency = 60%
- c) A radiation concept is exposed with following doses in layer 0.01 rad due to  $\alpha$  particles 0.1gy due to  $\beta$  particles 0.001R due to thermal neutrons find out the total effective dose he was exposed to. Is it permissible?

## SECTION -II

**Q4)** Answer any four of the following **[20]**

- a) Explain the terms PRP of water, G value and pulse radiolysis.
- b) Write a note on empirical rate studies in radiolysis of aqueous solutions.
- c) What are the various products formed in radiolysis of aromatic hydrocarbons?
- d) Describe the effect of solute concentration on molecular yield of aqueous solution
- e) Write a note on radical scavengers.
- f) Describe how radioactive species is isolated alternatively productive.

**Q5)** Answer any four of the following **[20]**

- a) Give an account of neutralization radiometric titration.
- b) Draw and explain the radiometric titration curve where in ion getting precipitated first and third are labelled.
- c) Describe the technique for measurement of beam energy and intensity.
- d) 50ml of labelled KI was titrated 5 ml of with 0.001M AgNO<sub>3</sub>. addition of AgNO<sub>3</sub> followed by removal of precipitate showed a decrease in activity from 20,000cpm to 4000 cpm. find out-amount of KI in a given solution  
Given at.wt. of Ag=108 I = 127, N=14, O=16, K=39 amu
- e) Draw an experimental set up for radiometric titration based on  $\beta$  absorption
- f) Describe how the sample is prepared for radio activity measurement.



Total No. of Questions : 4]

SEAT No. :

P1366

[Total No. of Pages : 2

[5123] - 55

M.Sc. -II (Semester - IV)

INORGANIC CHEMISTRY

CH -430: Inorganic Solids & Heterogeneous Catalysis  
(2008 Pattern)

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *All questions carry equal marks.*
- 3) *Neat diagrams should be drawn wherever necessary.*

**Q1)** Answer the following (any four)

**[20]**

- a) What are inorganic polymers? Give their characteristics.
- b) Explain the basic principles involved in heterogeneous catalysis.
- c) Discuss the effect of pH and  $\text{SiO}_2/\text{Al}_2\text{O}_3$  ratio on the zeolite synthesis.
- d) What is chemical reactor? Discuss construction, working and uses of the any one type of reactor.
- e) Discuss various types of clays and their uses as a heterogeneous catalyst.

**Q2)** Answer the following. (any four)

**[20]**

- a) Draw the structure and find out number of framework electrons in  $[\text{Ni}_6(\text{CO})_{12}]^{2-}$ .
- b) Differentiate between chemisorption and physisorption.
- c) Give an account of use of zeolite in shape selective catalysis.
- d) Discuss in detail the classification of heterogeneous catalysts.
- e) List out the various methods of nanoparticle synthesis. Discuss any one method in detail.

**P.T.O**

**Q3) Answer the following (any four) [20]**

- a) Write in detail about the double silicate structure with suitable example.
- b) Discuss the various methods of characterization of supported metal catalysts.
- c) "Semiconducting materials play an important role in catalysis". Justify with suitable examples.
- d) What do you understand by peroxy acids? Explain their structures and acidic properties with the help of appropriate examples.
- e) Discuss the role of support in the supported metal catalysts.

**Q4) Write notes on (any four) [20]**

- a) SN compounds
- b) Catalytic convertor
- c) Nanomaterials in organic synthesis
- d) MFI and MEL type zeolites
- e) Fischer - Tropsch synthesis



Total No. of Questions : 4]

SEAT No. :

P2236

[Total No. of Pages : 2

**[5123] -56**  
**M.SC. II (Semester -IV)**  
**INORGANIC CHEMISTRY**  
**CH-431: MATERIAL SCIENCE**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *All questions carry equal marks.*
- 3) *Use of calculator is allowed.*

**Q1)** Attempt any four of the following:

**[20]**

- a) What is nanomaterial? Explain the following
  - i) Quantum wall
  - ii) Quantum wire
  - iii) Quantum dot
- b) Explain the different types of semiconductor with the help of band energy diagram.
- c) What is biomaterials? Explain the different applications of biomaterial.
- d) Explain the different types of solid state reactions with suitable examples?
- e) Explain the sol-gel process.

**Q2)** Attempt any four of the following:

**[20]**

- a) What is asphalt? Explain the process of manufacture of asphalt.
- b) Explain the phenomenon of superconductivity with the help of meissner effect.
- c) Discuss the working of n-p-n junction.
- d) What is incandescences? Explain the different types of phosphorances.
- e) Explain the Bardeen-coper-schrieffer theory of superconductivity.

**P.T.O**

**Q3)** Attempt any four of the following:

**[20]**

- a) Calculate the conductivity of pure silicon at room temperature. When the concentration of carrier is  $3.2 \times 10^{10}$  cm<sup>2</sup>/volt second

Given:  $\mu_e = 3000$  cm<sup>2</sup>/volt.second.

$\mu_n = 1000$  cm<sup>2</sup>/volt.second.

- b) In germanium the bond gap is 0.75 e<sup>0</sup>volt what is the wavelength at which germanium start to absorb light.
- c) What is imperfection? Discuss the point defect with suitable example.
- d) What is Ferromagnetic materials? Draw the structure of first organic Ferromagnet.
- e) Write a short note on Ficks law of diffusion.

**Q4)** Attempt any four of the following.

**[20]**

- a) Explain the types of hysteresis Loops.
- b) What is reinforced concrete? Explain the process how reinforce concrete in formed.
- c) Explain the application of ceramic materials.
- d) Explain hard and soft magnet.
- e) What is ruby crystal? Explain the working of ruby crystal in photoconductivity.



Total No. of Questions : 9]

SEAT No. :

P1367

[Total No. of Pages : 4

[5123] -57

M.Sc. -II (Semester - IV)

INORGANIC CHEMISTRY

CH -445: Inorganic Applications in Industry, Biotechnology &  
Environmental Chemistry  
(2008 Pattern)

*Time : 3 Hours]*

*[Max. Marks : 80*

*Instructions to the candidates:*

- 1) *Attempt any two sections from the following.*
- 2) *Both sections should be written in the same answer book.*
- 3) *All questions are compulsory.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagram must be drawn wherever necessary.*
- 6) *Use of logarithmic table/calculator is allowed.*

**SECTION -I**

**Inorganic Applications in Industry**

**Q1)** Attempt any three of the following:

**[15]**

- a) What is meant by term pigment? Explain the following properties of inorganic pigments.
  - i) Hiding power
  - ii) Pigment size and shape
  - iii) Resistance to light
  - iv) Ease of wetting
- b) Give an account of preparation of copper dyes from O-hydroxy diaryl azo compounds and O-halogeno O-hydroxy diaryl azo compounds.
- c) Explain the microstructure of soft wood.
- d) Explain the production and properties of glass fibers from reinforcing plastic resin.

**P.T.O**

**Q2)** Attempt any three of the following: **[15]**

- a) Explain the basic materials and chemical composition of portland cement. Describe the various types of portland cement.
- b) Explain the role of co-ordination in electroplating.
- c) Give two examples and draw structure of -
  - i) Metallized dyes
  - ii) Additional reagents
  - iii) Medially metallized azodyes
- d) What do you understand by  $N\alpha$ - $N\beta$  isomerism in metal complexes of azo compounds? Explain with respect to Nickel and Copper complexes.

**Q3)** Write short notes on any two: **[10]**

- a) Carbon fiber reinforced epoxy resin
- b) White pigment
- c) Formazans

## SECTION -II

### Environmental Chemistry

**Q4)** Attempt any three of the following: **[15]**

- a) Discuss some of the advantages of physical-chemical treatment of sewage as opposed to biological waste.
- b) List the trace element pollution in natural water with source, effect and significance.
- c) What is meant by point and non point sources of Pollution? Give an example of each.
- d) Draw a schematic diagram of a Molten Carbonate Fuel Cell (MCFC). Write the reactions that occur at the cathode and anode. Show overall reaction. Describe the Molten electrolyte used in this fuel cell.

**Q5)** Attempt any three of the following: **[15]**

- a) What is powerball? Draw a schematic diagram of plant for producing powerball. How is the hydrogen gas liberated from a powerball. How is the powerball manufactured.
- b) What does tertiary treatment in a sewage treatment plant remove from the waste stream?
- c) Name the instrumental method for the determination of Hg, Cd, As and Pb. Explain XRF method for the determination of Pb from polluted water.
- d) What are the best option for energy sources for 21<sup>st</sup> century? Explain in short.

**Q6)** Write short notes on any two: **[10]**

- a) BOD
- b) Tidal power
- c) Reverse Osmosis

### **SECTION -III**

#### **Biotechnology**

**Q7)** Attempt any three of the following: **[15]**

- a) "Biotechnology is a branch which has developed by the contribution of various branches of science". Comment.
- b) Explain the effect of pH, concentration and temperature on making of curd.
- c) Explain the use of microbes in oil refinery.
- d) "Algae can be used as food as well as fuel". Explain.

**Q8)** Attempt any three of the following: **[15]**

- a) Explain the cycle of methane production using anaerobic bacteria.
- b) What is recombinant DNA technology? What are its advantage and limitations?
- c) What are enzymes? What makes them suitable as bio-catalyst? Explain.
- d) Name the different processes used in water treatment and explain the deep shaft process in detail.

**Q9)** Write notes on any two:

**[10]**

- a) Stages in Genetic engineering.
- b) Living cells-miniature chemical factories.
- c) Applications of single cell proteins.



Total No. of Questions : 6]

SEAT No. :

P1368

[Total No. of Pages : 4

[5123] -58  
M.Sc -II (Semester - IV)  
ORGANIC CHEMISTRY  
CH -450 Chemistry of Natural Products  
(2008 Pattern)

Time : 3 Hours]

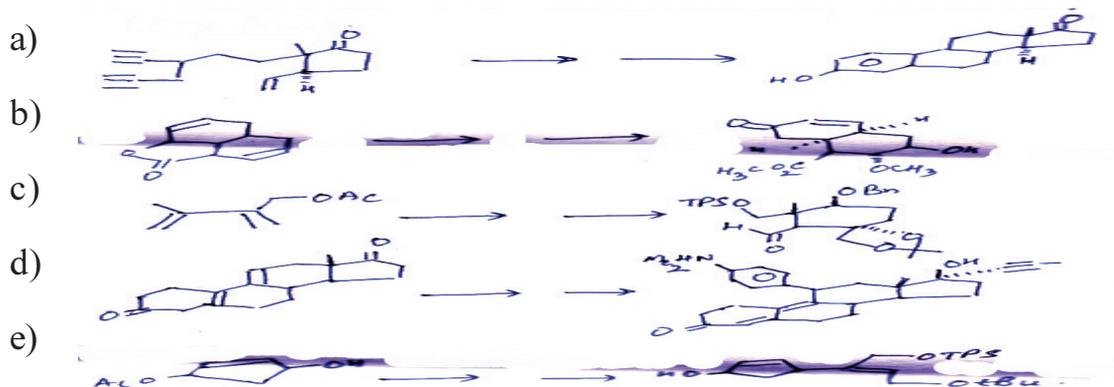
[Maximum Marks : 80

Instructions to the candidates:

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

SECTION -I

Q1) Outline the steps involved in the following synthetic sequences. Indicate the reagents used and discuss the mechanism and stereochemistry involved.(any four) [16]



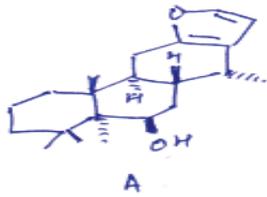
Q2) Answer the following (any three)

[12]

- a) Podophyllotoxin and Picropodophyllin are stereoisomers and not structural isomers. Justify.
- b) Give evidences to establish the presence of
  - i)  $\text{ArCH}_2\text{N}_\text{H}-\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{C}-$  group and
  - ii) Presence and position of ethyl group in hydroxy eamptothecin.

P.T.O

c) Draw the stereostructure for the following compound A.



Discuss: i) Nature of oxygen function.

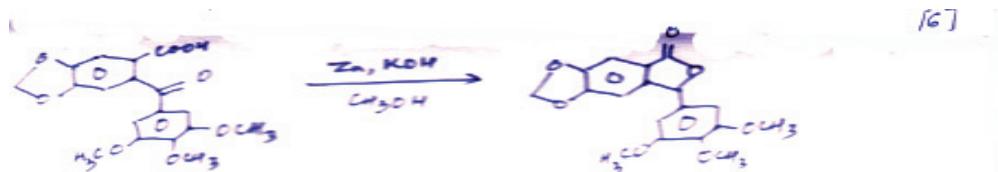
ii) Presence of for an ring and its substitution pattern

iii) Presence of trans diol system.

d) What is the role of acetic anhydride in establishing the stereochemistry at C-8 in Hard Wickiic acid.

Q3)

[6]



In the above mentioned reaction how will you prove presence of

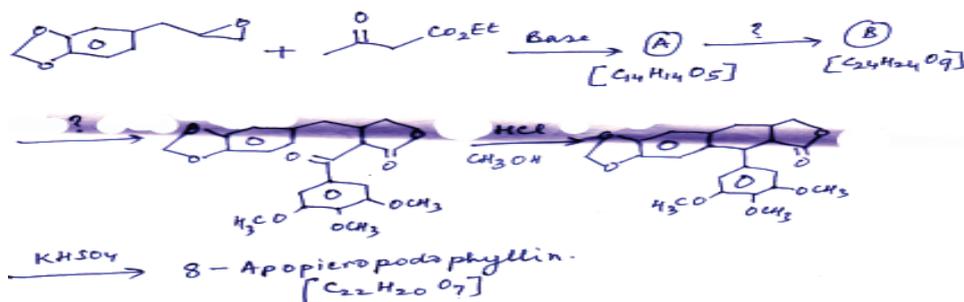
i) -CooH group

ii) Three -OCH<sub>3</sub> group

iii)  $\text{C} = \text{O}$  group

How will you study the course of reaction by I.R. spectroscopy.

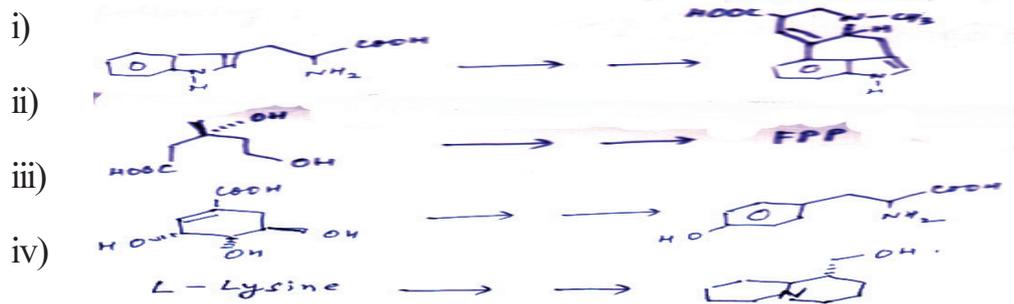
b) Complete the following synthetic sequence using appropriate Negents and inter mediates. Justify. [6]



### SECTION -II

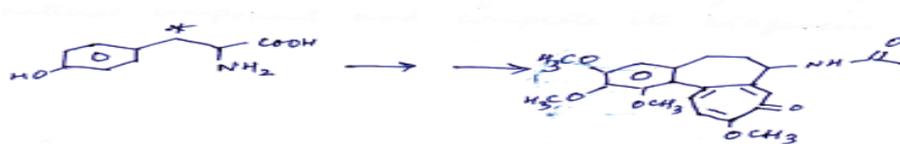
Q4) a) Explain the importance of Wagner-Meerwin rearrangements in biogenesis with suitable example. [4]

b) Suggest biogenetic scheme for any three of the following: [12]



Q5) Answer any two of the following. [12]

a) Predict the distribution of label in following natural compound and complete its biogenesis.



b) Suggest the biogenesis of

From

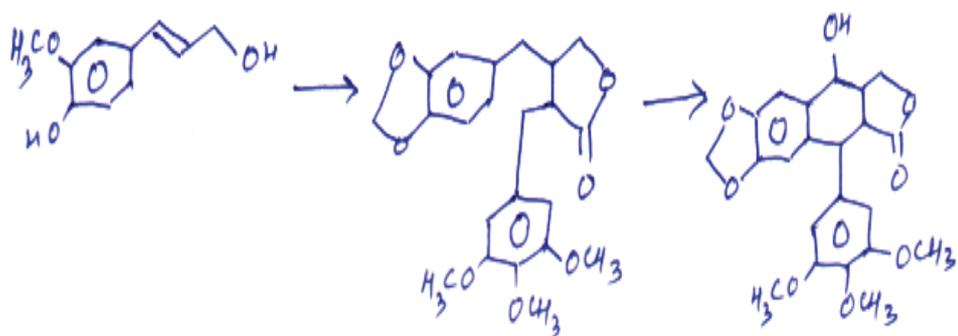


c) Complete the following biogenetic sequence

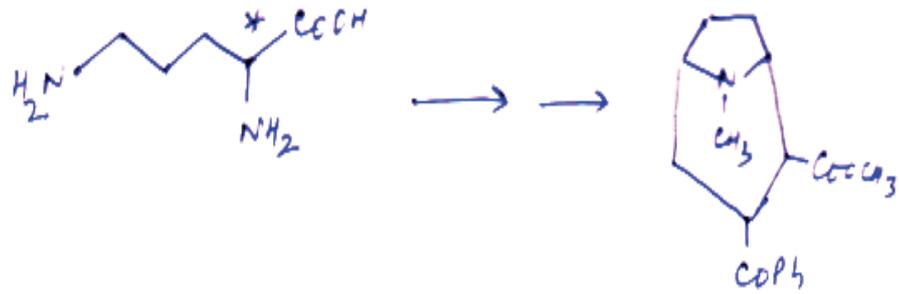


Q6) a) Answer any one of the following. [6]

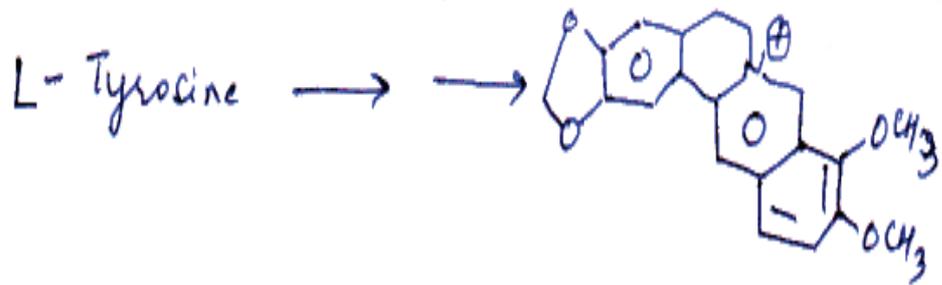
i) Complete the following biogenetic scheme.



- ii) Complete the biogenetic sequence and indicate the position of label in the product.



- b) Discuss the biosynthetic steps involved in the following conversion. [6]



Total No. of Questions : 6]

SEAT No. :

P1369

[Total No. of Pages : 3

[5123] -59

**M.Sc -II ORGANIC CHEMISTRY**  
**CH -451: Synthetic Methods in Organic Chemistry**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*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 indicates full marks.*

**SECTION -I**

**Q1)** Answer any three of the following. **[12]**

- a) Give the preparation of Collman's reagent and its synthetic applications
- b) Explain alkoxy carbonylation of alkyl halides catalyzed by Pd (0) in presence of basic alcohol.
- c) Explain the role of  $\text{Co}_2(\text{Co})_8$  in Pauson-Khand reaction.
- d) Explain preparation of optically active 2-butanol using hydroboration-oxidation.

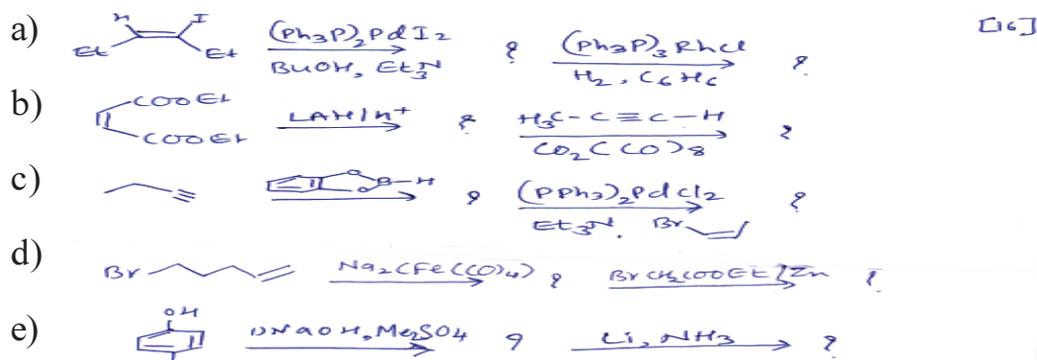
**Q2)** Write short notes on any three of the following. **[12]**

- a) Wacker oxidation
- b) Suzuki coupling
- c) Peterson olefination
- d) Hydroboration-oxidation reaction

**P.T.O**

Q3) Predict the product/s any four of the following.

[16]



### SECTION -II

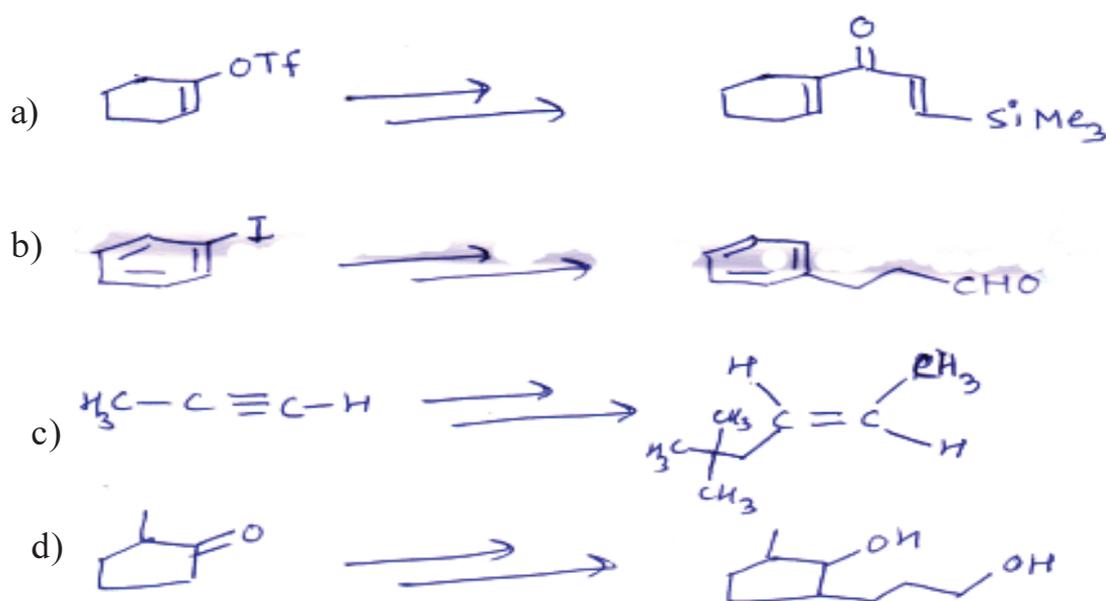
Q4) Explain any three of the following.

[12]

- Silyl ether protection is preferred for alcoholic hydroxyl group.
- Use of ketene in organic synthesis.
- Acyl anion equivalent can be prepared from enol ethers.
- Concept of Umpolung with suitable example.

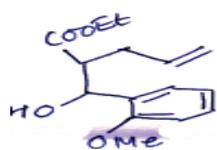
Q5) How will you effect the following conversions using suitable reagents (any three)

[12]

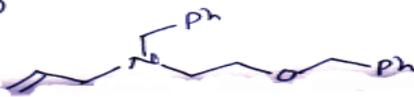


**Q6)** Using retrosynthetic analysis, suggest convenient route for synthesis of any four of the following compounds. **[16]**

a)



b)



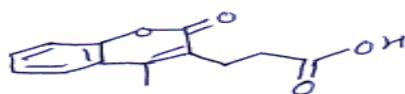
b)



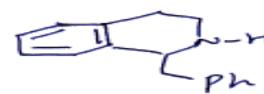
d)



c)



f)



Total No. of Questions : 6]

SEAT No. :

P1370

[Total No. of Pages : 4

[5123] -60

**M.Sc -II (Semester - IV) Organic Chemistry. 2017**  
**CH-452: Heterocyclic Chemistry, Chiron Approach & Medicinal**  
**Chemistry**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

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

**SECTION -I**

**Q1) A)** Explain any three of the following.

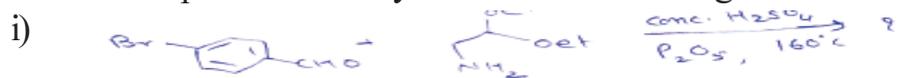
- i) Imidazole undergoes electrophilic substitution only under vigorous conditions. [9]
  - ii) Indole on reaction with chloroform and KOH in ethanol gives 3-chloroquinoline as one of the products.
  - iii) Reactivity of pyrrole is much higher than pyridine, pyrimidine in electrophilic substitution reaction.
  - iv) Isoquinoline reacts with sodamide to give 1-amino isoquinoline, while 5-nitro isoquinoline on reaction with ammonia gives 6-amino-5-nitro isoquinoline.
- B) How supra molecular chemistry is different than traditional chemistry?[3]

**Q2) A)** Give the reactions of following reagents with quinoline. [4]

- i)  $\text{Ts C}_1$ , KCN,  $\text{CH}_2 \text{Cl}_2$ ,  $\text{H}_2\text{O}$ , R.T.
- ii)  $\text{KNH}_2$ ,  $\text{NH}_3$  (liq.),  $-66^\circ\text{C}$ .
- iii) 30% Oleum,  $90^\circ\text{C}$ .
- iv) LAH,  $\text{E}_2^+ \text{O}$ .

**P.T.O**

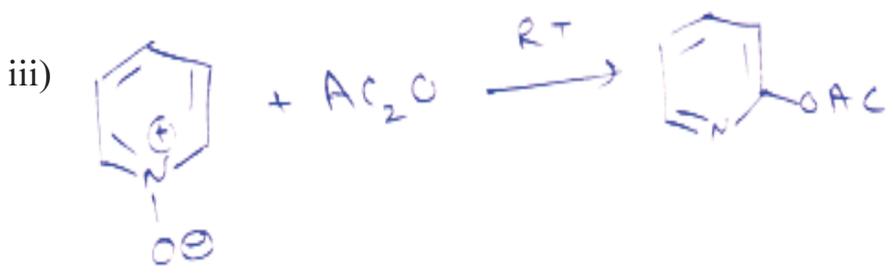
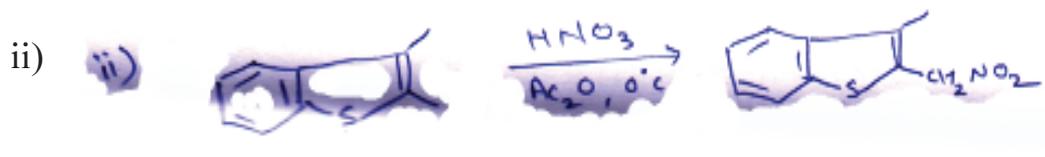
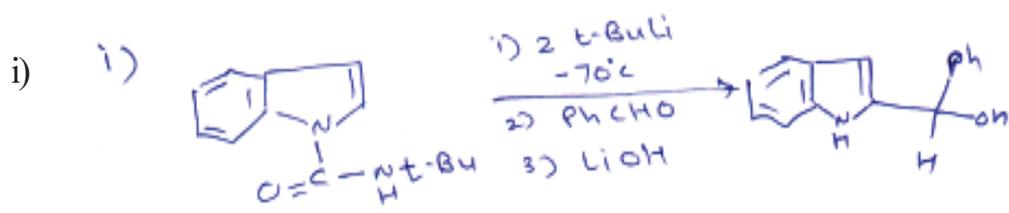
B) Predict the products in any four of the following. [8]



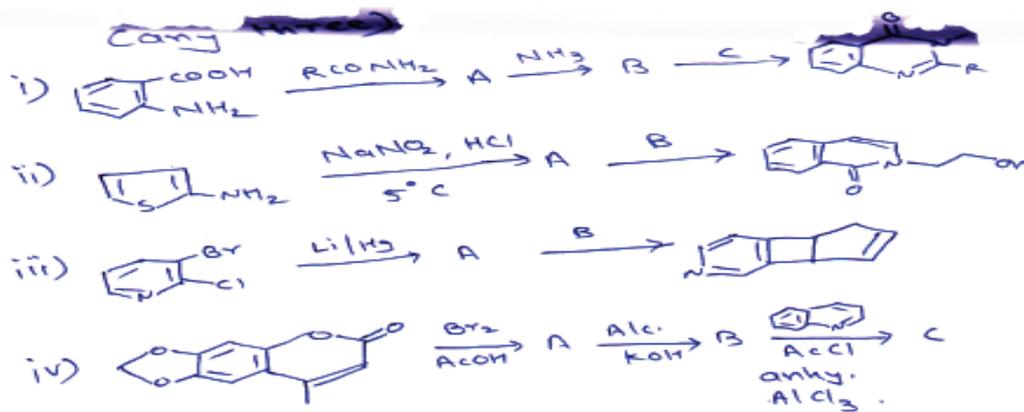
C) Write notes on (any two) [4]

- i) Hantzsch pyridine synthesis
- ii) Fischer indole synthesis
- iii) Feist-Benary synthesis.

Q3) A) Suggest suitable mechanism for any two of the following. [6]



B)



[6]

### SECTION -II

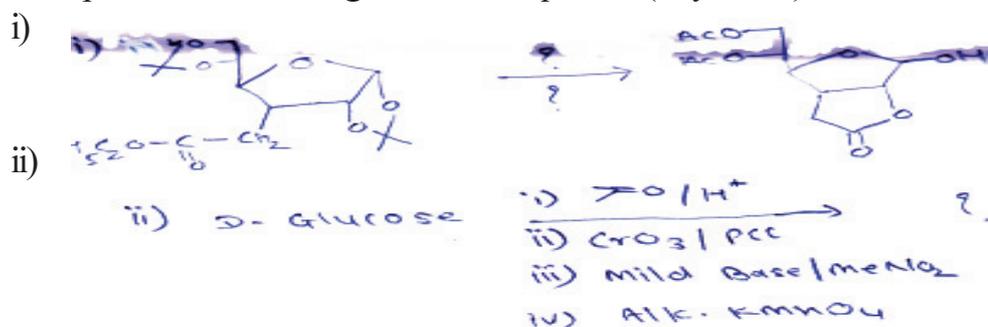
**Q4)** Answer any four of the following.

[16]

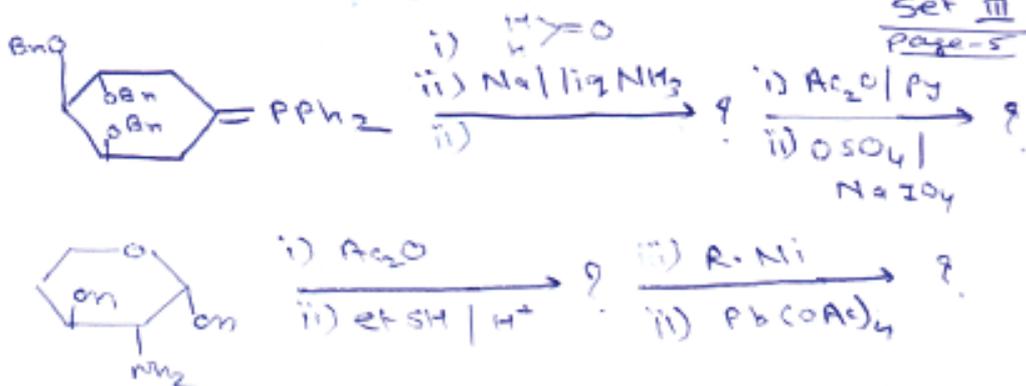
- i) Two Ruff degradation on an aldohexose give an aldo tetrose that is oxidised by  $\text{HNO}_3$  to meso tartaric acid. Give the possible structures of aldohexose.
- ii) Write the synthesis of s-Epichlorohydrin.
- iii) Draw  $1C_4$  and  $4C_1$  conformation of D-Glucose and L-Glucose.
- iv) Describe the basic principles of green chemistry.
- v) Write the short notes on
  - a) Anomeric effect
  - b) Anti-lone pair donation hypothesis

**Q5)** Complete the following reaction sequence (any three)

[12]



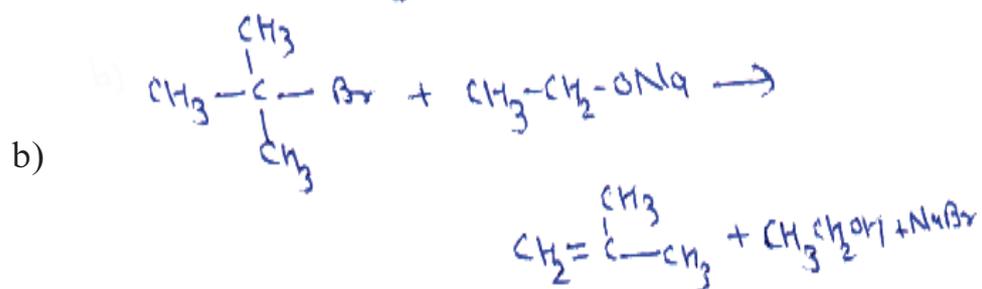
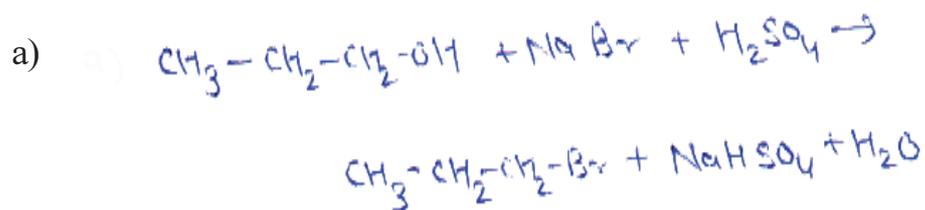
iii)



Q6) A) Solve any two of the following

[8]

i) Calculate the atom economy for following reactions.



ii) Write short note on ADME.

iii) Write short note on receptor and drug receptor interaction.

B) Answer the following

[4]

i) Retrosynthetic analysis of s-propanediol

ii) Rule of five



Total No. of Questions : 4]

SEAT No. :

P1371

[Total No. of Pages : 3

**[5123] -61**  
**M.Sc -II (Semester - IV)**  
**CH -481 ANALYTICAL CHEMISTRY**  
**Bioanalytical and Forensic Science**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

- 1) All questions are compulsory and carry equal marks.*
- 2) Answer to the two sections should be written in separate answer books.*
- 3) Use of logarithmic table/non-programmable calculator is allowed.*

**SECTION -I**

**Q1)** Attempt any four of the following.

**[20]**

- a) Define the terms:
  - i) Poppy straw
  - ii) Opium derivatives
  - iii) Psychotropic substances
  - iv) Charas
- b) Discuss the principle for isolation and determination of amphetamine and metamphetamine from urine sample.
- c) Write a note on. "Offences and penalties in Psychotropic substances Act".
- d) Out-line the procedure for warehousing of alcoholic preparations.
- e) In the sample containing caffeine in reference standard is 30.12  $\mu\text{g/ml}$ . peak height of caffeine sample is 16 min and peak height of reference standard is 17min. calculate content of caffeine in given sample.

**P.T.O**

**Q2)** Attempt any four of the following. **[20]**

- a) Describe the method for estimation of vitamin A.
- b) State and explain the principle for estimation of phosphatase. Give the procedure for the estimation of same.
- c) Write a note on "Preparation of laboratory food samples."
- d) Define saponification value of oil. Discuss the method used for the determination of the saponification value of oil.
- e) A 35.65 gram food sample containing sulphite as preservative was subjected to Tanner method and titre value obtained with 0.01N NaOH was 9.0ml. Calculate the amount of  $\text{SO}_2$  in the sample.

### **SECTION -II**

**Q3)** Attempt any four of the following. **[20]**

- a) What is UTH? Give suitable method for lactic acid determination from milk.
- b) Explain a method for estimation of tannin from tea sample using lowenthal permanganate oxidation procedure.
- c) Define vitamins. Explain Wald's visual cycle and deficiency symptoms of Vitamin C.
- d) Give the method for determination of adulteration of honey.
- e) A sample of ascorbic acid ( $\text{C}_6\text{H}_8\text{O}_6$ ) weighing 1.4 gm was dissolved in water and diluted to 100ml. An aliquot of 10ml of sample solution was titrated against 0.1N Iodine solution. It required 9.4 ml of Iodine calculate the percentage of ascorbic acid in sample.

**Q4)** Attempt any four of the following. **[20]**

- a) Explain the method for estimation of caffeine.
- b) What are carbohydrates? Give a method for its estimation.

- c) Write a short note on preparation of laboratory food samples.
- d) Define acid value. Discuss the method used for the determination of acid value of oil.
- e) A 4.2829 tea sample was analysed for tannin content. After treatment when tea sample solution titrated with 0.2 N  $\text{K}_2\text{Cr}_2\text{O}_7$  gave titre value 10.5ml. Calculate the percentage of tannin in given sample .

[Given: Mol-ut, of tannin = 208]



Total No. of Questions : 4]

SEAT No. :

P1372

[Total No. of Pages : 3

**[5123] -62**  
**M.Sc -II (Semester - IV)**  
**ANALYTICAL CHEMISTRY**  
**CH -490: Analytical Spectroscopy**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

- 1) All questions are compulsory and carry equal marks.*
- 2) Answers to the two sections should be written in separate answer books.*
- 3) Neat diagrams must be drawn wherever necessary.*
- 4) Use of logarithmic table/non-programmable calculator is allowed.*

**SECTION -I**

**Q1)** Attempt any four of the following. **[20]**

- a) What are ESCA satellite peaks? Why do we get satellite peaks?
- b) What are transducers? Explain with schematic diagram principle and working of pneumatic detector.
- c) Draw schematic diagram, explain the working of single beam spectrophotometer.
- d) What are monochromators? Explain the working of prism as a monochromator.
- e) The molar absorptivity of  $\text{KMnO}_4$  is  $1.5 \times 10^4 \text{ lit mole}^{-1}\text{cm}^{-1}$  in a 1.00cm cell at 520nm. The transmittance of solution is 90% calculate the concentration of  $\text{KMnO}_4$  solution.

**Q2)** Attempt any four of the following. **[20]**

- a) Enlist the diffraction methods of crystal structure analysis. Describe the Braggs method for crystal analysis.
- b) What is chemiluminescence? Explain the use of gas phase chemiluminescence in analysis.

**P.T.O**

- c) Write a short note on chemiluminescence titrations.
- d) An ESCA electron was found to have kinetic energy of 1054.5 eV, when ejected with Al,  $K\alpha$  source ( $\lambda = 8.34 \text{ \AA}$ ) and measured on spectrometer with work function 9.8 eV. Calculate the binding energy of electron.

[Given: Planck's constant =  $6.625 \times 10^{-34} \text{ Js}$ ;

Velocity of light =  $3 \times 10^8 \text{ m/s}$ ]

- e) A crystal of unknown compound was exposed to  $K\alpha$  line of copper at  $1.542 \text{ \AA}$ , diffracted at an angle  $28.5^\circ$  relative to the crystalline surface for first order diffraction. Calculate the spacing between the adjacent layers of nuclei in the crystal.

### SECTION -II

**Q3)** Attempt any four of the following.

**[20]**

- a) Discuss the quantum theory of NMR spectroscopy.
- b) Explain the following terms:
- i) Chemical shifts in NMR
  - ii) Coupling constant in NMR
- c) Draw a schematic diagram of NMR spectrometer. Explain the working of its components.
- d) Calculate the number of multiplet for each proton and their relative peak areas in the NMR spectrum of  $\text{CH}_3\text{CHBrCH}_3$ .
- e) A proton appears at a quartet at  $4.5 \delta$  with coupling constant 6 Hz on a 300 MHz instrument, indicates the line position in Hz of each line and give its relative intensities.

**Q4)** Attempt any four of the following.

**[20]**

- a) Discuss ENDOR and ELDOR techniques in EPR spectroscopy with suitable examples.
- b) Explain the terms: fine splitting, hyper fine splitting, and super hyperfine splitting in EPR spectra.
- c) Describe with suitable examples, the applications of EPR spectroscopy in qualitative analysis.
- d) Discuss the principle of electron microscopy and give its important applications.
- e) Calculate the resonance frequency of a free electron in a magnetic field of 250 kg.

[Given:  $g = 2.0023$ ,  $\mu_e = 9.285 \times 10^{-24} \text{ JT}^{-1}$ ]



Total No. of Questions : 4]

SEAT No. :

P1373

[Total No. of Pages : 3

**[5123] -63**  
**M.Sc -II (Semester - IV)**  
**ANALYTICAL CHEMISTRY**  
**CH-491: Polymer Technology**  
**(2008 Pattern)**

*Time : 3 Hours]*

*[Maximum Marks : 80*

*Instructions to the candidates:*

- 1) All questions are compulsory and carry equal marks.*
- 2) Answers to the two sections should be written in separate answer books.*
- 3) Draw diagram wherever necessary.*

**SECTION -I**

**Q1)** Attempt any four of the following. **[20]**

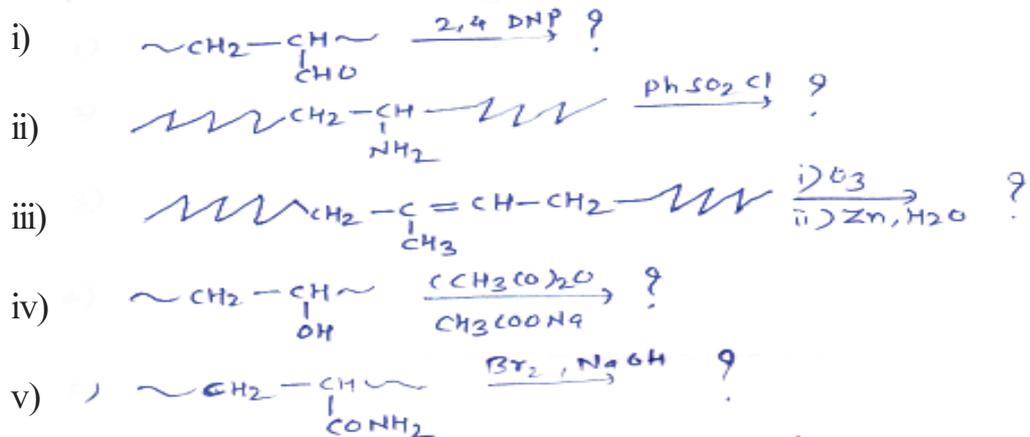
- a) How polymers are classified on their morphological behaviour.
- b) Give the salient features of suspension polymerisation.
- c) What are polymer degradation? Explain degradation by high energy radiation.
- d) Derive kinetic rate equation for cationic chain polymerisation.
- e) Discuss the effect of radiation on Teflon.

**Q2)** Attempt any four of the following. **[20]**

- a) What is oxidative degradation? Describe oxidative degradation of saturated polymers.
- b) Give method of preparation, types and uses of silicone polymers.
- c) Differentiate between the following:-
  - i) Organic polymer and Inorganic polymer
  - ii) Thermoplastic and thermosetting polymer.

**P.T.O**

d) Complete the following reactions;-



e) Determine percentage elongation of 10.00cm polystyrene sample that increases in length to 10.2 cm when subjected to tensile stress.

### SECTION -II

Q3) Attempt any four of the following.

[20]

- a) Explain the role of thermal methods in structure elucidation of polymeric material with respect to TGA and DTA.
- b) Explain the term fibre-spinning. Explain importance of post treatments of fibre.
- c) Give a full account of mechanical properties of polymers.
- d) Explain the terms;-
  - i) Flammability
  - ii) Gloss
  - iii) Fatigue test
  - iv) Haze
  - v) Vapour permeability
- e) Calculate molecular weight of polyethylene polymer whose degree of polymerisation is 870.

[Given At. wt. C = 12, H = 1]

**Q4)** Attempt any four of the following.

**[20]**

- a) Write full account of ageing process with suitable examples.
- b) Describe the cryoscopic method for molecular weight-determination of a given polymer sample.
- c) What is sol-gel? Explain aqueous chemistry of metal alkoxides.
- d) Define the term polymer processing. write an account of injection moulding.
- e) 0.01 m Acetic acid is used with 0.88 moles of an difunctional polymer. Determine functionality factor and degree of paymerisation for polymer having percent conversion 0.99

