

Total No. of Questions : 6]

SEAT No. :

P2118

[4823]-11

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY
CH-110 : Physical Chemistry-I
(2008 Pattern) (Semester-I)

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.*
- 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) What are exact and inexact differentials? Explain with suitable examples. State Euler's criterion for exactness.
- b) Derive the Clapeyron-Clausius equation and give its significance.
- c) What is meant by ultraviolet catastrophe? How was it overcome by Planck's hypothesis?
- d) Derive the expression for work done in the adiabatic expansion of one mole of an ideal gas.
- e) State Heisenberg's uncertainty principle. Explain its significance in case of microscopic and macroscopic particles.

Q2) Attempt Any Three of the following: **[15]**

- a) Explain Raoult's and Henry's laws.
- b) State the third law of thermodynamics. Hence explain the determination of absolute entropy of a gas.
- c) Explain Bohr's correspondence principle with respect to a particle in one dimensional box.
- d) What is partial molar volume? Explain the intercept method to determine it.
- e) What is Gibb's free energy? Explain the dependence of it on the temperature.

Q3) Attempt Any Two of the following: **[10]**

- a) The velocity of electrons ejected from a metal surface when irradiated with 215 nm light is 0.70 Mms^{-1} . Estimate the work function of the metal in electron volts.
- b) By how much the freezing point of benzene 5.53°C , be reduced if 10g hexane added to 100 g benzene?
(ΔH_f for benzene = $9.836 \text{ kJ mol}^{-1}$).
- c) Calculate the de-Broglie wavelength of an oxygen molecule at 25°C .

SECTION-II

Q4) Attempt Any Three of the following: **[15]**

- a) Show that, for parallel reactions, the ratios of product concentration is constant.
- b) Derive the expression for half-life period of n^{th} order reaction.
- c) Discuss the kinetics of reactors attaining pre-equilibrium.
- d) Explain explosive reactions with suitable diagram.
- e) What is meant by fast reactions? Explain flash photolysis to study fast reactions.

Q5) Attempt Any Three of the following: **[15]**

- a) Distinguish between collision theory and transition state theory.
- b) Discuss fermi-Dirac statistics.
- c) Derive the expression for rotational partition function.
- d) Write a note on diffusion controlled and activation controlled reactions.
- e) Discuss Lindemann theory of unimolecular reactions.

Q6) Solve Any Two of the following: **[10]**

- a) Calculate translational partition function of a molecule of oxygen gas at 1 atmosphere and 298 K moving inside a vessel of volume 22.4 L. What is the significance of this number?
- b) Show that for every first order reaction, the time required for 75% Completion is double that of its half life period.
- c) For the reaction between oxygen and benzene the pre-exponential factor was found to be $1.14 \times 10^{10} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ at 392.2 K. Estimate P-factor of the reaction.

Given: $\sigma(\text{O}) = 0.24 \text{ nm}^2$, $\sigma(\text{C}_6\text{H}_6) = 0.88 \text{ nm}^2$, At. wt. of H = 1, C = 12.



Total No. of Questions : 6]

SEAT No. :

P2119

[4823]-12

[Total No. of Pages : 4

M.Sc. (Part-I)

INORGANIC CHEMISTRY

CH-130 : Inorganic Chemistry-I

(2008 Pattern) (Semester-I)

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 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) By schematic representations, give the products of following symmetry operation in NF_3 molecule (any two).
 - i) $C_3 \times \sigma_{v_1}$
 - ii) $\sigma_{v_1} \times \sigma_{v_2}$
 - iii) $C_3 \times C_3^{-1}$
- b) What are the conditions of a mathematical group? Explain them considering an example of Abelian group.
- c) Discuss the symmetry operations of the molecules having following point group (any 2)
 - i) D_{2d}
 - ii) C_{4v}
 - iii) D_{3h}
- d) Show the matrices for C_2^z and $\sigma_{h^{xy}}$ symmetry operations. Using matrix multiplication method show that $S_2 = i$.

P.T.O.

Q2) Attempt Any Three of the following:

[15]

- Draw all possible isomers of $[M(AA)_2 b_2]$ complex. Explain which isomer is optically active. Justify your answer.
- 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 Td.

Direct product $T_1 \times E$

Td	E	$8C_3$	$3C_2$	σS_4	$6\sigma_d$
A_1	1	1	1	1	1
A_2	1	1	1	-1	-1
E	2	-1	2	0	0
T_1	3	0	-1	1	-1
T_2	3	0	-1	-1	1

- Sketch and describe all the symmetry elements in $[Ni(CN)_5]^{-3}$ complex ion and classify it into appropriate point group.
- Explain with the help of suitable examples the Weiss and Miller indices.

Q3) Attempt Any Two of the following:

[10]

- Find out normalized SALC using projection operator of A_1^1 irreducible representation on σ_1 of CO_3^{2-} ion.

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$
A_1^1	1	1	1	1	1	1

b) Identify the point group and develop the stereographic projection for the molecules. Justify the answer.



c) Fill the missing entries in the character table given below which is presented in the standard format. Label the irreducible representation with appropriate Mulliken symbols.

	E	2A	B	2C	2D
T_1	1	1	1	1	1
T_2	1	<u>X</u>	1	-1	-1
T_3	1	-1	1	<u>Y</u>	-1
T_4	1	-1	1	<u>Z</u>	1
T_5	<u>V</u>	0	<u>W</u>	0	0

SECTION-II

Q4) Answer Any Three of the following:

[15]

- Give synthesis and structure of xenonfluoride.
- Explain oxyacids of phosphorous.
- Give an account of Boron and nitrogen compounds.
- Interhalogens.

Q5) Write notes on Any Three:

[15]

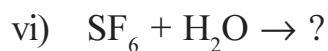
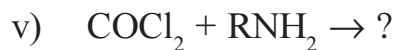
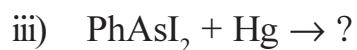
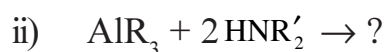
- Calthrate compounds of noble gases.

- b) Zeolites.
- c) Electron rich compounds.
- d) Sulphur-nitrogen compounds.

Q6) a) Draw Any Five Structures: [5]



b) Complete the following reactions (Any Five): [5]



Total No. of Questions : 6]

SEAT No. :

P2120

[4823]-13

[Total No. of Pages : 6

M.Sc.-I

ORGANIC CHEMISTRY

**CH-150 : Organic Reaction Mechanism & Stereochemistry
(2008 Pattern) (Semester-I) (New Course)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

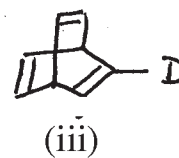
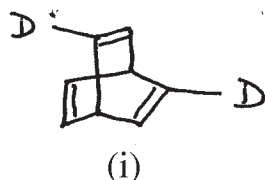
- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Answer to the two sections should be written in separate answer books.*
- 4) *Students admitted 2008 onwards must attempt new pattern (2008 Pattern).*

SECTION-I

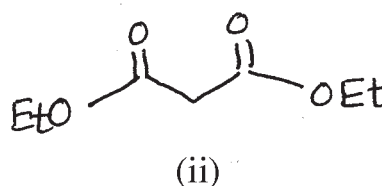
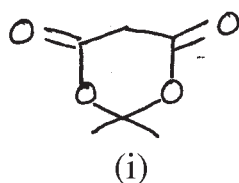
Q1) Attempt Any Four of the following:

[12]

- a) Bromination of toluene is five times faster than t-butyl benzene. Explain.
- b) 2, 5 - Dideuterio derivative of barrelene (i) is chiral, though parent hydrocarbon (ii) and the monodeuterio derivative (iii) are not. Explain.

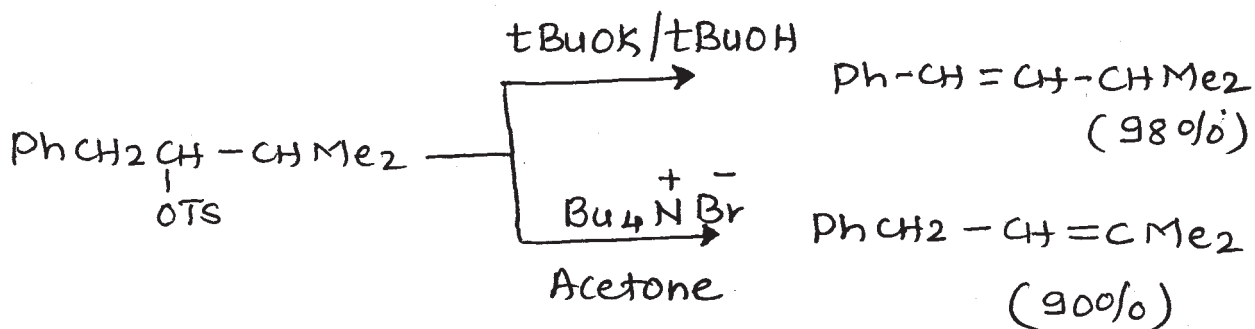


- c) In diphenyl acetaldehyde percentage of enol form is more than keto form. Explain.
- d) Which of the following is a stronger acid? Why?



P.T.O.

e) Justify the formation of products in the following reaction.



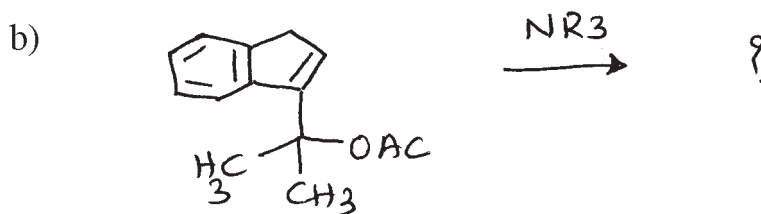
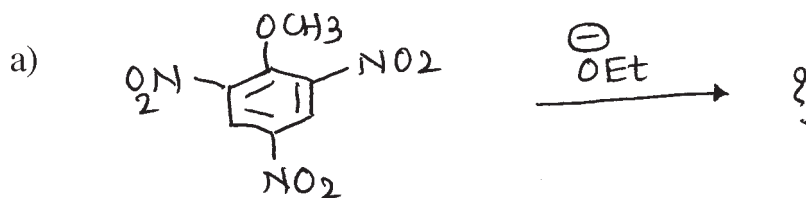
Q2) a) Write short notes on Any Two: [8]

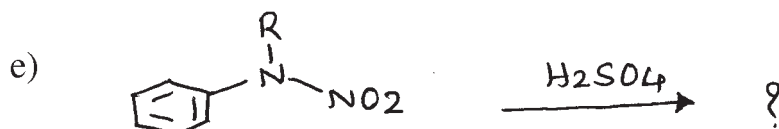
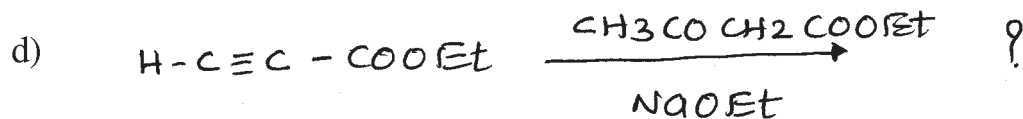
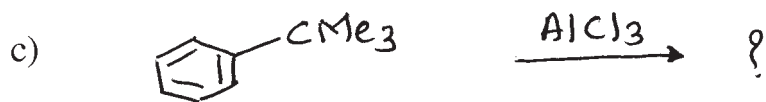
- i) S_Ni mechanism.
- ii) Phase Transfer Catalyst.
- iii) Alternant and non-alternant hydrocarbons.

b) Explain the following conversions by giving complete reaction sequence (Any Two): [8]

- i) Cinnamic acid from benzaldehyde.
- ii) Aniline from benzoic acid.
- iii) P-Toluidine from Toluene.

Q3) Predict the product/s and justify your answer (Any Four): [12]

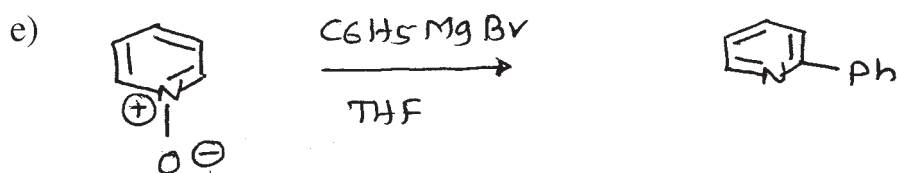
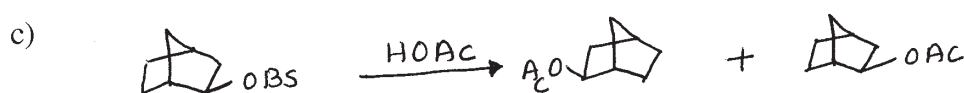
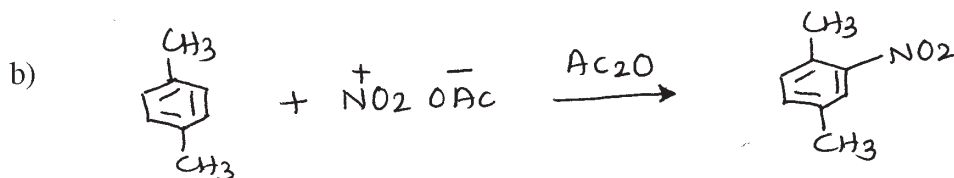
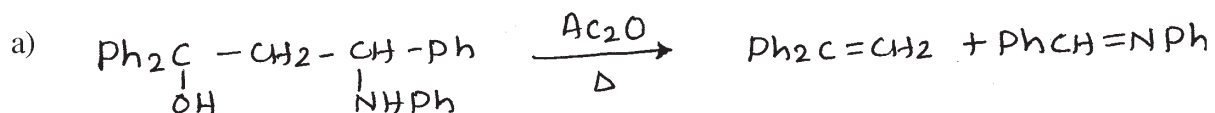




SECTION-II

Q4) Suggest mechanism for Any Four of the following:

[12]



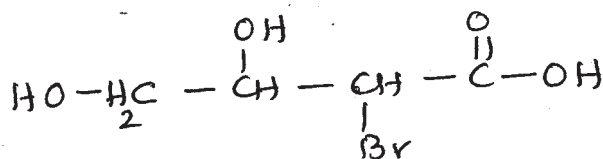
Q5) Attempt Any Eight of the following:

[16]

- a) Comment on the optical activity of the following compound.



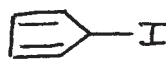
- b) Draw the structures of all possible stereoisomers of the following molecule. Assign R/S configuration to all chiral centres.



- c) Compound (i) when treated with silver perchlorate in propionic acid, solvolyses rapidly but under the same conditions compound (ii) does not undergo solvolysis. Explain.

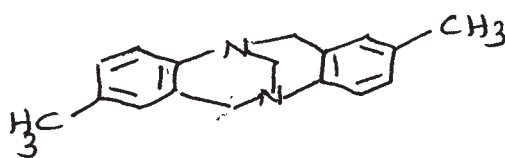


(i)

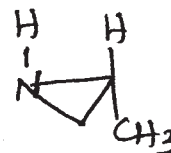


(ii)

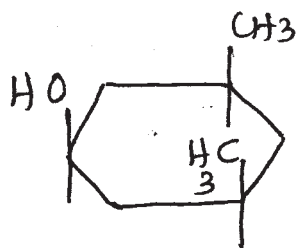
- d) Which of the following is optically active? Justify.



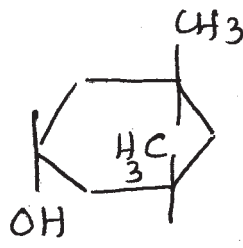
and



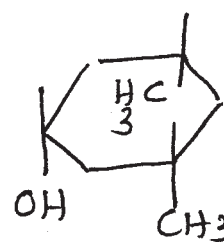
- e) Give the stereochemical relationship between the following compounds.



(i)

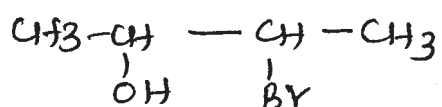


(ii)

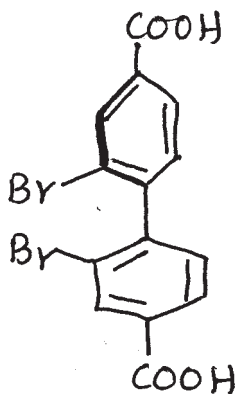


(iii)

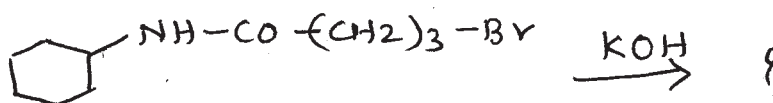
f) Draw the Newmann and Sawhorse projection for erythro



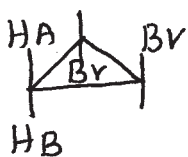
g) Assign R/S configuration.



h) Predict the product.



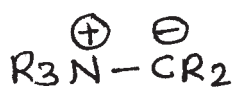
i) Identify whether HA and HB are enantiotopic, homotopic or diastereotopic. Justify.



Q6) Attempt Any Four of the following:

[12]

a) Arrange the following ylides according to their stability and justify.



(i)

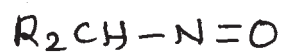


(ii)

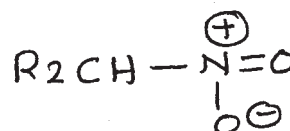


(iii)

- b) Acetic acid is three times as strong as pyridinium ion in water. In methanol the pyridinium ion is 12,000 times more acidic than acetic acid. Explain.
- c) Explain "Ortho effect" with suitable example.
- d) Give the evidences for S_N1 mechanism with aryl cation as intermediate.
- e) In compound (i) oxime form is more stable, whereas in compound (ii) Nitro form is more stable. Explain.



(i)



(ii)

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Total No. of Questions : 6]

SEAT No. :

P2121

[4823]-21

[Total No. of Pages : 4

M.Sc.

PHYSICAL CHEMISTRY
CH-210 : Physical Chemistry-II
(2008 Pattern) (Semester-II) (Old)

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.*
- 5) *Neat diagrams must be drawn wherever necessary.*

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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	$R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
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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 Three of the following: **[15]**

- a) Discuss Fourier transform spectroscopy.
- b) Explain how microwave spectra can be used to determine the isotopic abundance of elements. Give the expression for the centrifugal distortion constant and explain the terms therein.
- c) Give an account of the isotopic effect on vibrational spectra.
- d) Describe the vibrational spectra of polyatomic molecule with suitable example.
- e) Explain the applications of ESR spectroscopy.

Q2) Attempt Any Three of the following: **[15]**

- a) With a suitable example, explain the rule of mutual exclusion.
- b) Explain the quantum theory of Raman effect.
- c) What is dissociation energy? Illustrate dissociation by excitation into stable upper state and continuous state.
- d) Write a note on predissociation spectra.
- e) Write a note on fluorescence and phosphorescence.

Q3) Solve Any Two of the following: **[10]**

- a) The rotational spectrum of $^{79}\text{Br}-^{19}\text{F}$ shows a series of equidistant lines spaced at 0.7070 cm^{-1} apart. Evaluate the bond length of the molecule.
- b) If H^{35}Cl is irradiated with 435.8 nm Hg lines, calculate the Raman line in nm, if the fundamental vibrational frequency of H^{35}Cl $8.667 \times 10^{13}\text{ s}^{-1}$.

- c) The upper electronic state dissociates into ground state atom and excited state atom. The excitation energy is 15875 cm^{-1} . The dissociation energy of the ground state is $491.5 \text{ kJ mol}^{-1}$. Find the position where absorption spectrum becomes a continuum.

SECTION-II

Q4) Attempt Any Three of the following: **[15]**

- a) Explain in detail the quenching mechanism in G.M. counter. What do you mean by dead time of G.M. counter?
- b) Which are the different modes of interaction of gamma radiation with matter? Discuss the prominent mode of interaction with matter.
- c) Define the term-separation factor. Explain the electromagnetic method for separation of isotopes.
- d) What is hydrated electron? Explain various methods of obtaining the hydrated electron.
- e) Discuss, how the primary radiolytic products of water are formed in radiolysis? Describe in brief Lea-Gray-Platzmann model.

Q5) Attempt Any Three of the following: **[15]**

- a) Discuss the fast breeder test reactor (FBTR) at Kalpakkam.
- b) Explain in detail, nuclear waste management.
- c) Describe the use of radiotracer in the determination of friction & wear out of machine.
- d) Explain different applications of neutron activation analysis.
- e) Discuss the radio analytical method to determine surface area of a powder.

Q6) Solve Any Two of the following:

[10]

a) ^{90}Sr isotope emits β -rays with half life 28.1 years. If 1 μg of ^{90}Sr was absorbed by a newborn child, how much of it will remain at the age of 18 years in the body.

b) Find the molecular and mass absorption coefficient of propanol

(At wt - H = 1, C = 12, O = 16)

Given, $e^{\mu} = 0.211$ barn / electron.

c) A 150 mg of sample containing manganese shows an activity of 500 dps when irradiated in a neutron flux of $1.5 \times 10^8 \text{ n cm}^{-2} \text{ s}^{-1}$ for 10 hours. Find the percentage of manganese in the given sample.

(Given, $\gamma = 100\%$, $\sigma = 13.3 \text{ b}$, $t_{1/2}$ of $^{56}\text{Mn} = 2.58 \text{ h}$).



Total No. of Questions : 6]

SEAT No. :

P2122

[4823]-22

[Total No. of Pages : 6

M.Sc. (Part-I)

**CH-230 : INORGANIC CHEMISTRY-II
(2008 Pattern) (Semester-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 diagram must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and calculators are allowed.*

SECTION-I

Q1) Attempt Any Three of the following:

[15]

- a) Predict the expected electronic transition in the following complexes
 - i) $[\text{FeCl}_4]^{2-}$
 - ii) $[\text{V}(\text{H}_2\text{O})_6]^{3+}$
- b) Prepare a microstate table and hence derive the allowed R.S. terms for carbon atom in the ground state.
- c) Calculate total degeneracy for the following terms / configurations / states:
 - i) $t_2g^3e_g^3$
 - ii) $4f^2$
 - iii) ^5I
 - iv) $3d^4$
 - v) p^2d^2
- d) State Hund's rule to determine the ground state term symbol. Give the appropriate term symbols for the states with following values of L and S. Also find out the possible values of J. Justify your answer.
$$L = 0 \quad S = 7/2$$
$$L = 3 \quad S = 3/2$$
- e) Draw and explain Orgel diagrams for the cubic complexes of d^n ($n = 2, 3, 7$ and 8) configuration.

P.T.O.

Q2) Answer Any Three of the following:

[15]

- a) Assign spin multiplicities to the states arising from eg^2 configuration using Bethe's method.
- b) Predict in which of the following complexes orbital contribution to the magnetic moment is expected. Justify your answer.
 - i) $[CuCl_4]^{2-}$
 - ii) $[Mn(H_2O)_6]^{2+}$
- c) The electronic spectrum of $[Ni(NH_3)_6]Cl_2$ shows bands at 10850 cm^{-1} , 17600 cm^{-1} and 28300 cm^{-1} . Calculate the value of B , β and $10 Dq$.
Given
 - i) $B_o = 1030\text{ cm}^{-1}$
 - ii) $B = \frac{2\nu_1^2 + \nu_2^2 - 3\nu_1\nu_2}{15\nu_2 - 27\nu_1}$
- d) For complex $[CoBr_4]^{2-}$ ion spin orbital coupling constant is -190 cm^{-1} . The ν_1 transition is observed at 2940 cm^{-1} . Calculate effective magnetic moment of Co^{2+} ion in the complexation.
- e) Using character table for rotational point group O determine the splitting of 4F term in weak cubic field.

Given: Character table for O rotational group.

O	E	$6C_4$	$3C_2(\equiv C_4^2)$	$8C_3$	$6C_2$	
A_1	1	1	1	1	1	$x^2 + y^2 + z^2$
A_2	1	-1	1	1	-1	
E	2	0	2	-1	0	$(2z^2 - x^2 - y^2, x^2 - y^2)$
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)

Q3) Write short note on (Any Two):

[10]

- a) Nephelauxetic series.
- b) Quenching of orbital Angular moment.
- c) Charge transfer spectra.

SECTION-II

Q4) Answer Any Three of the following: **[15]**

- a) Explain the mechanism of action of cis-platin as anti-cancer drug.
- b) The uptake of chromium is through chromate ion and not through chromium (III) ion. Explain.
- c) Discuss the voltage-gated channels for sodium transport.
- d) Discuss the structure and function of haemoglobin.
- e) Describe chelate effect and Irving-William series with respect to complexes.

Q5) Write short notes on Any Three: **[15]**

- a) Concept of model compounds.
- b) Zinc fingers.
- c) Bioinorganic chips.
- d) Siderophores.
- e) Michael - Menton model

Q6) Draw structures of Any Five: **[10]**

- a) Porphyrin.
- b) Uracil.
- c) Deoxyhaemoglobin.
- d) Cardiolyte.
- e) 4Fe - 4S.

Character Table for O rotational group

O	E	6C ₄	3C ₂ (=C ₄ ²)	8C ₃	6C ₂	
A ₁	1	1	1	1	1	$x^2 + y^2 + z^2$
A ₂	1	-1	1	1	-1	
E	2	0	2	-1	0	
T ₁	3	1	-1	0	-1	$(2x^2 - x^2 - y^2)$ $x^2 - y^2$
T ₂	3	-1	-1	0	1	

(R_x, R_y, R_z); (x, y, z)

Correlation Table for the Group O_h

O _h	O	T _d	D _{4h}	D _{2d}	C _{4v}	C _{2v}	D _{2h}	D ₂	C _{2h}
A _{1g}	A ₁	A ₁	A _{1g}	A ₁	A ₁	A ₁	A _{1g}	A ₁	A _g
A _{2g}	A ₂	A ₂	B _{1g}	B ₁	B ₁	A ₂	A _{2g}	A ₂	B _g
E _g	E	E	A _{1g} +B _{1g}	A ₁ +B ₁	A ₁ +B ₁	A ₁ +A ₂	E _g	E	A _g +B _g
T _{1g}	T ₁	T ₁	A _{2g} +E _g	A ₁ +E	A ₁ +E	A ₁ +B ₁ +B ₂	A _{2g} +E _g	A ₁ +E	A _g +2B _g
T _{2g}	T ₂	T	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 ₂	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 _{1u} +E _u	B ₂ +E	A ₁ +E	A ₁ +B ₁ +B ₂	A _{1u} +E _u	A ₁ +E	A _u +2B _u
T _{2u}	T ₂	T ₁	B _{2u} +E _u	A ₂ +E	B ₁ +E	A ₁ +B ₁ +B ₂	A _{2u} +E _u	A ₁ +E	2A _u +B _u

DIRECT PRODUCTS

1. Groups of the form $G \times I$ or $G \times \sigma_1$:
 The g, u or $'$, $''$ additions to the IR symbols in these groups satisfy
 $g \times g = u \times u = g, g \times u = u, ' \times ' = '' \times '' = ', ' \times '' = ''$.
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_{4h}, D_{6h}, S_4 :
 $B \times E_1 = E_{21}, B \times E_2 = E_1$
 irrespective of the suffix on B. (If the group has only one B representative
 put $E_1 = E_2 = E$.)
 (c) For D_{4h} :
 $B \times E_1 = E_2, B \times E_2 = E_4, B \times E_3 = E_{21}, B \times E_4 = E_2, B \times E_5 = E_1$
 irrespective of the suffix on B.
 (d) For D_{6h}, S_4 :
 $B \times E_1 = E_2, B \times E_2 = E_3, B \times E_3 = E_1$
 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 $O_h, O, T_d, D_{2h}, D_6, C_{4v}, C_{2v}, C_{3v}, S_6, D_{3d}, D_{3h}, D_3, C_{2v}, C_{3v}, C_3$:
 $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_{21}; E_1 \times E_2 = E_2 + E_3 + E_4$.
 (b) For $D_{4h}, D_4, C_{2v}, C_{4h}, C_4, S_4, D_{2d}$:
 $B \times E = A_1 + A_2 + B_1 + B_2$.
 (c) For D_{4h} :
 $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$
 $E_3 \times E_3 = E_4 \times E_4 = A_1 + A_2 + E_4$
 $E_3 \times E_2 = A_1 + A_2 + B_1 + B_2$
 $E_1 \times E_2 = E_3 \times E_3 = E_1 + E_2, E_1 \times E_3 = E_2 \times E_3 = E_2 + E_4$
 $E_1 \times E_4 = E_2 \times E_3 = E_2 + E_3, E_2 \times E_3 = E_2 \times E_4 = E_1 + E_2$
 $E_1 \times E_3 = B_1 + B_2 + E_4, E_2 \times E_4 = B_1 + B_2 + E_2$.

(d) $D_{5d}, D_{5h}, D_5, C_{5v}, C_{2h}, C_5$

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

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

(e) For D_{4d}, S_8 .

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

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

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

5. 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	$T_1 + T_2$	$A_2 + E + T_1 + T_2$	$A_1 + E + T_1 + T_2$

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Total No. of Questions : 6]

SEAT No. :

P2123

[4823]-23

[Total No. of Pages : 4

M.Sc. I

ORGANIC CHEMISTRY

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

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) Explain Any Four of the following: [16]

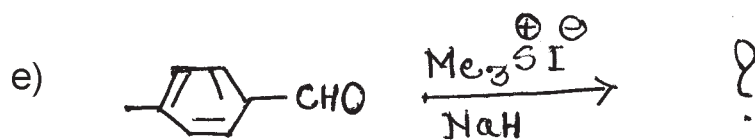
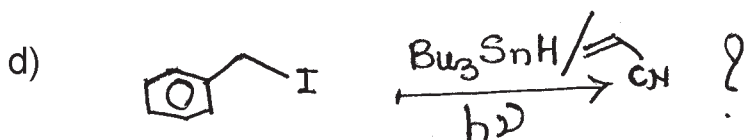
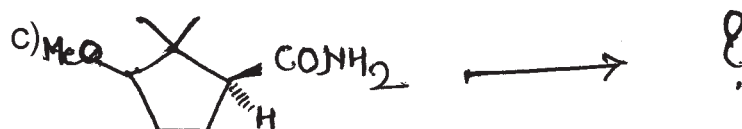
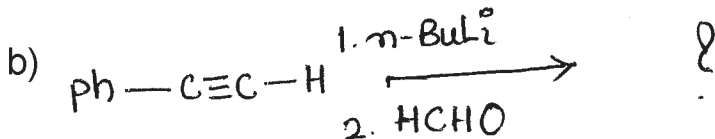
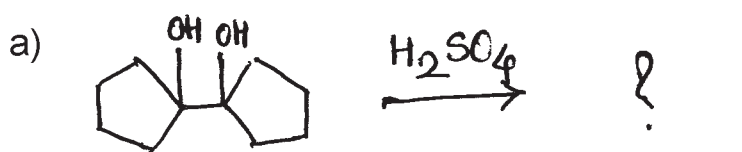
- a) N-methyl benzamide fails to undergo Hoffmann rearrangement.
- b) Give significance of Wittig reaction with suitable examples.
- c) Describe the use of organo copper compounds in organic synthesis with suitable examples.
- d) Cyclohexane on treatment with OsO_4 gives Cis diol while with per m-CPBA followed by hydrolysis gives trans diol.
- e) Reduction of 4-t-butyl cyclohexanone with LiAlH_4 gives trans product whereas reduction with NaBH_4 gives Cis product. Explain.

Q2) Write short notes on Any Three of the following: [12]

- a) Use of SeO_2 in organic synthesis.
- b) Claisen rearrangement.
- c) Reformatsky reagent.
- d) Wilkinson catalyst.

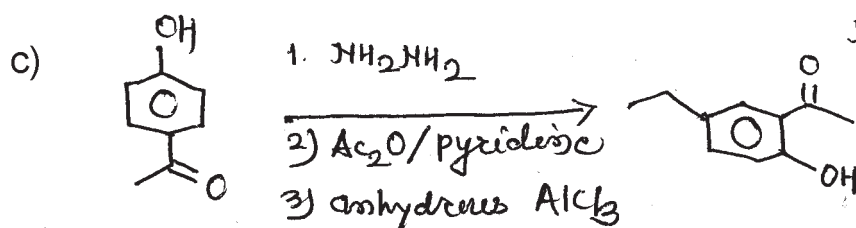
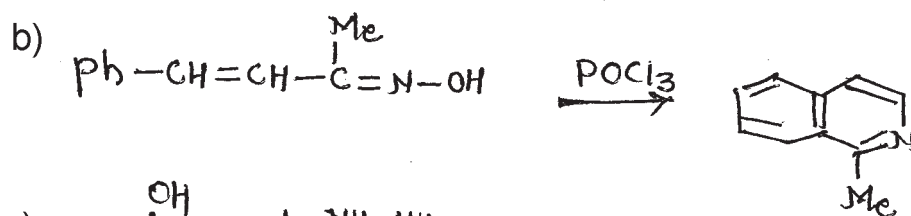
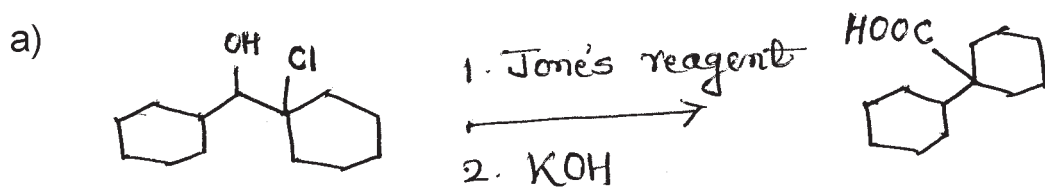
P.T.O.

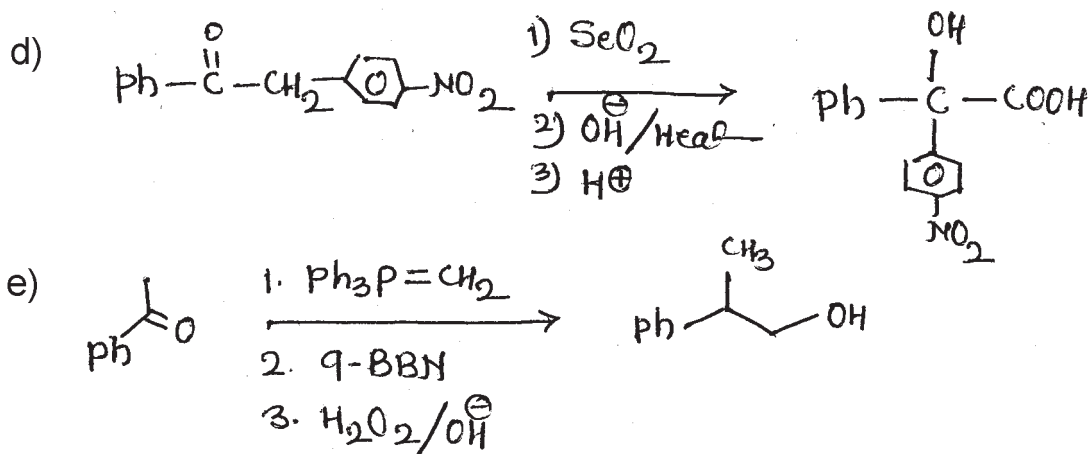
Q3) Predict the product and suggest the mechanism for Any Four of the following: [12]



SECTION-II

Q4) Suggest mechanism for Any Four of the following: [12]

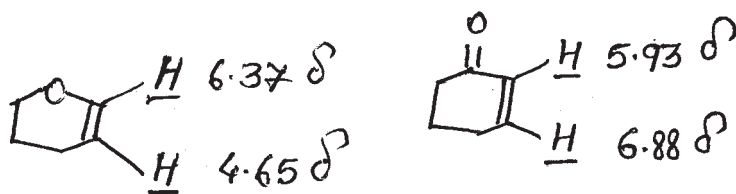




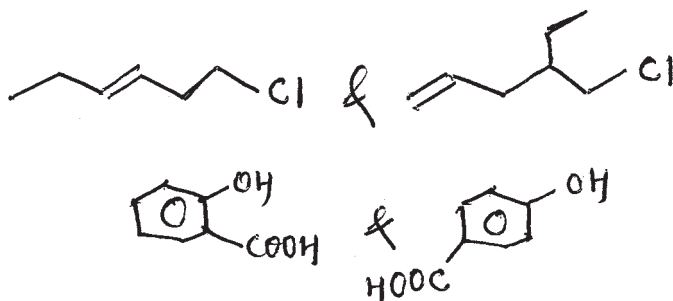
Q5) Attempt Any Four of the following:

[16]

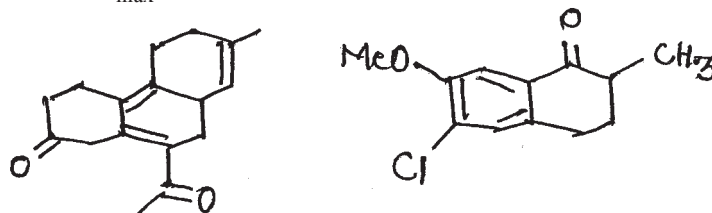
- a) Explain the chemical shift of underlined protons.



- b) Distinguish between the following pairs using IR spectroscopy.



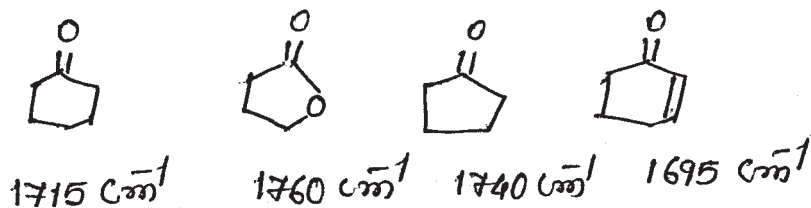
- c) Calculate λ_{\max} for the following. Clearly show the calculations.



- d) Explain Any Two of the following:

- Bathochromic shift.
- Diamagnetic anisotropy.
- α -haloketo rule.

e) Explain IR absorption frequencies for the following.



Q6) Deduce the structures of Any Three of the following compounds using spectral data and justify your answer: [12]

- a) M.F. : $\text{C}_9\text{H}_{10}\text{O}_2$
 I.R. : 1738, 1600, 1500 cm^{-1}
 PMR : 1.3 δ (s, 12 mm)
 29 δ (s, 08 mm)
 7.25 δ (m, 20 mm)
- b) M.F. : $\text{C}_{12}\text{H}_{14}\text{O}_4$
 UV : λ_{max} 220 nm (ϵ 11000)
 I.R. : 1730, 1600, 750 cm^{-1}
 PMR : 1.25 δ (t, J = 6 Hz, 30 mm)
 4.28 δ (q, J = 6 Hz, 20 mm)
 7.45 δ (dd, J = 2 Hz & 8 Hz, 10 mm)
 7.68 δ (dd, J = 2 Hz & 8 Hz, 10 mm)
- c) M.F. : $\text{C}_{10}\text{H}_{10}\text{O}_2$
 UV : 260 nm (ϵ 13000)
 I.R. : 1710, 1630, 1590, 960, 710 cm^{-1}
 PMR : 3.8 δ (s, 12 mm)
 5.65 δ (d, 14 Hz, 4 mm)
 6.60 δ (d, 14 Hz, 4 mm)
 7.35 δ (t, 8 Hz, 8 mm)
 7.50 δ (m, 4 mm)
 7.70 δ (dd, 2 Hz, 8 Hz, 8 mm)
- d) M.F. : $\text{C}_6\text{H}_{12}\text{O}$
 I.R. : 3500, 2900, 1610, 690 cm^{-1}
 PMR : 1.20 δ (s, 6 H)
 1.60 δ (d, 7 Hz, 3 H)
 3.40 δ (bs, 1 H, exchange)
 4.80 δ (dq, 7 & 10 Hz, 1 H)
 5.75 δ (d, 10 Hz, 1 H)

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Total No. of Questions : 5]

SEAT No. :

P2124

[4823]-31

[Total No. of Pages : 4

M.Sc.

PHYSICAL CHEMISTRY

CH-310 : Quantum Chemistry and Solid State 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.*
- 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	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

Q1) Attempt Any Four of the following:

[20]

a) Prove that

$$(px - xp)\psi = \frac{h}{2\pi i}\psi$$

Where $p = \frac{h}{2\pi i} \frac{\partial}{\partial x}$, x is the operator for position.

b) State the conditions for a wave function to be acceptable.

c) Show that the function $(\sin K_1x)(\sin K_2y)(\sin K_3z)$ is an eigen function of

$$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}. \text{ What is the eigen value?}$$

d) A and B are two operators then show that $[A, B^{-1}] = -B^{-1}[A, B]B^{-1}$

e) Explain the properties of Angular momentum operators in brief.

f) Find the term symbols for

i) $L = 2, S = \frac{1}{2}$ and

ii) $L = 1, S = \frac{3}{2}$

Q2) Attempt Any Four of the following:

[20]

a) Derive the equation for the first order perturbation energy for a non-degenerate state.

b) State and prove the variation theorem.

c) What are the drawbacks of Hückel's method of calculating delocalization energies of conjugated hydrocarbons?

- d) Apply the HMO theory to obtain the delocalisation energy for butadiene molecule.
- e) Explain the basis of Schaad and Hess model used to modify Hückels method.
- f) Deduce the secular determinant for ethene and obtain the HMO energy value for the molecule.

SECTION-II

Q3) Attempt Any Three of the following: [15]

- a) Define defects, explain with a suitable diagram various types of point defects.
- b) Compare the resistivities of annealed and unannealed Cu-Au alloys.
- c) Write a note on-transistors.
- d) Show that fermi energy lies midway between energy of conduction and valence band for an intrinsic semiconductor.
- e) Describe the methods of growing the crystal from solution phase.

Q4) Attempt Any Three of the following: [15]

- a) Write and explain the mechanism for the reactions occurring at the
 - i) Interphase Ag I/Ag₂ HgI₄ for the reaction between AgI and HgI₂,
 - ii) Interphase Cu/CuCl and CuCl/AgCl for the reaction between Cu(s) and AgCl(s).
- b) Write a note on Piezoelectricity in ionic crystals.
- c) Explain the terms: birefringence, ferrimagnetism and superexchange in insulators.

- d) Explain addition reactions in a solid with a suitable examples.
- e) What is a colour centre? Explain the origin of colour centres in halide crystals.

Q5) Solve Any Two of the following: [10]

- a) How deep will Aluminium penetrate in silicon at 1450°C in one hour?

Given: $\Delta H = 73$ Kcal/mole, $D_0 = 1.55$ cm²/sec.

- b) Calculate mean free time for an electron in a semiconductor crystal having drift mobility 630 cm²/Volt sec.
- c) Calculate the relaxation time for copper having density 8.92 g/cc.

[At. wt. of Cu = 63.5].



Total No. of Questions : 6]

SEAT No. :

P2125

[4823]-32

[Total No. of Pages : 4

M.Sc.

PHYSICAL CHEMISTRY

CH-311 : Nuclear and Radiation 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.*
- 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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4. Electronic Charge	e	=	$4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		=	$23.06 \text{ k cal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
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12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

Q1) Attempt Any Three of the following: **[15]**

- a) Give an account of fission energy and fission barrier.
- b) Write a note on natural nuclear reactor.
- c) Give a comparative account of various nuclear models for the nucleus.
- d) Write a note on neutron evaporation and spallation.
- e) Draw an experimental set up for PIXE measurement. What are disadvantages of this technique?

Q2) Attempt Any Three of the following: **[15]**

- a) Give an account of thermonuclear reactions.
- b) Draw and explain linear accelerator.
- c) Explain the terms prp of water, G value, Spur & dosimetry.
- d) Define 'maximum permissible dose' which points are to be considered while applying this dose?
- e) Write a note on Szilard Chalmer's reaction.

Q3) Solve Any Two of the following: **[10]**

- a) Find the dose due to 500 μCi ^{60}Co source at a distance of 3 meters.
Given: $E_{\gamma} = 1170$ and 1330 keV.

- b) Compute the number of uranium atoms that must fission per sec such that the power generated equals 200 MW. Given: energy released per uranium fission is 200 MeV.
- c) ${}^7\text{Li}$ target is bombarded by protons of energy 8 MeV. Calculate the energy of protons observed at 90° after they have excited the lithium to a level of 0.5 MeV.

SECTION-II

Q4) Answer Any Three of the following: **[15]**

- a) What are semiconductors? Draw a band structure of electron energies in insulators and semiconductors. Discuss their working.
- b) Discuss the causes of the chernobyl accident. What are its after effects?
- c) Explain the terms annealing, retention and reverse bias potential.
- d) Write the expression for $G(\text{Fe}^{3+})$ for Fricke dosimeter and explain it on the basis of mechanism of radiolysis of Fricke solution.
- e) Discuss the ICRP recommendation for maximum permissible dose.

Q5) Answer Any Three of the following: **[15]**

- a) Enlist the various man made sources of radiations.
- b) What is the role of cupric ions in modified ferrous sulphate dosimeter?
- c) How can the external radiation hazards be controlled?
- d) Explain the terms, G-value, recoil energy and efficiency of detector.
- e) Describe the working of any one personal dosimeter.

Q6) Solve Any Two of the following:

[10]

- a) Calculate activity of Na-22 which gives a dose rate of 4 rem/h at a distance of 2m. It emits gamma radiations of energy 1.28 MeV.
- b) The recoil energy of Mössbauer nuclei is 1900 keV. Find the energy of a gamma photon emitted by the nucleus.
- c) Find the thickness of lead required to reduce the dose due to gamma rays from 2.53 rad/min to 0.08 rad/min. Given $\mu_{\text{pb}} = 0.57 \text{ cm}^{-1}$.



Total No. of Questions : 6]

SEAT No. :

P2126

[4823]-33

[Total No. of Pages : 4

M.Sc.

PHYSICAL CHEMISTRY

**CH-312 : Advanced Instrumental Methods of Analysis
(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.*
- 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	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

Q1) Attempt Any Three of the following: **[15]**

- a) Describe typical x-ray absorption spectra and write Beer's law for x-ray absorption.
- b) Why is comparator method preferred over absolute method in NAA technique?
- c) State and explain various types of capture cross section of nuclear reaction.
- d) With a neat labelled diagram explain time of flight analyzer used in mass spectrometry.
- e) Describe the retarding potential analyzer used in ESCA.

Q2) Attempt Any Three of the following: **[15]**

- a) Describe electron-bombardment ionization source in mass spectrometer.
- b) Describe lithium drifted silicon detector.
- c) Discuss the basic components for the ESCA apparatus.
- d) Enlist the applications of mass spectrometry.
- e) Discuss the electron microprobe technique.

Q3) Solve Any Two of the following: **[10]**

- a) What accelerating voltage is required to direct a singly charged water molecule through the exit slit of magnetic sector mass spectrometer if magnet has field strength of a 0.25T and radius of curvature of the ion through the magnetic field is 12.5 cm.

- b) Calculate the mass absorptive coefficient at 0.193 nm of homogeneous mixture that contain 60% CaCl_2 and 40% CuCl_2 . The mass absorptive coefficients at 0.193 nm of Ca, Cl and Cu respectively are 306, 198 and 96.2 cm^2/g .
- c) 0.01 g sample of an alloy was analysed for Ni content. Irradiation for 30 minutes was carried out in a neutron flux of $10^9 \text{ n cm}^{-2}\text{s}^{-1}$. After 20 minutes the activity was 1680 cpm with the instrument having 20% efficiency. Find Ni percent in the alloy.

$$t_{1/2} \text{ for } ^{65}\text{Ni} = 2.52 \text{ hrs}, \sigma = 1.49 \text{ b}, \gamma = 0.91\%.$$

SECTION-II

Q4) Attempt Any Three of the following: **[15]**

- a) What is coulometer? Describe any one coulometer.
- b) Discuss the principle of differential pulse voltammetry.
- c) What is plasma? State its type. Describe with neat diagram a typical ICP source.
- d) Define the term quantum efficiency. Derive the relation $I_L = 2.303 abc \phi I_0$ for photoluminescence.
- e) Describe in brief the determination ozone by gas-phase chemiluminescence.

Q5) Attempt Any Three of the following: **[15]**

- a) Discuss the factors affecting TGA curve.
- b) State the principle of hydrodynamic voltammetry. Describe different electrodes used in it.
- c) Discuss briefly quantitative analysis using ICP emission spectrometry.

- d) Discuss the applications of DSC.
- e) Describe the applications of coulometric titrations.

Q6) Solve Any Two of the following:

[10]

- a) A constant current of 10 mA passed through a chloride solution for 200s. Calculate the weight of chloride reacting with Ag anode.
- b) The work function of a spectrometer is 45 eV. The binding energy of the emitted electron is 1050 eV. If the kinetic energy of the electron is 1.75 eV. Find the wavelength of the incident x-ray.
- c) 1g of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ sample when subjected to TGA showed weight loss of 0.30g in temperature range 365 to 548 K. Calculate the purity of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ sample.

Atomic weight of Cu = 63.55, S = 32.06, O = 16.00, H = 1.008.



Total No. of Questions :6]

SEAT No. :

P2127

[4823]-34

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH - 314: Polymer Chemistry

(2008 Pattern) (Semester - III) (Optional)

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 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		=	$1.673 \times 10^{-27} \text{ kg}$
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12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

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

- a) Discuss the stress - strain behaviours of Newtonian and non-Newtonian polymers.
- b) Write a note on conducting polymers.
- c) What are the various polymerization process?
- d) Discuss 'living polymers'. Give their utility.
- e) Derive the copolymer equation.

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

- a) Explain why chemical reactivity is independent of molecular size.
- b) Write a note on vulcanization.
- c) Explain the Flory-Krigbaum theory of polymer solutions.
- d) Discuss the classification of polymers.
- e) Explain the use of XRD in polymer analysis.

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

- a) Discuss the role of ziegler - Natta catalyst in polymerization.
- b) Write a note on block and graft polymers.
- c) Find viscosity of a polymer at 0.5 g/dl concentration.

[Huggias constant = 0.33, $k = 1.2 \times 10^{-4}$, $d = 0.72$, $M = 120000$]

SECTION -II

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

- a) Explain compression molding.
- b) Describe the process of dying.
- c) Discuss the process of melt spinning.
- d) Explain the utility of NMR and ESR in polymer analysis.
- e) Write a note on radiation effect on polymers.

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

- a) Discuss the vapour phase osmometry method to determine the molecular weight of a polymer.
- b) How are IR spectra useful in polymer analysis?
- c) Define reduced, and intrinsic viscosity.
- d) Write a note on XRD analysis of polymers.
- e) Explain the calendaring technique.

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

- a) Discuss the mechanism of viscous Phenomenon.
- b) Write a note on solubility of polymers.
- c) Discuss the used of DTA in polymer analysis.

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Total No. of Questions : 4]

SEAT No. :

P2128

[4823]-35

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

**CH-315 : Special Topics in Physical Chemistry
(2008 Pattern) (Semester-III) (Optional Course)**

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	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
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3. Planck Constant	h	=	$6.626 \times 10^{-27} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ J s}$
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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		=	$4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
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11. Bohr magneton	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

Q1) Answer Any Four of the following:

[20]

- a) Write a note on conductometric sensor.
- b) Draw and explain the block diagram of sensor system.
- c) Define the terms, activity, sensitivity, stability, inhibitor and catalyst.
- d) Explain catalytic cycle for acetal hydrolysis in aqueous acid solution.
- e) Explain the properties of conducting electrodes for operation of sensors.
- f) Write a charge balance, mass balance and proton condition on thiosulphate in a 0.4M $\text{H}_2\text{S}_2\text{O}_3$ solution.

Q2) Attempt Any Four of the following:

[20]

- a) Find the concentration of H_2CO_3 , HCO_3^- and CO_3^{2-}
[Given $\text{pH} = 5$, $\text{K}_{a1} = 4.1 \times 10^{-7}$, and $\text{K}_{a2} = 5.6 \times 10^{-11}$]
- b) Write a proton condition for H_2Se and NaHSe .
- c) Discuss the mechanism of general acid-base catalysis.
- d) Find the fractions of $\text{H}_2\text{C}_2\text{O}_4$, HC_2O_4^- and $\text{C}_2\text{O}_4^{2-}$
Given: $\text{pH} = 11.59$, $\text{K}_{a1} = 0.053$, $\text{K}_{a2} = 5.37 \times 10^{-5}$.
- e) Write the charge balance for 0.1 M HCN and 0.1 M NaCN .
- f) Discuss catalysis in concentrated strong acid solution.

SECTION-II

Q3) Attempt Any Four of the following:

[20]

- a) Explain the construction and working of tunable transducers.
- b) Differentiate between passive smartness and active smartness. Give two examples of each.
- c) What do you mean by replicating nature? How is it applied to prepare smart materials?
- d) Write a note on electron microscope.
- e) Write a note on carbon nanotubes.
- f) Give an account of Sushi sensor.

Q4) Attempt Any Four of the following:

[20]

- a) Write a note on Fullerin.
- b) Explain the applications of the phase rule in partially miscible liquids.
- c) Explain the principle of steam distillation.
- d) How are rubber like ceramics prepared? Discuss their applications.
- e) What is mean by actuator? Describe the functions of piezoelectric devices.
- f) What are the applications of nanogels?



Total No. of Questions : 4]

SEAT No. :

P2129

[4823]-36

[Total No. of Pages : 3

M.Sc.-II

INORGANIC CHEMISTRY

**CH-326 : Organometallic Compounds of Transition Metals and
Homogeneous Catalysis
(New Course) (2008 Pattern) (Semester-III)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory and carry equal marks.*
- 2) *Figures to the right indicates full marks.*
- 3) *At No.: V = 23, Cr = 24, Fe = 26, Co = 27.*

Q1) Attempt Any Four of the following:

[20]

- a) Give the systematic classification of σ -bonded T.M. hydrocarbyls.
- b) Justify the statement "IR spectroscopy is an extremely useful spectroscopic technique to demonstrate the coordination of π acceptor ligands".
- c) What do you understand by the term haptacity? "some ligand can show different haptacity in the same molecule". Give examples in support of the above statement.
- d) What is catalysis? Why do T-metals act as catalyst? Give two examples of homogeneous catalysis.
- e) Give the typical reactions of Cp_2TiCl_2 .

Q2) Attempt Any Four of the following:

[20]

- a) Propose a structure of $(\text{C}_5\text{H}_5)_3\text{Ni}_3(\text{CO})_2$ based on IR data. Does each Ni atom obey the 18-electron rule?

P.T.O.

- b) Give a brief account of preparative routes and bonding descriptions of metallocene compounds.
- c) Comment on role of Copper(II) chloride in Wacker process.
- d) Explain the role of OMC'S as protecting agents.
- e) Give brief account of Monsanto process of acetic acid synthesis.

Q3) Attempt Any Four of the following:

[20]

- a) What is EAN rule? Which of the following obey EAN rule?

- i) $(\eta^4-C_4H_4)(\eta^5-C_5H_5)Co$
- ii) $Fe_3(CO)_{12}$
- iii) $(\eta^5-C_5H_5)(\eta^1-C_5H_5)Fe(CO)_2$
- iv) $(\eta^5-C_5H_5)V(CO)_4$
- v) $[Cr(CO)_4(pph_3)_3]$

- b) Complete the following reactions.

- i) $2PhC \equiv CPh + Fe(CO)_5 \xrightarrow{230^\circ} ?$
- ii) $Mo(CO)_6 \xrightarrow[-78^\circ C]{Cl_2} ?$
- iii) $R-\overset{O}{\parallel}C-X + [Co(CO)_4]^- \longrightarrow ?$
- iv) $\text{Cp}^*Mn(CO)_3 + RC \equiv CR \xrightarrow{UV} ?$
- v) $(CO)_5C_2 = C \begin{matrix} \text{ome} \\ \diagup \\ R \end{matrix} \xrightarrow{HNR'R''} ?$

- c) Explain giving appropriate examples the oxidative and reductive elimination reactions shown by OMC's.

- d) Explain the role of alkyne molybdate in the epoxidation of propylene.
- e) Draw the structures-
- i) $[\text{Co}(\text{H})(\text{N}_2)(\text{pPh}_3)_2]$ ii) $\text{Fe}_5(\text{CO})_{15}\text{C}$
- iii) $\mu\text{-CO-}\mu\text{CRR}'\text{-}[\text{Cp}^*\text{Rh}]_2$ iv) $\text{OS}_3(\text{CO})_{12}$
- v) Azaferrocene

Q4) Write short notes Any Four:

[20]

- a) Industrial applications of the Heck reaction.
- b) Group V organometallics in medicine.
- c) Pianostool compounds.
- d) Fluxional behaviour of organometallics.
- e) Tertiary phosphine complexes of transition metals.



Total No. of Questions : 4]

SEAT No. :

P2130

[4823]-37

[Total No. of Pages : 4

M.Sc.-II

INORGANIC CHEMISTRY

CH-330 : Coordination Chemistry Magnetism and Inorganic

Reaction Mechanism

(2008 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 80

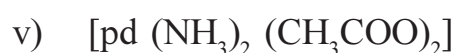
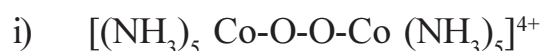
Instructions to the candidates:

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

Q1) Answer Any Four of the following:

[20]

a) Give the nomenclature of the following complexes.



b) Draw the structure of the following compounds.

i) Triangulo - μ - carbonyl - monodeca carbonyl triiron (O).

ii) Quadro Bis [dimethyl glyoximato) nickel (II).

P.T.O.

- iii) Monobipyridyl bis (thiocyanato) palladium (II).
 - iv) Mev - triamine trichloro Co (III).
 - v) Tetrahydro tri - μ^2 carbonyl nonacarbonyl tetracobalt (O).
- c) What is meant by mixed valence complexes. Explain in detail its applications in biology?
- d) Discuss the various models to account for the anomalous magnetic behaviour of transition metal complexes?
- e) i) Define magnetically dilute and magnetically concentrated system.
- ii) Explain Curie-Weiss law.

Q2) Discuss Any Four of the following:

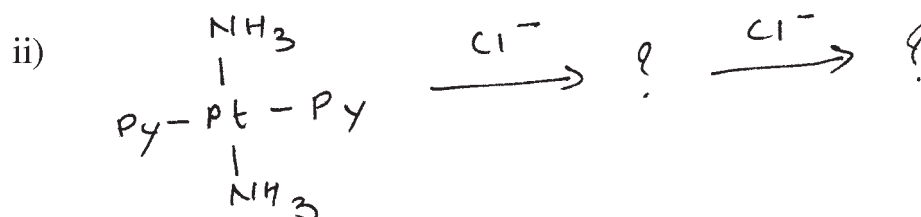
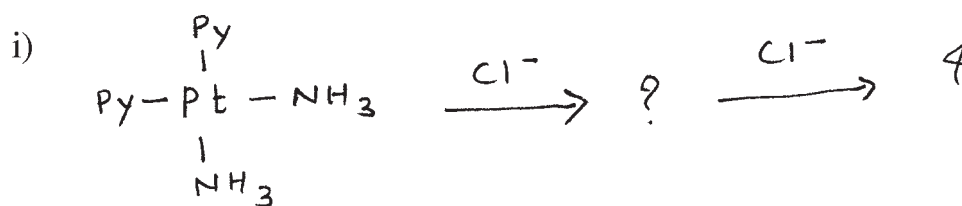
[20]

- a) What are the basic assumptions of crystal field theory? Discuss the crystal field splitting of tetrahedral and square planar complexes.
- b) The complex $(\text{Et}_4\text{N})_2 [\text{NiCl}_4]$, shows $\mu = 3.89$ B.M. Explain it.
- c) Draw the structure of $[\text{Re}_2\text{Cl}_8]^{2-}$ and explain the bonding present in this complex.
- d) Predict the type of magnetic exchange which occurs via the 90° exchange pathway in the systems, $d^1 - d^1$, $d^2 - d^2$, $d^3 - d^3$, $d^8 - d^8$, and $d^9 - d^9$.
- e) Explain why pink colored $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ turns into blue $[\text{Co}(\text{H}_2\text{O})_4]^{2+}$ on dehydration.

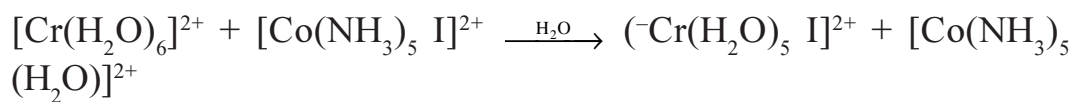
Q3) Answer Any Four of the following:

[20]

a) Complete the following reactions.



b) Explain the mechanism for the following reaction.



c) Explain in detail the Marcus equation.

d) Explain in detail polarisation theory.

e) Explain in detail one electron transfer reaction with one example.

Q4) Discuss Any Four of the following:

[20]

a) Explain in detail the Arrhenius equation. Which kinetic and thermodynamic factors can be calculated from this equation.

b) Discuss with suitable examples the substitution reaction taking place in square planar complexes.

c) Discuss the mechanism of base hydrolysis of $[\text{Co}(\text{NH}_3)_5 \text{Cl}]^{2+}$ complex.

- d) Explain with suitable examples oxidative addition and reductive elimination reaction.
- e) Explain in detail the effect of the following factors on associative, dissociative and interchange mechanisms.
 - i) Positive charge of central metal ion increases.
 - ii) Negative charge of entering group increases.
 - iii) Size of leaving group increases.
 - iv) Size of entering group increases.
 - v) Size of central metal ion increases.



Total No. of Questions : 4]

SEAT No. :

P2131

[4823]-38

[Total No. of Pages : 3

M.Sc. II

INORGANIC CHEMISTRY

CH-331 : Structural Methods in Inorganic Chemistry

(2008 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Draw neat diagrams wherever necessary.*
- 3) *Use of log tables and calculators is allowed.*

Q1) Answer the following (any 4):

[20]

- a) Explain the following Mössbauer spectral data

	ΔE_q mm/s	δ mm/s
$\text{Na}_3[\text{Fe}(\text{CN})_5 \text{NH}_3]$	0.6	-0.25
$\text{K}_2[\text{Fe}(\text{CN})_5 \text{NO}]$	1.85	-0.27

- b) Discuss the characteristics of cyclic voltammogram of $\text{K}_3[\text{Fe}(\text{CN})_6]$.

- c) Explain the following terms in ESR spectroscopy.

- i) Fine splitting.
- ii) Hyperfine splitting.
- iii) Super-hyperfine splitting.
- iv) g-factor.

- d) Explain the applications of Auger spectroscopy.

- e) "NQR spectrum is a tool to get structural information about molecules". Justify with the help of suitable examples.

P.T.O.

Q2) Attempt Any Four:

[20]

- a) What are the selection rules for NQR transitions? Draw the quadrupole energy levels and predict the number of lines for a nuclear spin of $I = 3/2$.
- b) Explain the following terms in NMR
 - i) Spin-spin coupling.
 - ii) Fermi contact term.
- c) A six coordinate transition metal complex is ESR and Mössbauer active and its μ_{eff} is ~ 5.9 BM.
Which is the metal ion and what is the number of unpaired electrons?
- d) Predict the number of lines in the ESR of Cu^{2+} , Mn^{2+} , Ni^{2+}
- e) How many lines are expected in
 - i) Fluorine NMR of SiF_6^{2-} .
 - ii) Phosphorus NMR of diphosphate anion.

Q3) Attempt Any Four:

[20]

- a) What is Electron Microscopy? Explain the principle of SEM.
- b) How is DTA used for the following measurements:
 - i) Heat of reaction.
 - ii) Specific heat.
 - iii) Thermal diffusivity.
 - iv) Reaction Kinetics.

- c) Discuss the applications of Mössbauer spectra with reference to:
- Structure determination.
 - Determination of oxidation states.
- d) Write the expressions used to quantify the following
- Isotope effect in H_{fs} in ESR spectra of complexes.
 - Contact shift in NMR.
- e) 500 mg of a sample of $KClO_3$ was heated to $500^\circ C$, the residue weighed 250 mg. Write the equation and determine the purity of the sample.

Q4) Write short notes on (Any Four):

[20]

- DSC.
- Factors affecting DTA.
- Kramer degeneracy.
- Isomer shift.
- NMR for study of paramagnetic complexes.



Total No. of Questions : 4]

SEAT No. :

P2132

[4823]-39

[Total No. of Pages : 3

M.Sc. (Tech.)

INORGANIC CHEMISTRY

CH-332 : BIOINORGANIC CHEMISTRY

**Inorganic Elements in the chemistry of life
(New) (Semester-III) (Revised)**

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *All questions carry equal marks.*

Q1) Answer the following (any four):

[20]

- a) Distinguish between hydrolytic and oxidative mechanism of DNA cleavage with suitable examples.
- b) What are different vit-B₁₂ coenzymes. Draw and explain the unique features of vit-B₁₂
- c) Explain model compounds for manganese cluster in PSII.
- d) Give functions of Cu, Fe and Zn enzymes in biological system.
- e) Discuss the mechanism by which resistance to cisplatin is developed.

Q2) Answer any four of the following:

[20]

- a) Give a brief account of different targets for drug design.
- b) Discuss the types of blue copper proteins.
- c) Explain in detail why Technetium is used as a radiopharmaceutical.
- d) Describe the S₄ cycle for oxygen production at a Mn₄ cluster in photosystem II.
- e) Active site structure and function of carboxypeptidase A.

P.T.O.

Q3) Write short notes on (any four):

[20]

- a) Blue copper oxidases
- b) Manganese Peroxidase
- c) Urease enzyme
- d) Zinc-finger proteins
- e) MRI contrast agents

Q4) a) Tick the correct option

[5]

- i) Nature has chosen Zn(II) ion at the active site of many hydrolytic enzymes because
 - 1) Zinc (II) is a poor Lewis acid
 - 2) Zn (II) does not have chemically accessible redox states
 - 3) Zn (II) forms both four and higher coordination complexes
 - 4) Zn (II) forms weak complexes with oxygen donor ligands.
- ii) In biological systems, the metal ion involved in the dioxygen transport besides Fe is
 - 1) Co
 - 2) Zn
 - 3) Mg
 - 4) Cu
- iii) The trivalent ion of lanthanide element which is used as NMR construction agent is
 - 1) Gadolinium
 - 2) Technetium
 - 3) Cerium
 - 4) Lutetium
- iv) Cytochrome C oxidase has ___ at its active site
 - 1) Cu & Zn
 - 2) Cu&Fe
 - 3) Fe & Mo
 - 4) Fe&r

- v) Studies of Zn (II)- containing proteins often make use of Co (II)- for Zn(II) substitution. Which statement is correct?
- 1) Tetrahedral coordination is one of several environments observed for both Co^{2+} and Zn^{2+} .
 - 2) Tetrahedral Co^{2+} and Zn^{2+} are both diamagnetic.
 - 3) The ionic radius of Co^{2+} is significantly smaller than that of Zn^{2+} .
 - 4) The visible spectra of complexes of Co^{2+} are similar to those of related complexes of Zn^{2+} .
- b) Describe in brief (any five): [10]
- i) Biomethylation reactions by cobalamin.
 - ii) Galactose oxidase.
 - iii) Plastocyanin.
 - iv) Alkaline phosphatase.
 - v) Lithium in the treatment of manic depression.
 - vi) Role of Zinc in Cu-Zn SoD.
- c) Draw the structures of : [5]
- i) $[\text{Ru}(\text{phen})_3]^{2+}$.
 - ii) Corrin ring.
 - iii) Azurin
 - iv) Dexoy hemocyanin.
 - v) Carboplatin.



Total No. of Questions : 6]

SEAT No. :

P2133

[4823]-40

[Total No. of Pages : 4

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

SECTION-I

Q1) Attempt Any Three of the following: [12]

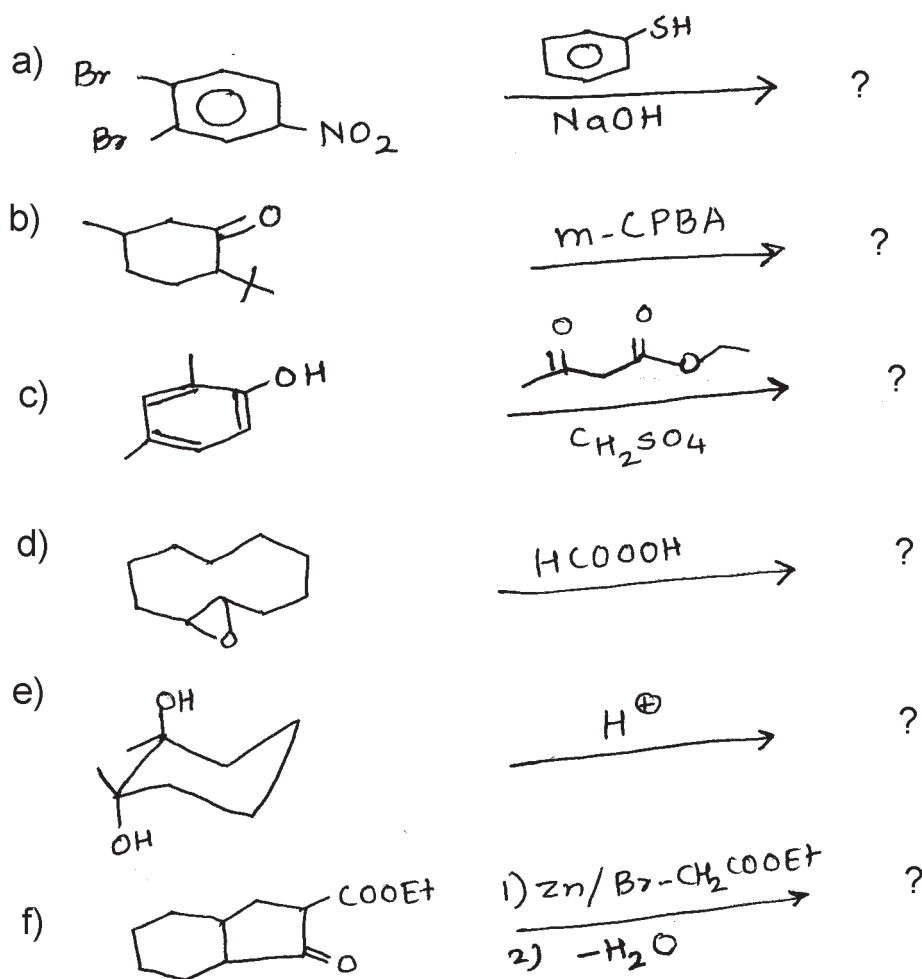
- a) Reduction of Pyruvic acid with sodium borohydride gives racemic lactic acid while enzymatic reduction gives optically active product.
- b) Explain role of isotopes in determining mechanism of reaction with suitable example.
- c) The ionisation constant of 3 & 4 cyanobenzoic acids are 2.51×10^{-4} and 2.82×10^{-4} at 30°C respectively Benzoic acid has the ionisation constant $K_a = 6.76 \times 10^{-8}$ at 30°C . Calculate σ_m and σ_p for the cyano substituent.
- d) Explain the Kinetic and thermodynamic control of the reaction.

Q2) Write short notes on Any Three of the following: [12]

- a) Reactions of carbenes.
- b) Trapping of intermediates.
- c) Claisen schmidt reaction.
- d) Linear Hammett plot.

P.T.O.


Q3) Predict the products with mechanism for Any Four of the following: [16]



SECTION-II

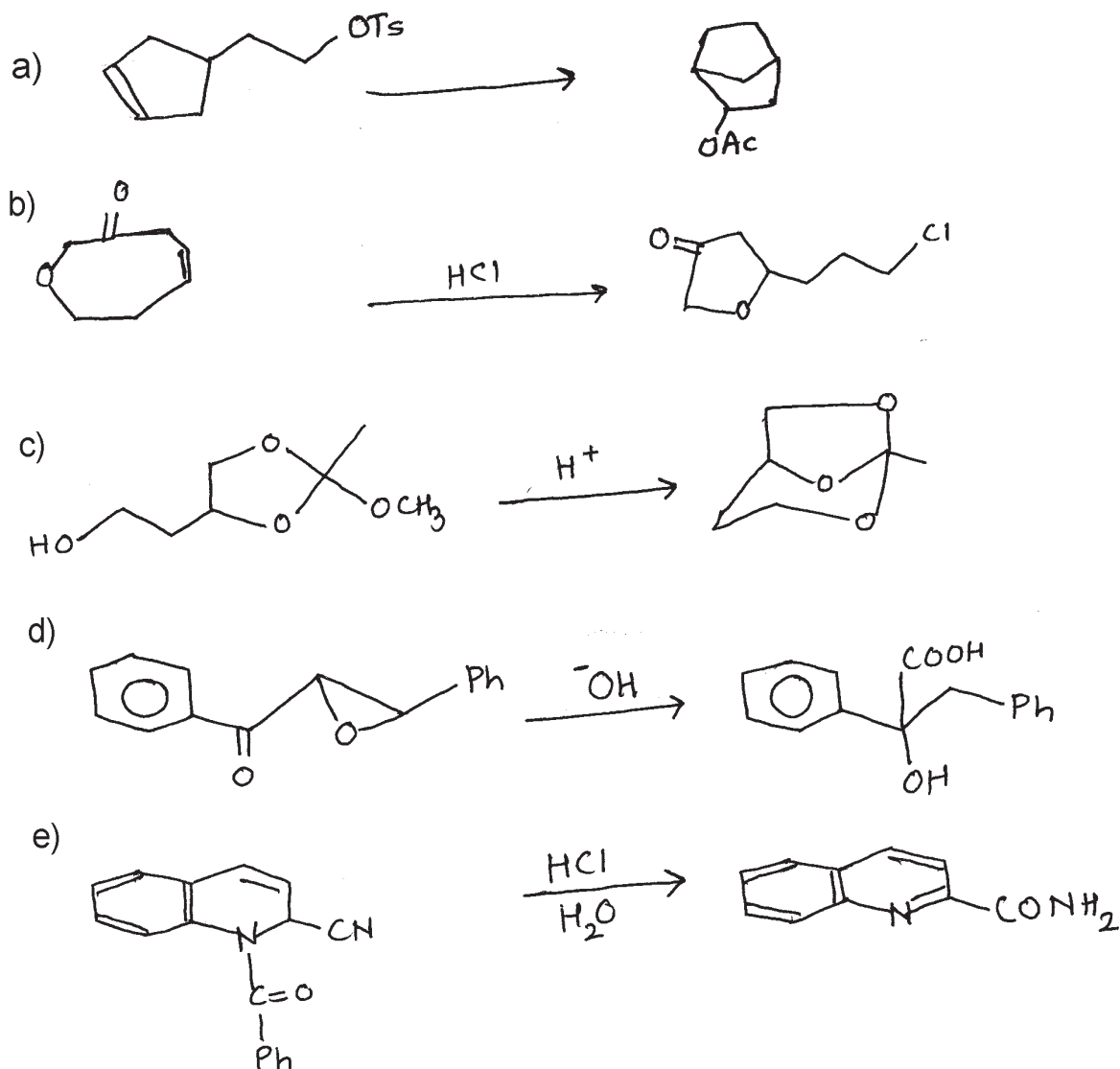
Q4) Explain Any Three of the following: [12]

- Pyridoxal trans amination.
- Newman rule of six with suitable examples.
- Substitution at β position reduces the rate of hydrolysis of AAC² mechanism.

- d) Role of E^+  in benzoin condensation.
thiazolium salt

Q5) Suggest the mechanism of Any four of the following:

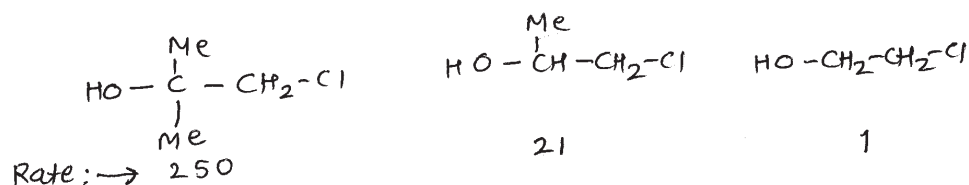
[16]



Q6) Answer Any Three of the following:

[12]

a) Epoxide formation is facilitated by alkyl substitution.



b) The α -methylation of Ketones with methyl iodide is much more effectively catalysed by dimethylamine than by trimethylamine.

- c) Thioester hydrolysis occurs rapidly than ordinary ester hydrolysis.
- d) Pyridine-2-Carboxylic acid decarboxylates faster than it's 3-or4-isomer.
- e) Substitution at β -position reduces the rate of hydrolysis in AAc^2 mechanism. Explain.



Total No. of Questions :6]

SEAT No. :

P2134

[4823]-41

[Total No. of Pages :9

M.Sc. - II

ORGANIC CHEMISTRY

CH - 351: Spectroscopic Methods in Structure Determination

(2008 Pattern) (Semester - III)

Time : 3 Hours]

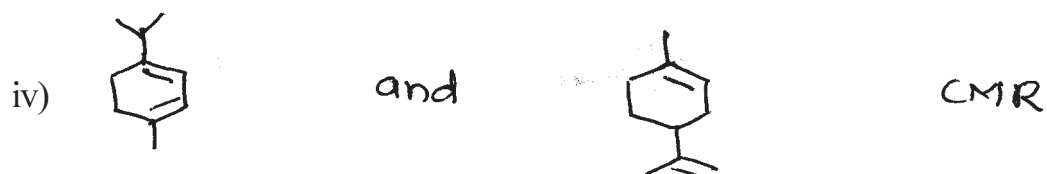
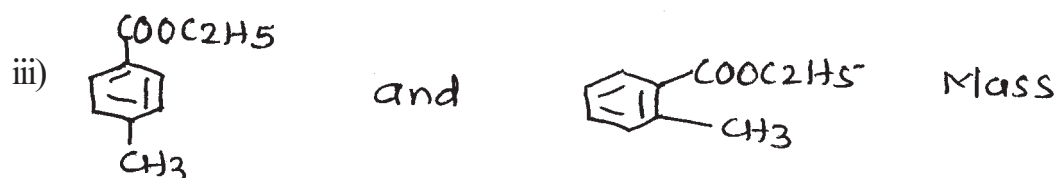
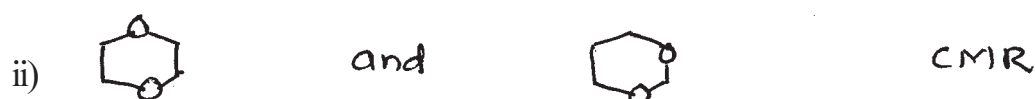
[Max. Marks :80

Instructions to the candidates:

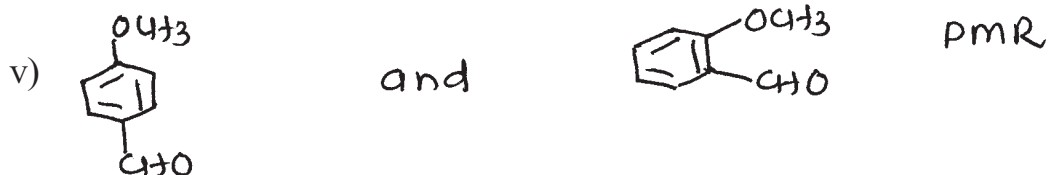
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION - I

Q1) a) Distinguish between the following pairs by using the indicated spectral method (any four): [8]



P.T.O.



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

- A laboratory sample of ethanol shows a broad singlet for OH proton, whereas spectral grade pure ethanol shows a triplet for the same.
- 2-Nitrobutane shows a non-equivalence of methylene protons.
- The 'OH' proton usually appears at lower field in DMSO than in CDCl_3 .

Q2) Answer any four of the following: [16]

a) Predict the structure and justify your answer.

MF: $\text{C}_8\text{H}_9\text{NO}_2$

IR: 3500, 3300, 1680, 1600, 1500, 850 cm^{-1}

PMR(δ): 2.1 (S, 3H), 1.5 (S, 1H exchangeable),

11 (S, 1H, exchangeable), 6.8 (d, $J = 8\text{Hz}$, 2H), 6.5 (d, $J = 8\text{Hz}$, 2H).

CMR: 24.6, 115 (strong), 121.7 (strong), 131.9, 154, 169

DEPT 1 24.6, 115, 121.7 up 131.9, 154, 169 Absent

DEPT 2 115, 121.7 up

b) Deduce the structure

MF: $\text{C}_7\text{H}_{14}\text{O}_2$

PMR (δ): 1.3 (S, 6H), 2.2 (S, 3H), 2.5 (S, 2H), 3.2 (S, 3H)

CMR (δ): 208 (S), 75 (S), 54(t), 50 (q), 33 (q), 25(q, strong).

Mass: 130, 115, 100, 73, 43

(m/e)

c) Deduce the structure.

MF: $C_8H_{13}NO_3$

IR: 1690, 1725 cm^{-1}

PMR(δ): 4.25 (q, J = 6.7 Hz, 2H), 3.8 (t, J = 7Hz, 4H), 2.45 (t, J = 7Hz, 4H),
1.3 (t, J = 6.7 Hz, 3H).

CMR(δ): 207 (S), 155 (S), 62 (t), 43 (t), 41(t), 15(q).

Mass: 171, 142, 56, 42 (100%).

m/e

d) Predict the structure and justify your answer.

MF: $C_8H_{11}N$

IR: 3354, 1596, 1020, 761, 703 cm^{-1}

PMR(δ) : 7.2 (S, 5H), 3.87 (q, J = 6.6Hz, 1H), 1.83 (bs, 2H),
1.2 (d, J = 6.6 Hz, 3H).

CMR(δ): 148, 128 (strong), 126, 125 (strong), 51, 26.

e) Deduce the structure

MF: $C_6H_{11}NO$ IR: 1680, 1100 cm^{-1}

PMR(δ): 2.1 (S, 3H), 2.6 (t, J = 6Hz, 4H), 3.5 (t, J = 6Hz, 4H).

CMR(δ): 165, 64 (strong), 47 (strong), 21.


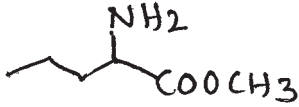
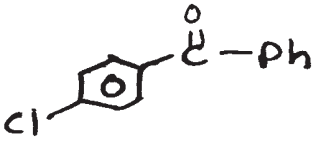

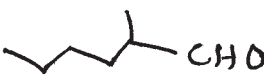
Q3) Write notes on any three of the following:

[12]

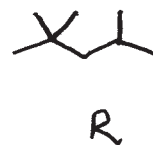
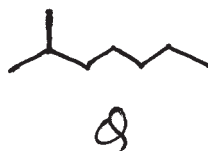
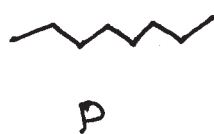
- Karplus equation.
- Spin-Spin decoupling.
- Chemical ionisation in Mass spectroscopy.
- Nuclear overhauser effect.

SECTION -II

Q4) a) Explain the genesis of the ions (any four): **[12]**

- i)  108, 107, 77
- ii)  131, 72, 30
- iii)  218, 216, 141, 113
- iv)  126, 83, 41
- v)  113, 85, 58

b) Mass spectral data for one of the three structures P, Q, R is given below. Identify the structure consistent with the given mass spectral data. **[4]**



Mass (m/e): 114, 99, 71, 70, 57, 43 (100%).

Q5) a) Assign the chemical shifts and comment on the observed coupling constants & spin decoupling experiment. **[8]**

2.32 (s, 6H),

3.09 (ddd, $J = 12.7$ & 1.5 Hz, 1H),

3.11 (ddd, $J = 12, 4$ & 2 Hz, 1H),

5.18 (dd, $J = 7, 4$ Hz, 1H),

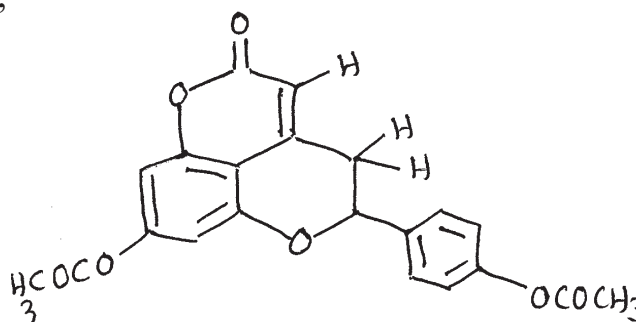
6.06 (bd, $J = 2$ Hz, 1H),

6.62 (d, $J = 2$ Hz, 1H),

6.69 (d, $J = 2$ Hz, 1H),

7.17 (d, $J = 8$ Hz, 2H),

7.46 (d, $J = 8$ Hz, 2H).



Decoupling Experiment.

Irradiation at

Change at

5.18 δ

3.09 (dd, $J = 12$ & 4 Hz)

3.11 (dd, $J = 12$ & 2 Hz)

3.11 δ

3.09 (dd, $J = 7$ & 1.5 Hz)

6.06 (d, $J = 1.5$ Hz)

5.18 (d, $J = 7$ Hz)

NOE Experiment

Irradiation at

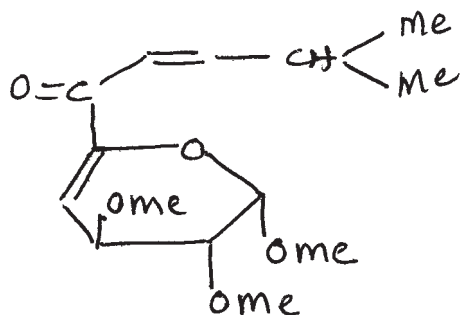
NOE enhancement

3.09 δ

7% at 6.06 δ

b) Assign the chemical shifts to various carbon atoms.

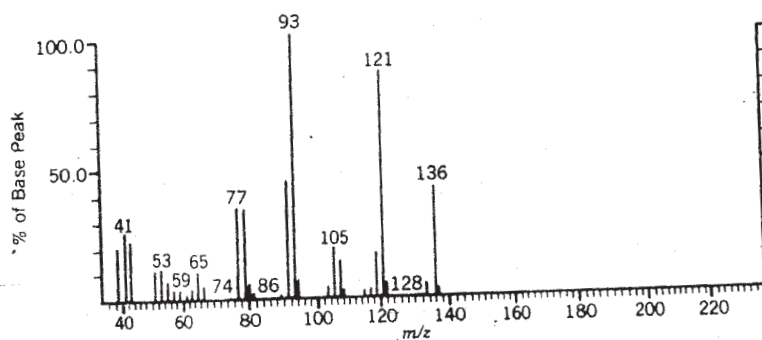
[4]



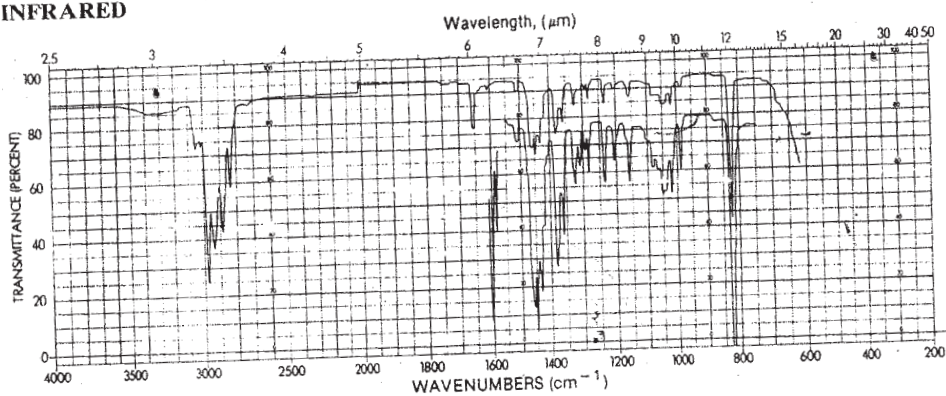
CMR (δ) 185 (S), 156 (d), 147 (d), 121 (S) 108.2 (d), 99 (d), 77.8 (d),
74.6 (d), 58.8 (q), 57 (q), 56.8 (q), 31.4 (d), 21.2 (q, strong).

Q6) You are provided with the spectra of a compound. Analyse these spectras and arrive at a structure consistent with the data. Justify your structure. [12]

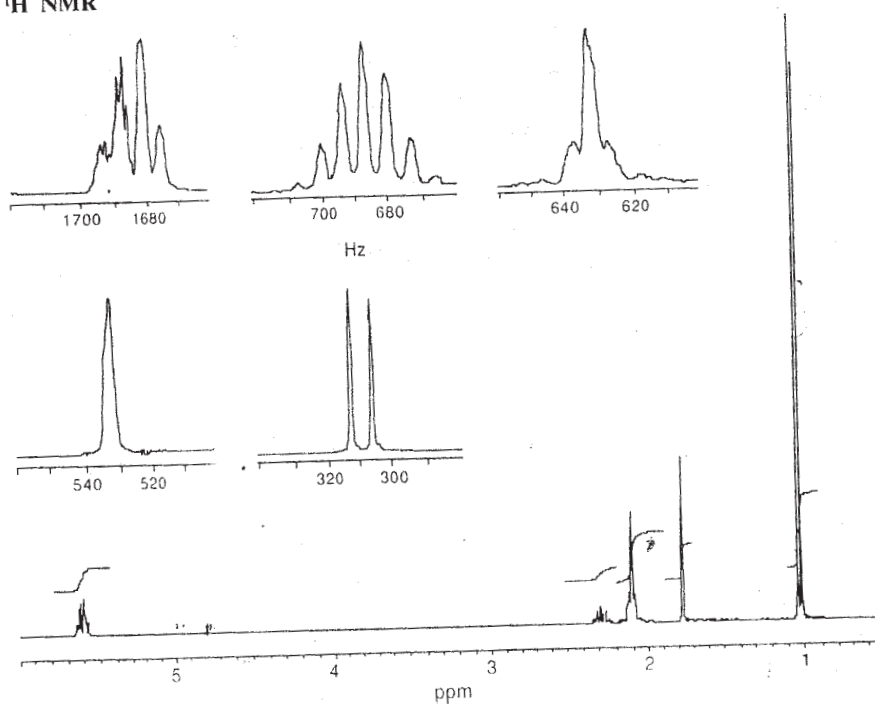
MASS



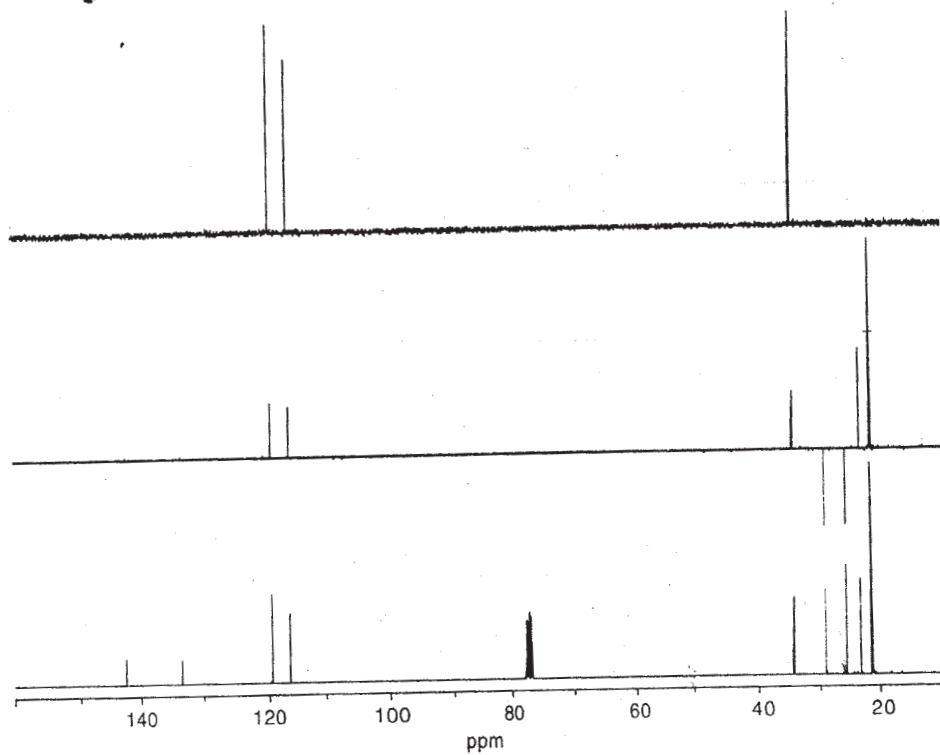
INFRARED



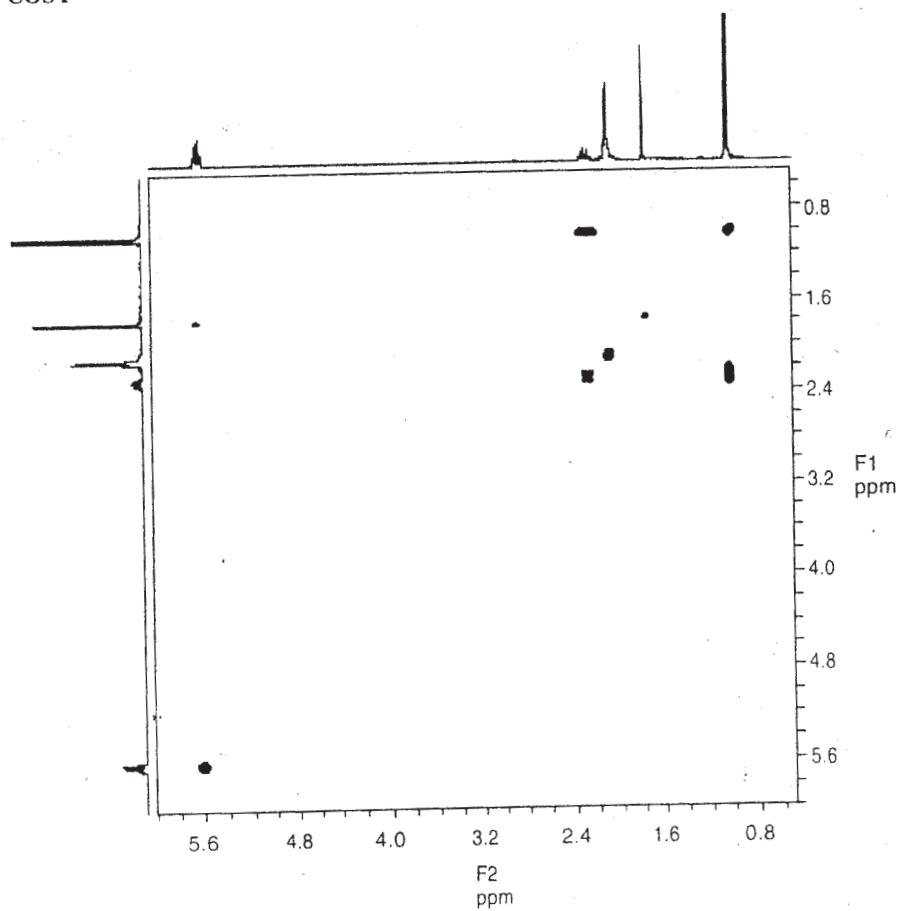
¹H NMR



¹³C/DEPT



COSY



Total No. of Questions :6]

SEAT No. :

P2135

[4823]-42

[Total No. of Pages :5

M.Sc. -II

ORGANIC CHEMISTRY

CH - 352: Organic Stereochemistry

(2008 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

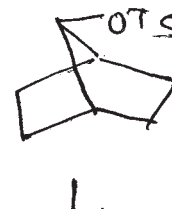
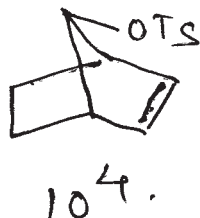
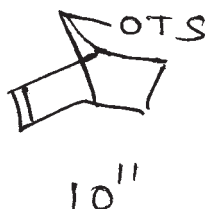
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION -I

Q1) Answer any four of the following:

[16]

- a) Alkaline saponification of both yohimbine and corynanthine gives yohimbic acid. Explain.
- b) Draw the structures of cis-anti-trans and cis-anti-cis isomers of perhydrophenanthrenes and comment on their stability and optical activity.
- c) Reduction of cyclobutanone is much easy as compared to cyclo-octanone by Na BH_4 . Explain.
- d) Relative rates of acetolysis for the following compounds are mentioned below.

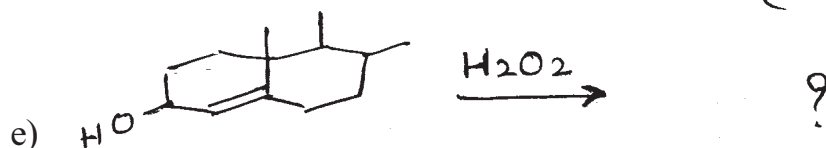
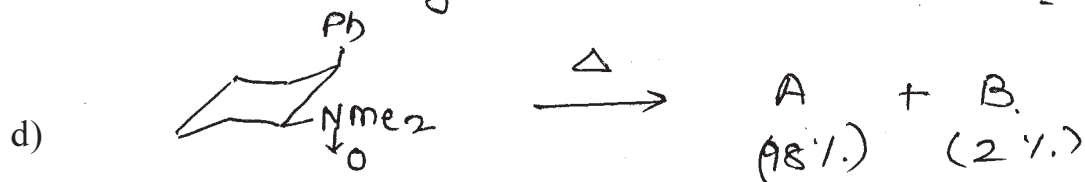
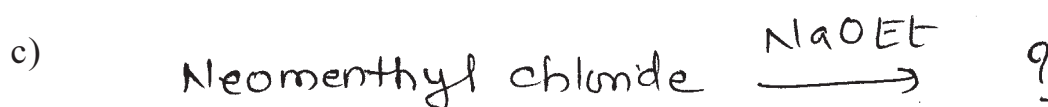
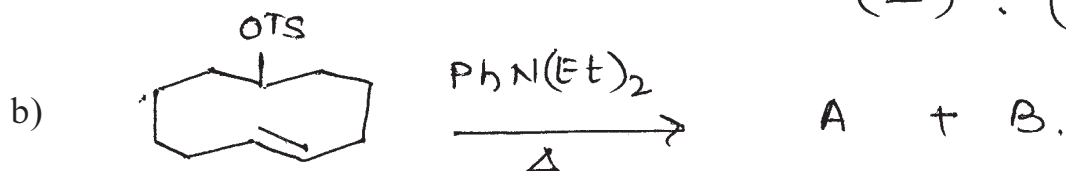
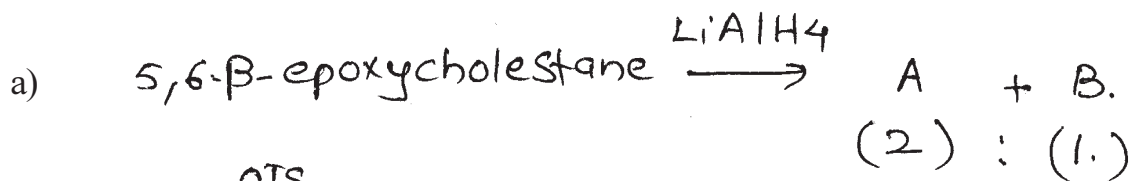


compare the rates and explain.

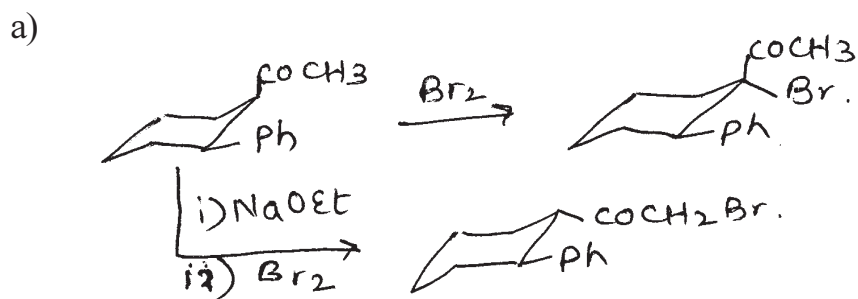
- e) Describe α - pinene hydrochloride-bornylchloride rearrangement.

P.T.O.

Q2) Predict the product/s in any four of the following and explain stereochemical principles involved. Justify: [12]



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



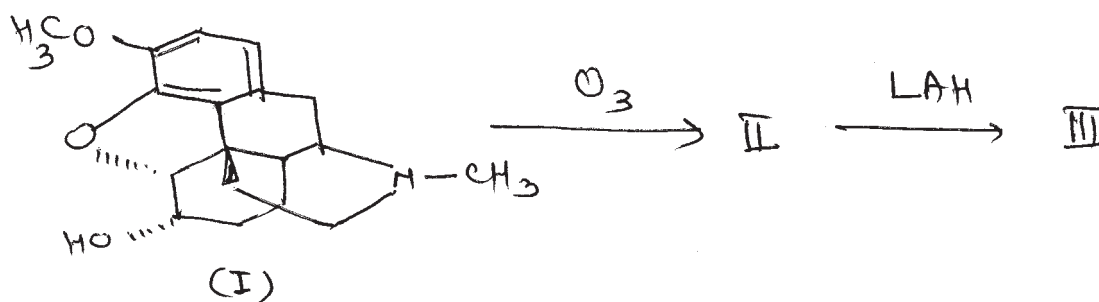
Explain the difference observed in the above reaction.

- Conformation of steroid alcohols and their rate of oxidation with chromic acid. Discuss.
- Describe the use of chromatography in resolution.
- Write a note of 'conformational rule'.

SECTION -II

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

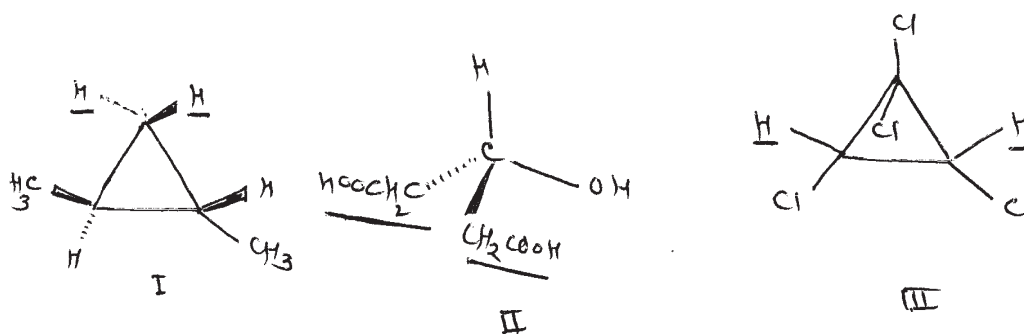
- a) Reaction of Enhydrin with diazomethane yield two epimeric pyrazoline derivative at Enhydrin. How this reaction used to assign the stereochemistry of lactone fusion to Enhydrin.
- b) Give the evidences to explain the stereochemistry of C₃ - Vinyl group is quinine.
- c) Dihydrocodine (I) on ozonolysis yield compound (II), which on LAH reduction furnish compound (III). Also compound III gave facile reaction with Pb(OAc)₄. Give the structures \uparrow compounds II and III and write the conclusion from above information.



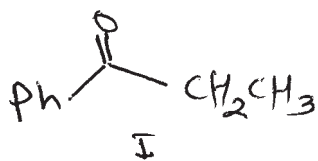
- d) Explain the stereochemistry of C₆ and C₁₃ is codeine.

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

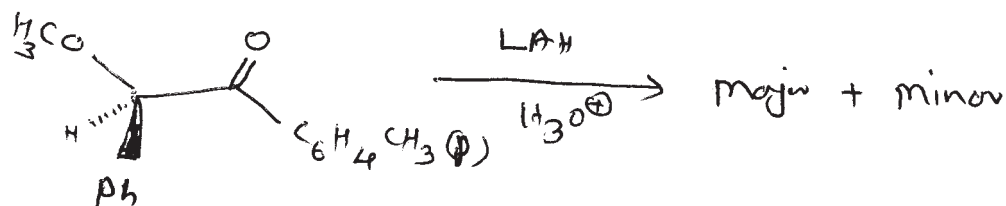
- a) Identify the marked Hydrogens / ligands in as Homotopic or Heterotopic.



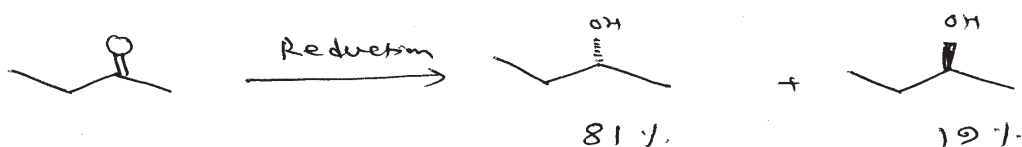
- b) Write the products by hydride attack from Re any Si faces on compounds (I). Give the relation between two products.



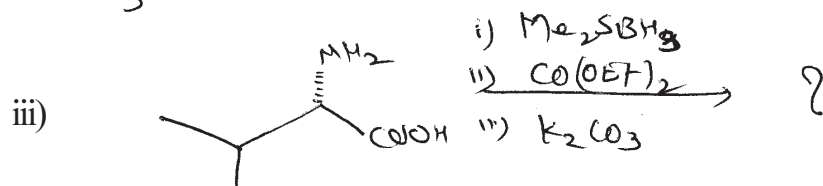
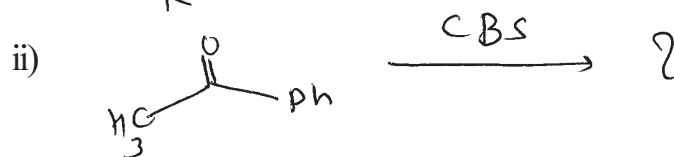
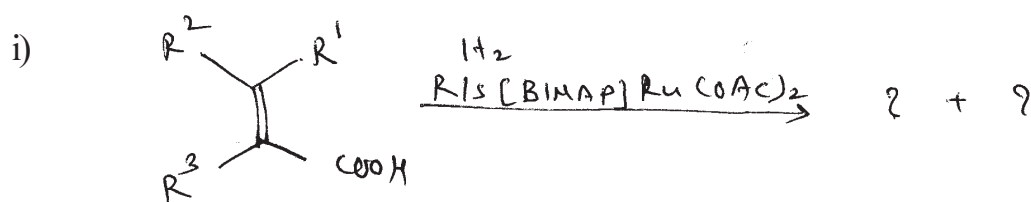
- c) Explain the Felkin. Ahn model. Give major and minor obtain in following reaction.

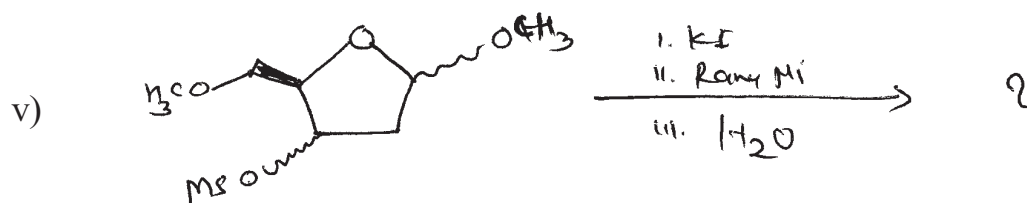
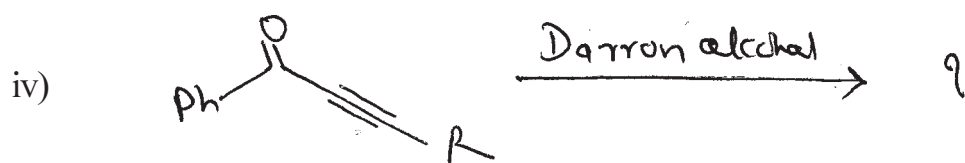


- d) Explain the term optical purity. Calculate enantiomeric excess in following reactions.



- Q6) a) Predict the product/s. Explain stereochemistry & mechanism in any four of the following reactions. [8]

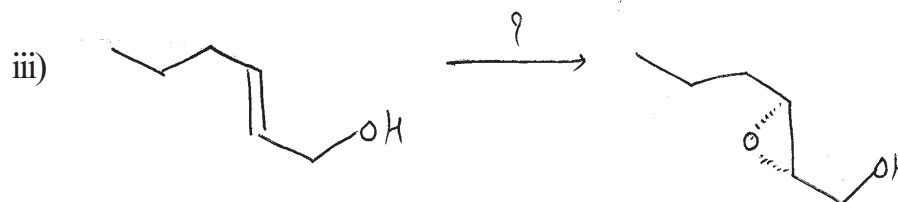
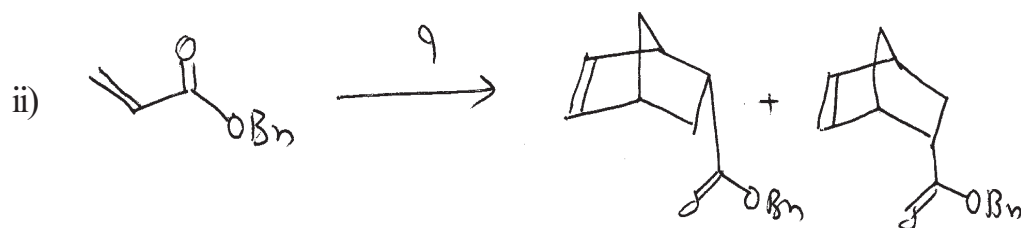
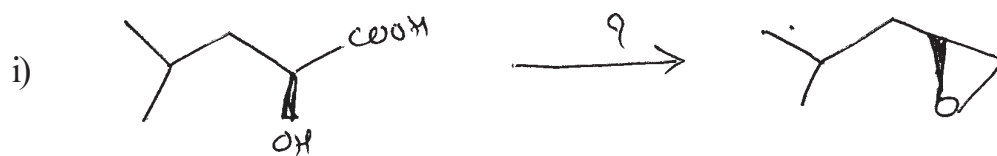




b) Solve the following:

Explain the concept of nature pool strategy, with suitable example. [2]

c) Give the reagents and write stereochemistry in following reaction. (Any two): [6]



EEE

Total No. of Questions :6]

SEAT No. :

P2136

[4823]-43

[Total No. of Pages :5

M.Sc. II

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 side 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) Autoxidation.
- ii) Di- π methane rearrangements.
- iii) Intermolecular Hydrogen transfer.

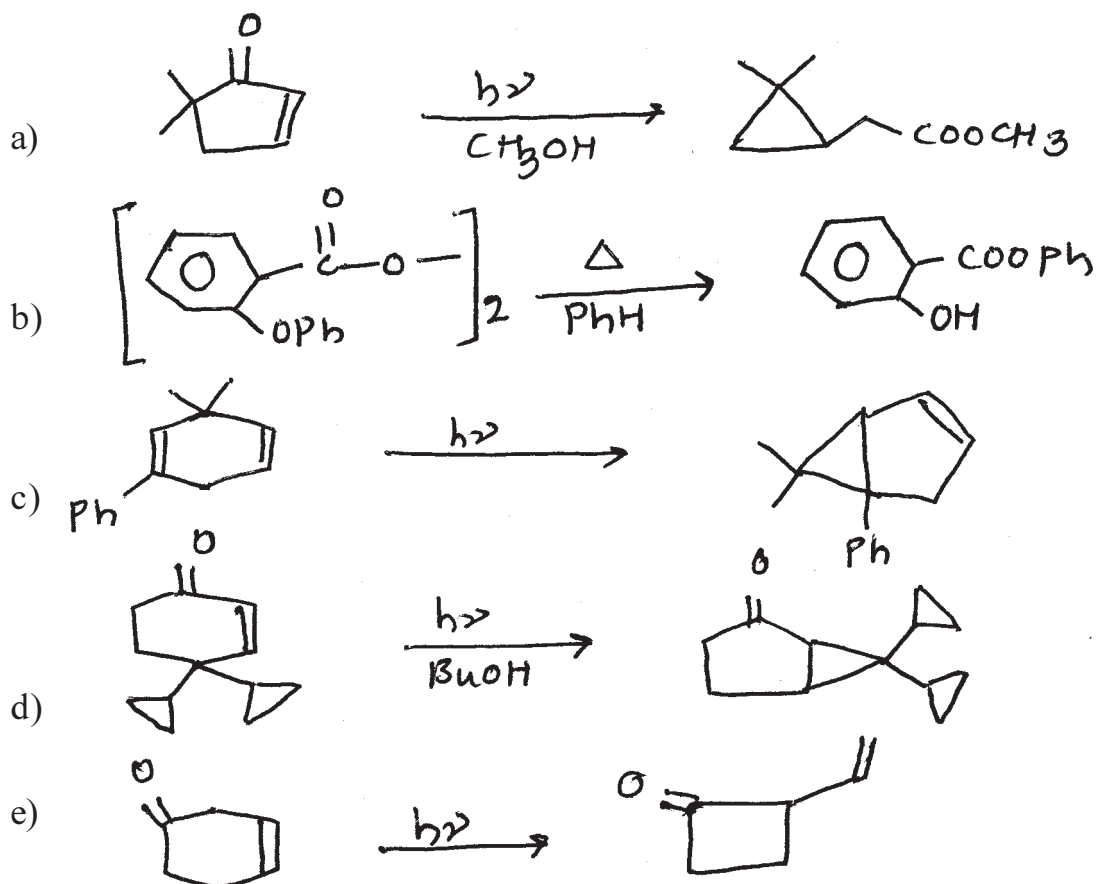
b) Explain any two of the following: [6]

- i) Irradiation of 4,4-diphenyl cyclohexenone yields a mixture of two products.
- ii) Detection of triplet biradical in photoenolisation.
- iii) Mechanism of dimerisation of 1, 3-butadiene in solution in the presence of sensitiser.

P.T.O.

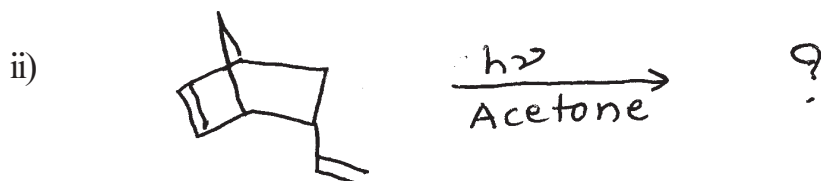
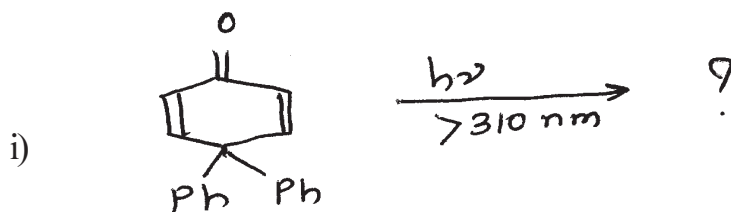
Q2) Suggest suitable mechanism for any four of the following:

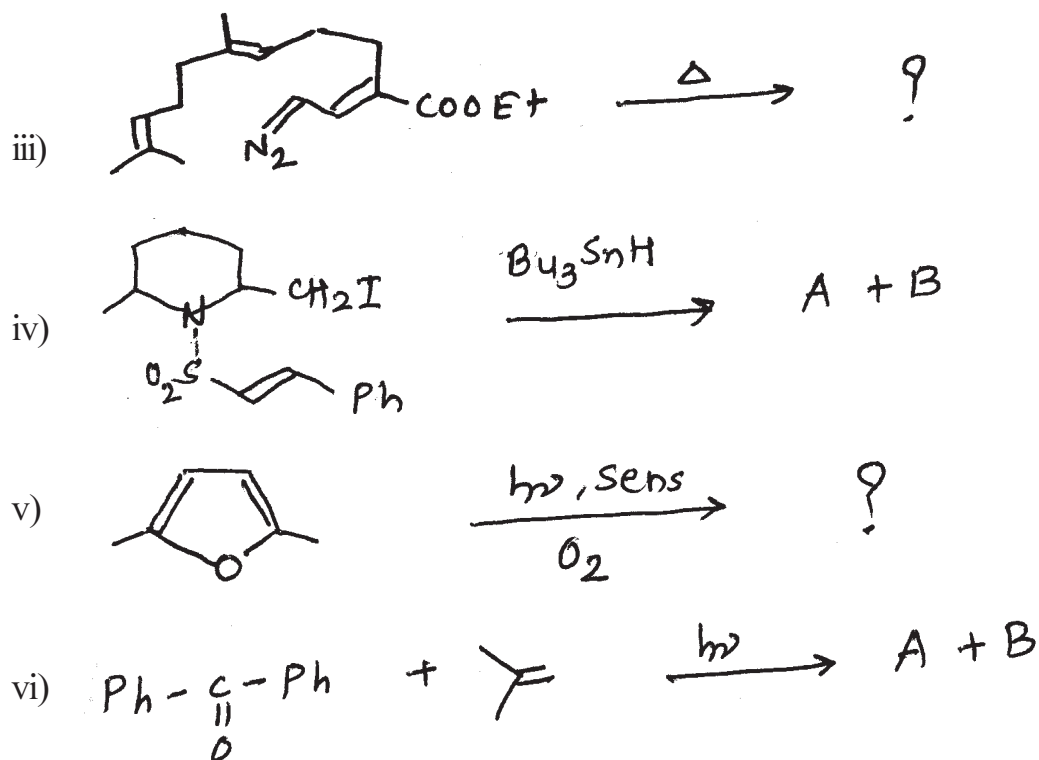
[12]



Q3) a) Mixture of four monochloro hexanes are obtained from the vapor phase chlorination of 3-methylpentane at 450°C. Write their structures, which one is obtained in major amount. [4]

b) Predict the product/s indicating mechanism in any five of the following: [10]

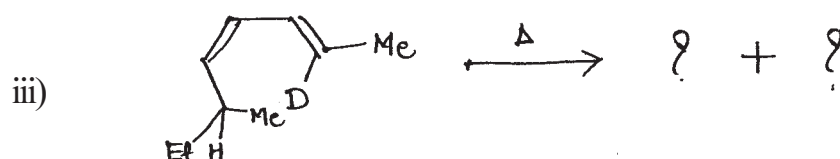
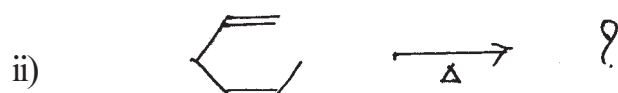
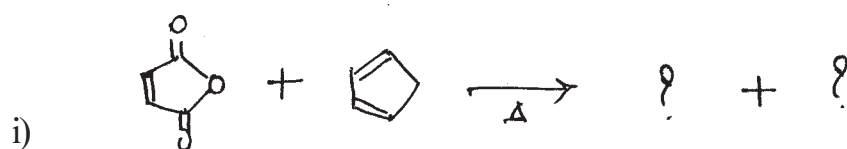


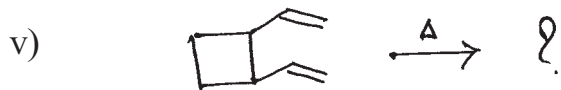
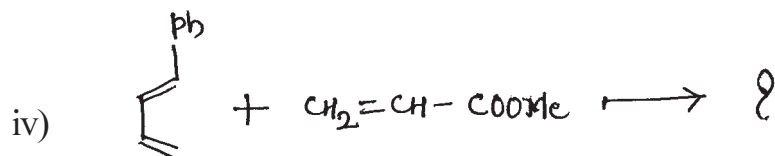


SECTION - II

Q4) a) Draw PMOs for ($\pi^4S + \pi^2S$) cycloaddition and develop correlation diagram. Predict whether the reaction is photochemically allowed. [6]

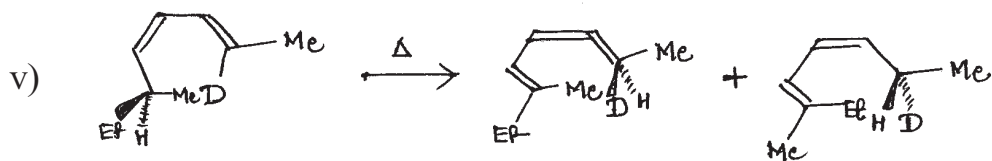
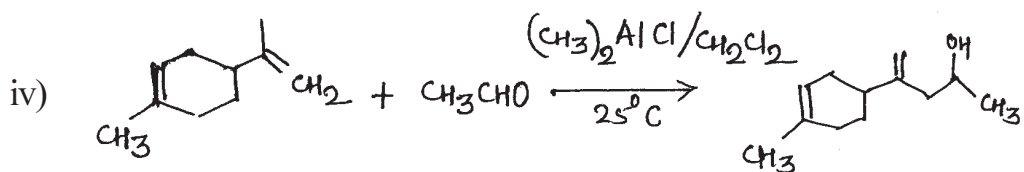
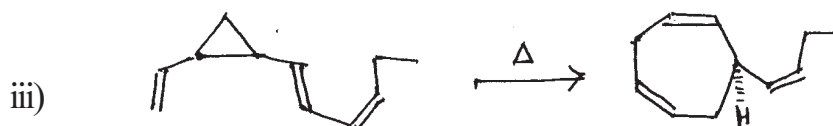
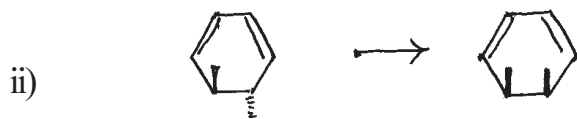
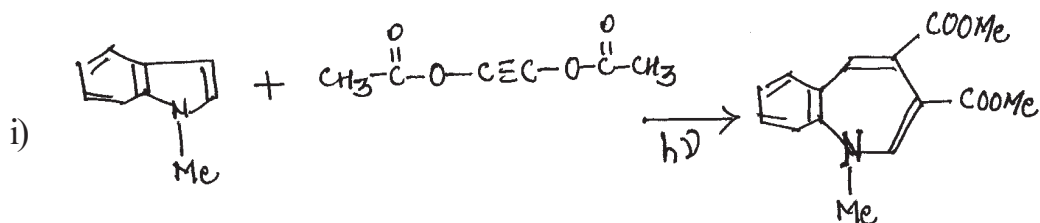
b) Predict the products in any four of the following reactions. Explain mechanism & stereochemistry. [8]



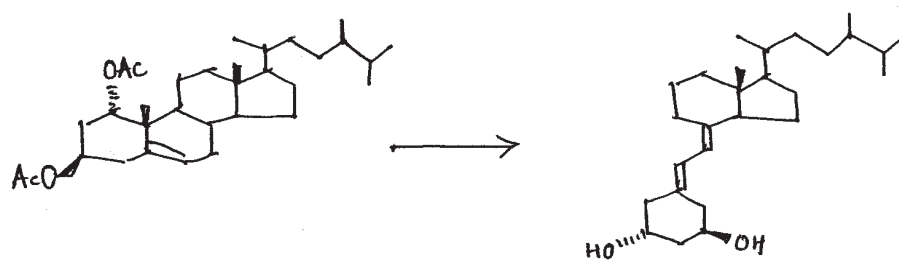


Q5) a) Draw correlation diagram for conrotatory ring opening of cyclobutene to 1,3-butadiene. Justify whether the reaction is thermally allowed. [4]

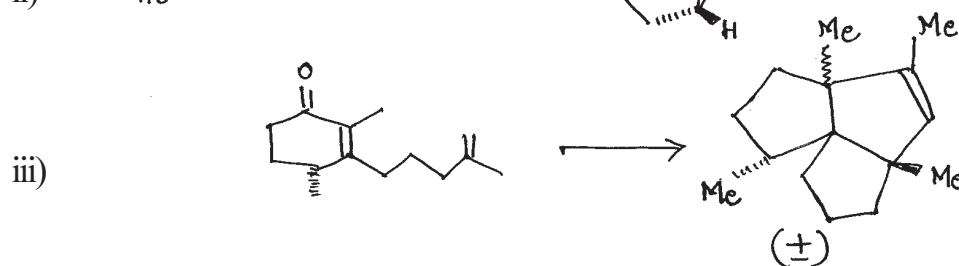
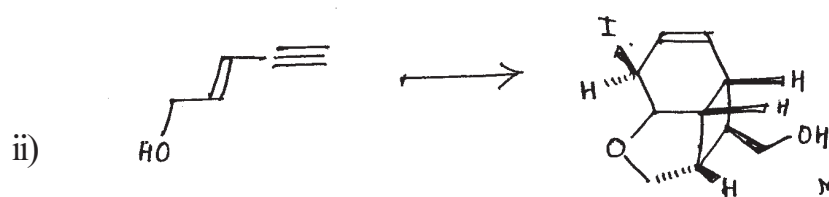
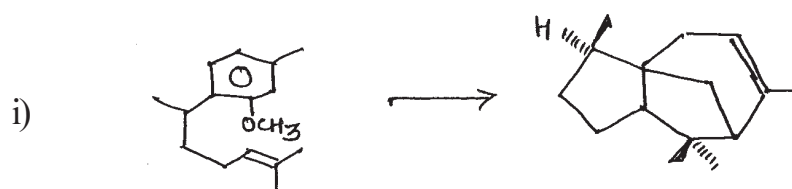
b) Explain mechanism for any four of the following: [8]



- Q6) a) Outline the synthesis indicating reagents required and intermediates involved. [6]



- b) Complete any two synthetic sequences mentioning reagents and intermediates formed in steps. [8]



EEE

Total No. of Questions : 4]

SEAT No. :

P2137

[4823]-44

[Total No. of Pages : 3

M.Sc. (II)

ANALYTICAL CHEMISTRY

**CH-390 : Electroanalytical and Current Analytical Methods in Industries
(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 table/ calculator (non programmable) is allowed.*

SECTION-I

Q1) Attempt Any four of the following:

[20]

- a) Draw a labelled polarographic curve. Explain the role of maximum suppressor and bubbling of nitrogen gas through the solution in the polarographic analysis.
- b) Describe construction and working of DME in polarographic analysis. Mention it's advantages.
- c) Explain the following terms:
 - i) Limiting current
 - ii) Half wave potential
- d) 2.2g of ore containing aluminium is electrolysed. The constant current of 3.5A and 10.0 minutes are required for complete electrolysis. Calculate the percentage of aluminium in the ore. [Given: At.wt. of Al = 27].
- e) Calculate the diffusion current of Pb^{2+} ion in a solution having concentration 5.5mm, if drop time was measured at the rate of 3.47 sec per drop. The mercury flow rate was 1.72 mg per sec.

[Given: diffusion coefficient of $Pb^{2+} = 9.0 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$].

P.T.O.

Q2) Attempt Any Four of the following:

[20]

- a) State the principle of electrogravimetric analysis. Discuss the importance of hydrogen over potential in the electrogravimetric analysis of metals.
- b) What is stripping voltametry? Explain anodic and cathodic stripping voltametry.
- c) Distinguish between linear scan polarography and pulse polarography.
- d) State principle of amperometry. Describe the nature of amperometric titrations.
- e) An electroactive species yielded a wave with a limiting current of $22.5 \mu\text{A}$ at a rotated disk electrode, which was rotated at 20.0 rotations per second. Calculate the limiting current that would be expected at 60.0 rotations per second.

SECTION-II

Q3) Attempt Any Four of the following:

[20]

- a) Discuss the principle and technique of double isotope dilution analysis. Mention its limitations.
- b) State and explain the principle of activation analysis. Give advantages and disadvantages of neutron activation analysis.
- c) Explain the principle of radiometric titration. Discuss the nature of the titration of calcium by EDTA with solid radioactive silver iodate as indicator.
- d) The concentration of chloride in unknown solution is 45.0 ppm. The transmittance of same solution is 54.8 % in the cell of pathlength of 1.00 cm. Calculate the turbidity coefficient of chloride.
- e) 1.2 ml of a sample solution containing 4.8×10^4 dps radioactivity due to tritium injected into the blood stream of laboratory animal. After sufficient time of circulation, 0.1 ml of blood was found to have an activity of 128 dpm. Calculate the volume of blood in the body of animal.

Q4) Attempt Any Four of the following:

[20]

- a) Write a note on nephelometric titrations.
- b) Draw the diagram and describe the parts of modern thermobalance. Give an account of furnace temperature measuring system in thermobalance.
- c) Explain the terms exotherm and endotherm in DTA.
- d) Write a note on electrochemical sensors.
- e) A TGA curve was obtained for 3 mg of a sample containing magnesium sulphate heptahydrate. When monohydrate formation complete, the loss in mass was 0.6 mg. Find the percentage of heptahydrate in the sample.

[Given : At. Wt. of H =1, O=16, Mg = 24, S=32].



Total No. of Questions : 4]

SEAT No. :

P2138

[4823]-45

[Total No. of Pages : 3

M.Sc.- II

ANALYTICAL CHEMISTRY

**CH-391 : Environmental and Analysis of Industrial Materials
(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 calculator is allowed.*

SECTION-I

Q1) Attempt Any four of the following:

[20]

- a) Describe the alkalimetric ammonium - molybdophosphate method to estimate phosphorous in given sample of fertilizer containing phosphorous.
- b) What are colouring constituents of glass? How is iron estimated from coloured glass?
- c) Give the suitable analytical method for determination of sulphate from cosmetics.
- d) Discuss the method to extract and estimate unsulphonated and sulphonated material from sample of detergent.
- e) A 0.670 gm sample containing Zinc is dissolved in 100 ml of acid. An aliquot of 25ml needed 12.6 ml 0.0125 M EDTA. Calculate the percentage of Zinc in the sample.

[Given: At .Wts. Zn = 65.33].

P.T.O.

Q2) Attempt Any Four of the following:

[20]

- a) Outline the procedure for determination of chromium from Pigments.
- b) Describe any one method for determination of calcium in propellant.
- c) What are explosives? How is moisture determined by Karl Fischer titration.
- d) From 0.3 gm of sample containing calcium was dissolved in acid and calcium was precipitated as Ca-oxalate. The precipitate was dissolved in dil. H_2SO_4 solution and diluted to 100ml. An aliquot of 10 ml was titrated with 0.025 N KMnO_4 and gave burette reading 7.5 ml. Calculate the percentage of calcium in the given sample.

[Given : At .wts. Cu = 40.08, O = 16, Mn = 54.94, K=39].

- e) 1.5gm sample of ilmenite ore was dissolved in conc. H_2SO_4 . After removal of insoluble matter filtrate was diluted to 250 ml. An aliquot of 100ml is used to precipitate Ti and Fe. The precipitate on ignition gave 0.321 gm of mixed oxide of Titanium and Iron . 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 8.5 ml. Calculate percentage of TiO_2 and Fe_2O_3 in sample.

[Given : At.wts. Fe = 55.85, Ti = 47.90, O =16].

SECTION-II

Q3) Attempt Any Four of the following:

[20]

- a) Outline the analytical procedure for determination of any one of the following:
 - i) Tin from ilmenite ore.
 - ii) Silica from bauxite ore.
- b) Explain the sodium bismuthate method for determination of Manganese in steel alloy.
- c) Explain the analytical procedure for estimation of calcium from Dolomite ore.

- d) Phosphate detergent weighing 0.5 gm was ignited to red hot to destroy organic matter. The residue was dissolved in hot HCl gave H_3PO_4 . The phosphate was precipitated as $MgNH_4PO_4 \cdot 6H_2O$ by addition of Mg^{+2} ions followed by aq. ammonia. After filtration, washing, drying and ignition at $1000^\circ C$, Weight of residue [$Mg_2P_2O_7$] was 0.4 gm. Calculate percentage of Phosphorous in the given sample.

[Given: At .wts. P= 30.97, Mg = 24.31, O = 15.99]

- e) Borosilicate glass weighing 0.4 gm was fused with Na carbonate in platinum crucible and the melt was converted into boric acid by suitable process. Mannitol is added in whole solution and titrated with 0.1N NaOH using paranitrophenol as indicator and 28.80 ml of alkali required for complete neutralisation. Calculate percentage of B_2O_3 in sample of glass.

[Given : At.wts. B= 10.81, O = 15.99].

Q4) Attempt Any Four of the following:

[20]

- How NO_x is generated ? Explain it's hazardous effect on material. How is it controlled?
- Describe in brief any two methods used for disposal of sludge.
- Explain terms BOD and COD. How is COD estimated from the waste water?
- Explain principle and construction of cyclone separator.
- Describe trickling filter process.



Total No. of Questions : 4]

SEAT No. :

P2139

[4823]-46

[Total No. of Pages : 3

M.Sc.-II

ANALYTICAL CHEMISTRY

CH-392 : Advanced Analytical Techniques

(2008 Pattern) (Semester-III)

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/ calculators (non -programmable) is allowed.*
- 5) Use of graph paper is allowed.*

SECTION-I

Q1) Attempt any four of the following:

[20]

- a) State and explain ohm's law and Kirchoff's law. Explain with a suitable example. How these laws are useful in circuit analysis
- b) Draw the circuit symbols of the following
 - i) Photoresistor
 - ii) Zener diode
 - iii) Photodiode
 - iv) P-N junction diode
 - v) Light emitting diode
- c) Explain the properties of ideal amplifier as differentiation and integration.
- d) Draw a circuit diagram showing forward and reverse biasing of a p-n junction.
- e) Write binary equivalent of a decimal numbers 18 and 23 add binary numbers, convert the answer to a decimal numbers.

P.T.O.

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

- a) Write a critical note on discrete sample analyzer.
- b) Draw the outline of microprocessor control in X-ray spectrometer.
- c) Write a critical note on flow injection analyzers.
- d) Give a detailed about of process control analyzer.
- e) Three capacitors of 5 μf , 10 μf and 20 μf are connected in parallel. Find equivalence capacitance

Q3) Attempt any four of the following [20]

- a) Explain the following terms with respect to A.A.S.
 - i) Sputtering
 - ii) Releasing agent
 - iii) Spectral interference and its convention method.
- b) Mention the element required in micronutrients for the growth of fruits. Explain any one suitable method for the determination of Zinc from soil sample.
- c) Compare the flame emission and atomic absorption spectroscopic techniques of analysis with respect to principle and method of analysis.
- d) Write a note on Atomic fluorescence spectroscopy.
- e) Chromium in a aqueous sample was determined by pipetting 10ml of unknown into each five 50ml volumetric flask, various volumes of standard containing 12.5ppm, chromium were diluted to flask upto 50ml from the following data. caculate the ppm of chromium sample.

unknown sample inml	Standard in ml(Vs)	Absorbance (A)
10	0.0	0.201
10	10.0	0.292
10	20.0	0.378
10	30.0	0.467
10	40.0	0.554

Q4) Attempt any four of the following:

[20]

- a) Write a note on laser enhanced ionisation.
- b) Write a note on single immuno diffusion and double immuno diffusion
- c) Give a brief account of Enzyme linked immunosorbent assay with respect to principle, practical aspect and application.
- d) Explain clinical application of progesterone.
- e) Magnesium in blood serum can be determined by A.A.S.; A 5.0 ml serum sample was diluted to 100ml and its absorbance was found to 0.125; A standard containing 2×10^{-2} m of Mg^{2+} gave the absorbance 0.187. Calculate the Mg^{2+} concentration in milligrams present in sample of blood.

(Given At. mass of $Mg^{2+} = 24$ gm /mole)



Total No. of Questions : 4]

SEAT No. :

P2140

[4823]-47

[Total No. of Pages : 2

M.Sc. -II

ANALYTICAL CHEMISTRY

CH-380 : Pharmaceutical Analysis

(2008 Pattern) (Semester-III) (Optional)

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.*

SECTION-I

Q1) Answer Any four of the following:

[20]

- a) What are the sources of impurities in pharmaceutical chemicals? Discuss inadequate storage conditions.
- b) Give determination of acid insoluble ash in vegetable drug.
- c) What are capsules? Describe in detail the disintegration test for capsule.
- d) Explain the limit test for arsenic.
- e) 1.8 gm Aspirin [$C_9H_8O_4$] tablet was dissolved in 50 ml of 0.2 N NaOH solution. This solution was titrated with 0.5 N HCl using Phenolphthalein indicator , gave burette reading 20.1 ml. Blank titration reading was found to be 50 ml. Calculate percentage of Aspirin in given tablet.

Q2) Answer Any Four of the following:

[20]

- a) What are Suspensions? Give advantages of suspension.
- b) What are Ointments? Give the classification of ointment bases with suitable examples.

P.T.O.

- c) What are tablets? Explain different types of tablets.
- d) Write a note on steroid identification.
- e) 0.43 gm sample of oxyphenbutazene $C_{19}H_{20}N_2O_3H_2O$ was dissolved in 25 ml Acetone. This solution was titrated with 0.1 N NaOH using bromothymol blue indicator gave Burette reading 9.1 ml. Calculate percentage of oxyphenbutazene in given sample. [At. wt. C=12, N=14, H=1, O=16].

SECTION-II

Q3) Attempt Any Four of the following: [20]

- a) Define sterilization process for pharmaceutical products.
- b) What are parentals. Give classification of parentals.
- c) How is expiry date of certain drug is determined? Explain with suitable example.
- d) Write a note on assay of Sulphacetamine.
- e) 0.3 gm of isoniazide [$C_6H_7N_3O$] sample was dissolved in 40 ml water and diluted to 100 ml. Diluted solution was taken in a stoppered bottle to which 10 ml 0.1N bromine solution, 5 ml con. HCl solution and 10 ml 10% KI solution were added. The liberated I_2 was titrated with 0.1 N $Na_2S_2O_3$ solution using starch indicator. The titration reading was 2.3 ml. The blank titration reading was 9 ml. Calculate the percentage of isoniazide present in sample.

[Given mol.wt. of isoniazide [$C_6H_7N_3O$] \equiv 137.14 gm].

Q4) Attempt Any Four of the following: [20]

- a) What are limit test? Explain limit test for chloride.
- b) How is amylase activity determined?
- c) Write short note on microbial limit test.
- d) Give an assay of Mannitol.
- e) 0.42 gm of Ibuprofen sample ($C_{13}H_{18}O_2$) was dissolved in 100 ml of alcohol which was previously neutralised using phenolphthalein. It was titrated with 0.1 N NaOH solution using same indicator and burette reading found to be 18.4 ml. Calculate percentage of Ibuprofen in given sample.

[At.wt. C = 12, H=1, O =16].



Total No. of Questions : 4]

SEAT No. :

P2141

[4823]-48

[Total No. of Pages : 2

M.Sc. (II)

ANALYTICAL CHEMISTRY

CH-381 : Medicinal Chemistry

(2008 Pattern) (Semester-III) (Optional)

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 calculator is allowed.*

SECTION-I

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

- a) What is a drug? Give systematic classification of drugs.
- b) Discuss history and development of QSAR.
- c) Write a short note on Hansch analysis.
- d) Give an account of chemical assay of drugs.
- e) What are novel drug delivery systems? Discuss.

Q2) Attempt Any Four of the following: **[20]**

- a) Write a short note on uses of pharmacokinetics in drug development process.
- b) What are the major aspects of biological assay of drugs?
- c) Define:-
 - i) Drug activity
 - ii) Drug receptors
 - iii) Pro- drug
 - iv) Soft- drug

P.T.O.

- d) Give a brief account of new procedures followed in drug design.
- e) Discuss the process of drug absorption disposition and elimination.

SECTION-II

Q3) Attempt Any Four of the following: **[20]**

- a) Discuss the role of alkylating agents and antimetabolites in cancer treatment.
- b) Give an account of cardiovascular diseases.
- c) What is a local antifective drug? Discuss with suitable examples.
- d) Discuss the mode of action of hypnotics and anti-anxiety drugs.
- e) Give the process of synthesis of :
 - i) Penicillin G.
 - ii) Streptomycin.

Q4) Attempt Any Four of the following: **[20]**

- a) Write a short note on recent developments in cancer chemotherapy.
- b) Discuss with suitable examples antipsychotic drugs and CNS depressants.
- c) Give the structure and detailed mode of action of chloramphenicol.
- d) Define:-
 - i) Drug inhibitor.
 - ii) Mitotic inhibitor.
 - iii) Neuroleptic drug.
- e) Discuss the stereochemical aspects of psychotropic drugs.



Total No. of Questions :6]

SEAT No. :

P2142

[4823]-51

[Total No. of Pages :4

M.Sc.

PHYSICAL CHEMISTRY

CH - 410: Molecular Structure and Spectroscopy

(2008 Pattern) (Old) (Semester - IV)

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 side indicate full marks.*
- 5) *Use of logarithmic tables / calculator is allowed.*

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	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

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

- a) Explain the principle and mechanism of FT nmr.
- b) Describe the instrumentation used in nqr spectroscopy with a suitable diagram.
- c) Explain the nature of ABX and A_3 type of nmr spectra and deduce the situations when ABX spectrum is reduced to A_3 .
- d) Write a note on: Use of nmr in medical diagnostics.
- e) What is the need of reference for recording high resolution nmr? Explain the advantages of TMS.

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

- a) Describe the instrumentation used in esr spectroscopy and explain the working of a Klystron.
- b) Explain the terms: Kramers degeneracy, zero field splitting and hyperfine coupling constant involved in esr spectroscopy.
- c) Distinguish between nmr and esr spectroscopy.
- d) Explain the Mc Connell relationship and discuss its applications in esr spectroscopy.
- e) What is the basic principle of PAS spectroscopy? Describe the instrumentation used in it.

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

- a) Calculate the frequency required to excite proton from $m_1 = \frac{1}{2}$ to $m_1 = -\frac{1}{2}$. [Given: $g_n = 5.585$, $H = 1.4$ Tesla]

- b) Predict the nature of esr spectra of $^{14}\text{NH}_3$ and $^{15}\text{NH}_3$.

Given: ^{14}N , $I = 1$, $A = 20 \text{ G}$ (for $^{14}\text{N-H}$)

^{15}N , $I = \frac{1}{2}$, $A = 6 \text{ G}$ (for $^{15}\text{N-H}$)

^1H , $I = \frac{1}{2}$

- c) Find the magnetic field that produces resonance condition for a sample with g- value 3.1 in an esr spectrometer using 30 mm radiation.

$[\mu_e = 9.27 \times 10^{-24} \text{ J T}^{-1}]$

SECTION -II

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

- a) What is X-ray diffraction? Explain the interference of wave motions observed in X-ray diffraction.
- b) Describe the rotating crystal method in XRD analysis with a suitable diagram.
- c) Define 'structure factor' and relate it to the reflection intensities.
- d) Discuss the advantages and disadvantages of XRD method as an analytical tool.
- e) Describe the electron diffraction experimental method with a suitable diagram.

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

- a) Describe with a diagram, the uniform field method used for the measurement of magnetic susceptibility.
- b) Discuss the Wierl equation.

- c) Define and explain the following terms:
- i) Pole strength
 - ii) Magnetic field and
 - iii) Intensity of magnetization
- d) Derive the expression for gram susceptibility (χ_g) as used in Gouy method.
- e) What is 'spin only' magnetic moment? Find it for a metal complex with three unpaired electrons.

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

- a) Calculate the glancing angle:
[Given: $\lambda = 153.9$ pm, $d = 400$ pm, $n = 1$]
- b) The mass and density of copper atom are 63.5 and 8.94 g cm^{-3} respectively. It has FCC structure. calculate the atomic radius of the copper atom.
- c) Calculate the volume, and mass paramagnetic susceptibilities of a sample of a complex salt with five unpaired electrons at 273 K.
[Given: density = 2.87 g cm^{-3} , molar mass = 324.4 g mol^{-1}]

EEE

Total No. of Questions :6]

SEAT No. :

P2143

[4823]-52

[Total No. of Pages :4

M.Sc.

PHYSICAL CHEMISTRY

CH - 411: Surface and Electrochemistry

(2008 Pattern) (Semester - IV) (Old)

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 side indicate full marks.*
- 5) *Use of logarithmic table / calculator is allowed.*

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	β_e	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION -I

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

- a) Give a critical comparison of various models used for multilayer adsorption.
- b) What is Gibb's monolayer? Describe PLAWM technique for measuring film pressure.
- c) Differentiate between physical adsorption and chemisorption.
- d) Explain the term
 - i) Turnover number
 - ii) Functionality
 - iii) Catalyst selectivity
- e) Write BET equation and explain terms involved in it. How it is used for determination of surface area of solid adsorbent.

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

- a) Define detergency and explain various factors involved in detergent action.
- b) Derive two dimensional ideal gas law for film on liquid surface.
- c) What is spreading coefficient? Derive equation for spreading coefficient interms of surface tension.
- d) What are zeolites? Give their important applications.
- e) Discuss the role of contact angle in flotation.

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

- a) The adsorption of N_2 on $Zr - SiO_4$ at liquid nitrogen temperature fit the BET equation. The volume of nitrogen necessary to form a monolayer on powder sample is found to be 11.05 cm^3 at STP. Calculate area per gram of powder if sample weights 17.52 g and one molecule of nitrogen occupies 16.2 \AA .

- b) At 20°C, the surface tension (γ) of solution of butyric acid in water can be represented by the equation $\gamma = \gamma_0 \ln(1 + bc)$ where γ_0 is surface tension of water, $a = 13.1$ and $b = 19.60$ as constants. Calculate the excess concentration of 0.2 M solution.
- c) Following table gives data for adsorption of methane on 1 g of charcoal at 0°C, the data obeys the Langmuir isotherm, determine the constants a and V_m in Langmuir equation.

P (mm Hg)	100	200	300	400
V (ml)	9.75	14.5	18.2	21.4

SECTION -II

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

- a) Describe the structure of water when ion is present in it.
- b) Derive expression for thickness of ionic atmosphere.
- c) Explain the terms:
 - i) Galvani potential
 - ii) Volta potential
 - iii) Surface potential
- d) Derive Einstein equation relating diffusion coefficient and mobility of ion.
- e) Describe the Gouy-chapman model for electrical double layer across the interface.

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

- a) Explain the term
 - i) Exchange current density
 - ii) Over potential
 - iii) Equilibrium potential
 - iv) Transfer coefficient

- b) Discuss the local cell theory for corrosion of metals.
- c) With neat diagram describe $H_2 - O_2$ fuel cell.
- d) Give one example of each of anodic oxidation and cathodic reduction in electrosynthesis.
- e) Derive Tafel equation from Butler-Volmer equation.

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

- a) A 500 ml of 0.2 M Na_3PO_4 is mixed with 200 ml of 0.4 m $ZnCl_2$. Calculate ionic strength of solution assuming complete dissociation.
- b) Calculate the value of thickness of ionic atmosphere at 25°C in 1 molar solution of KBr. Given : dielectric const of water = 78.54.
- c) The drift velocity of an univalent ion is $3 \times 10^{-5} \text{ cms}^{-1}$ under a potential gradient of 0.075 V cm^{-1} calculate the absolute ionic mobility and conventional ionic mobility.

EEE

Total No. of Questions : 5]

SEAT No. :

P2144

[4823]-53

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

CH-414:Biophysical Chemistry & Related Techniques

(2008 Pattern) (Semester-IV) (Optional Course)

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	=	$6.022 \times 10^{23} \text{ mol}^{-1}$
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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	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
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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 the strategy adopted to study the details of a biophysical macro molecule.
- b) Compare 'DNA' and 'RNA' molecule.
- c) State the Loewy definition of cell. Sketch and explain the structure of mitochondria, state its function.
- d) Explain Pauling corey concept of structure of proteins.
- e) Write a note on: chaperones and protein folding.

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

- a) Discuss the role of Ca^{++} in muscle contraction.
- b) Explain the effect of directionality on the strength of H-bonding.
- c) Write a note on: Phosphonhydride bond in ATP.
- d) What is the role of reverse osmosis in biology?
- e) Explain blood battering system.

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

- a) Calculate the pH of a three litre solution containing $5 \text{ cm}^3 \text{ CH}_3 \text{ COOH}(5\text{M})$ and $5\text{cm}^3 \text{ CH}_3 \text{ COONa}(1\text{M})$. $[\text{pK}_a=4.75]$
- b) The molecular weight of haemoglobin is 64500 daltons. Calculate the mass of two haemoglobin molecule in kilogram.
- c) Calculate R_{rms} for a polymer having 260 monomer and 500 nm long.

SECTION-II

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

- a) Explain the role of channel proteins and carrier proteins in ion transport.
- b) Explain the structure of cell membrane on the basis of fluid mosaic model.
- c) Define the terms: specific viscosity, Reduced viscosity and Intrinsic Viscosity.

- d) Derive Michaelis-Menton equation for enzyme catalysis.
- e) How is the size of biopolymer determined by ultra filtration method? State the characteristics of biopolymers.
- f) What are micelles and bilayers? Explain their functions with a suitable structures.

Q5) Attempt any four of the following.

[20]

- a) Discuss the theory of optical rotatory dispersion.
- b) What is electrophoresis? State its types.
- c) Describe the light scattering method for calculating the molecular weight of biopolymer.
- d) What is a nerve? State its types by giving typical examples.
- e) Explain the biological significance of Donnan membrane phenomenon.
- f) Write a note on: Oscillatory reactions.



Total No. of Questions : 5]

SEAT No. :

P2145

[4823]-54

[Total No. of Pages :3

M.Sc.

PHYSICAL CHEMISTRY

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

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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12. Nuclear magneton	β_n	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	=	$9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION-I

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

- a) What are in-vivo and in-vitro techniques for diagnosis of diseases? Explain any one of them in details .
- b) Describe the procedure for synthesis of ^{125}I , ^{123}I , ^{127}I , ^{201}Tl .
- c) Enlist the various isotope separation techniques. Discuss any one of them.
- d) Discuss the general principles used in application of radiopharmaceuticals. Give any application of it in the therapy of disease.

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

- a) Give an account of solid radioactive waste management.
- b) Which precautions are to be taken while handling the radioactivity.
- c) Write down various P-P reactions.
- d) Describe solar neutrino problem.

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

- a) Find out the activity of $^{99\text{m}}\text{Tc}$ extracted with 80% efficiency after a loading period of 8h in a technicium generator. Given: $t_{1/2}$ of $^{99\text{m}}\text{Tc}=6\text{h}$ $^{99}\text{Mo}=66\text{h}$.
- b) Find out the dose due to 300 mci Co-60 source at a distance of 3 m. Given $E_{\gamma} = 1170$ and 1330 keV.
- c) Find out the total effective dose of a radiation worker when he is exposed to following doses 0.001 R due to β particles 0.1Gy due to α - particles 0.0001 rads due to γ -rays.

SECTION-II

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

- a) Explain with suitable example competition kinetics in radiolysis of aqueous solutions.
- b) What is carrier? Write in brief about target chemistry.
- c) Discuss the chemical problems in purification & isolation of radioactive species during its production.

- d) Give an account of choice of counting methods for measurement of activity of sample.
- e) Write down the radiolysis reaction of alcohols.
- f) Describe how radiolytic yield is determined.

Q5) Attempt any four of the following.

[20]

- a) Write a note on chain reactions during radiolysis.
- b) Explain molecular kinetics on the basis of Arrhenius law.
- c) Draw & explain the radiometric titration curve of a binary mixture when the ion precipitating second is labelled.
- d) Draw Duncan and Thomas's experimental set up used in radiometric titration studies.
- e) With suitable example explain the complexometric radiometric titration curve.
- f) 100 ml solution of K^*I with an activity of 8000 cpm was titrated with 0.05 M $AgNO_3$. Addition of 5ml $AgNO_3$ decreased this activity to 2000 cpm. Find out the amount of KI in a given solution. Given: at.wt. of $Ag=108$, $I=127$, $K=39$, $N=14$, $O=16$ amu.



Total No. of Questions : 4]

SEAT No. :

P2146

[4823]-55

[Total No. of Pages : 2

M.Sc. (II)

INORGANIC CHEMISTRY

CH-430 : Inorganic Solids and Heterogeneous Catalysis

(2008 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Q1) Answer Any four of the following:

[20]

- a) Explain the potential energy curve for the adsorption of H₂ on Ni surface.
- b) Give the preparation, properties and structure of S₄N₄.
- c) How are heterogeneous catalyst classified? Give two examples each.
- d) With the help of suitable examples, explain the role of nanomaterials in organic synthesis.
- e) Explain in details hetero polyanions of Molybdenum and Tungsten.

Q2) Answer Any Four of the following:

[20]

- a) Draw the structure and Find out the number of framework electrons in [Ni₆(CO)₁₂]²⁻.
- b) What is meant by phase transfer catalyst? Describe one reaction catalysed by this type of catalyst.
- c) Write a note on SOD and ZSM- 5 type of zeolite.
- d) Explain different Factors which govern chemisorption of substrate on catalytic surface.
- e) Differentiate between linear and cyclic inorganic polymers.

P.T.O.

Q3) Answer Any Four of the following: **[20]**

- a) Explain the role of sulphides as a catalyst.
- b) What are catalytic reactors? Name the different reactors and explain working of any one of them.
- c) Give an account of phosphazenes with their structural aspects.
- d) What do you understand by the term “Supported metal catalyst”. Explain their applications.
- e) Silicon forms a number of polyoxoanions but not carbon. why? Draw the structure of polyoxoanions of silicon

Q4) Write short notes(any Four) **[20]**

- a) MCM-41
- b) Ultramarines.
- c) SN Compounds.
- d) Photocatalytic reactions.
- e) MFI and MEL type Zeolites.



Total No. of Questions : 4]

SEAT No. :

P2147

[4823]-56

[Total No. of Pages : 2

M.Sc.-II

INORGANIC CHEMISTRY

CH-431 : Material Science

(2008 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 80

Instructions to the candidates:

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

Q1) Attempt Any four of the following:

[20]

- a) Explain Clinical uses of Biomaterials.
- b) Explain sol-gel process with the help of flow sheet diagram.
- c) What is the difference between normal & inverse Spinel?
- d) Discuss BCS theory of Superconductors.
- e) Explain in brief types of semiconductors.

Q2) Attempt Any Four of the following:

[20]

- a) What is the difference between softwood & hardwood? Explain, with the examples. Describe the different layers in the cross section of a tree stem.
- b) What is portland Cement? What are the different types of portland Cement?
- c) Explain Meissner effect & Applications of Superconductors.

P.T.O.

- d) What is the points of difference among metals, Semiconductors & insulators?
- e) Explain in brief the types of defects in crystals.

Q3) Attempt Any Four of the following: **[20]**

- a) Explain the different types of plots of ' α ' Vs 'T' in solid state reactions.
- b) What is point defect ? Explain the Schottky & Frenkel defects in Solids?
- c) Calculate no.of atoms per unit cell of BCC Fe & net magnetic moment per Fe atom in Crystal.
[Given: Lattice Parameter of BCC Fe = 2.87 \AA , Saturation magnetisation of BCC Fe = 1650 k A/m^2]
- d) In 'Ge' energy gap is 0.75 eV. What is the wavelength at of which it starts absorption of light?
- e) Derive the expression of Curie law.

Q4) Write a short notes on (any Four) **[20]**

- a) Photoconductivity.
- b) i) Oil- well Cement.
ii) Macrodefect free Cement.
- c) Czochralski method for obtaining single crystal of Ge.
- d) Hysteresis loop.
- e) Fick's law of Diffusion.



Total No. of Questions : 9]

SEAT No. :

P2148

[4823]-57

[Total No. of Pages :3

M.Sc.(II)

INORGANIC CHEMISTRY

**CH-445:Inorganic Applications in Industry, Biotechnology and
Environmental Chemistry
(2008 Pattern) (Semester-IV)**

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

- 1) *Attempt any two sections of 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? What are the general properties of pigment. Explain any two of them.
- b) What are formazans? How are they classified as ligand. Give at least two examples of each and draw the structure of metal complexes of they form.
- c) Explain the microstructure of Soft and Hard wood.
- d) "Azo groups are weak donar, but a large number of metal complexes having arylazoligand are known". Justify the statement with the suitable example.

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

- a) What do you understand by N_{α} - N_{β} isomerisms in metal complexes of tridentate azo compounds? Explain with respect to Ni & Cu complexes.
- b) Explain the methods of alloy plating.
- c) Explain the production and properties of carbon fiber reinforced epoxy resin.
- d) Give in details production of portland cement.

P.T.O.

Q3) Write notes on (any two)

[10]

- a) Fixing agent in photography.
- b) Co-ordination compounds in electroplating.
- c) Yellow pigment.

SECTION-II

(Environmental Chemistry)

Q4) Attempt any three of the following.

[15]

- a) Discuss some of the advantage of physical- chemical treatment of sewage as opposed to biological waste.
- b) Name the instrumental method for the determination of metals such as Hg, Cd, As & Pb. Explain cold-vapour atomic absorption method for the determination of Hg from polluted water.
- c) Describe how nitrogen can be removed from the waste water by biological treatment.
- d)
 - i) The coliform bacteria count is used to test water for what type of contamination?
 - ii) Do coliform bacteria cause disease?
 - iii) How do you treat water that contains pathogens?

Q5) Attempt any three of the following.

[15]

- a) Determine pE for waste water that contain $5.0 \times 10^{-7} \text{M Cd}^{+2}$. Does this waste water favours oxidation or reduction? ($pE^{\circ} = -6.81$)
- b) Mercury (Hg^{+2}) has a $t_{1/2}$ of 6 days. If a person ingests 2 mg/day, calculate the steady-state concentration of mercury.
- c) Draw a schematic diagram of a polymer electrolyte membrane (PEM) fuel cell. Show overall reaction. Why is the PEM often referred to as a “proton exchange membrane fuel cell”?
- d) List five provisions of clean water act, which of these are considered the most important?

Q6) Write notes on (any two) [10]

- a) Energy from biomass.
- b) Biorefractory organic pollutant.
- c) Trace element in water.

SECTION-III

(Biotechnology)

Q7) Answer any three: [15]

- a) With the help of suitable examples explain the relationship between biotechnology, other branches of science and technology.
- b) What is renin? Describe an experiment to demonstrate the effect of different factors on the action of renin on milk.
- c) Write an account on food and beverage fermentation.
- d) Discuss the process of producing spirulina.
- e) How is cheese prepared? Explain different steps in cheese making.

Q8) Attempt any three: [15]

- a) Why are cells called as miniature factories?
- b) What are enzymes? Discuss the techniques for their immobilization.
- c) What is meant by biomass? Explain how biomass can be converted to energy.
- d) Explain the role of microbes in oil refineries.
- e) Explain the reactions involved in production of biohydrogen.

Q9) Write short notes on (any two) [10]

- a) Antibiotics.
- b) Biotechnology and food industry.
- c) Bacteria as a source of food.



Total No. of Questions : 6]

SEAT No. :

P2149

[4823]-58

[Total No. of Pages :4

M.Sc. II

ORGANIC CHEMISTRY

CH-450:Chemistry of Natural Products

(2008 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

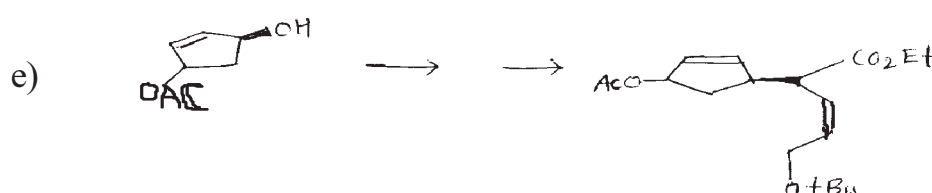
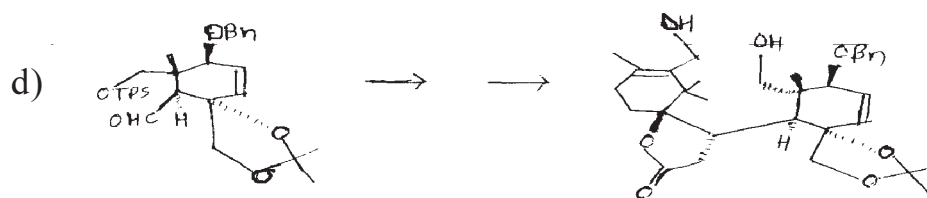
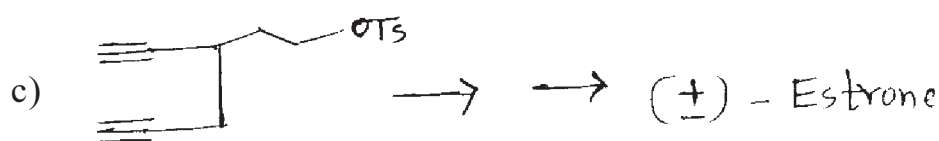
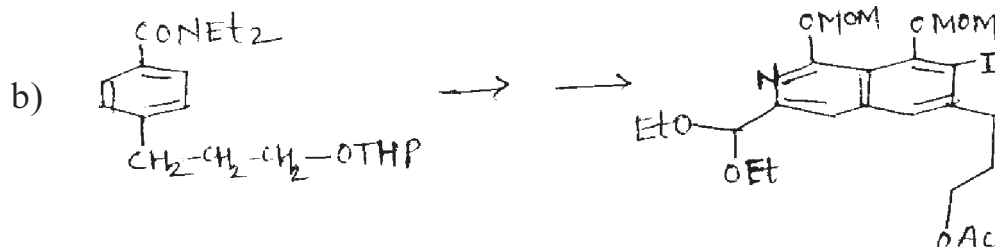
- 1) ALL questions are compulsory.
- 2) Figures to right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION-I

Q1) Outline the steps involved in the following synthetic sequence. Indicate the reagents and discuss the mechanism and stereochemistry involved. (Any four).

[16]

a) 6-methoxy tryptamine \rightarrow (\pm) Reserpine.



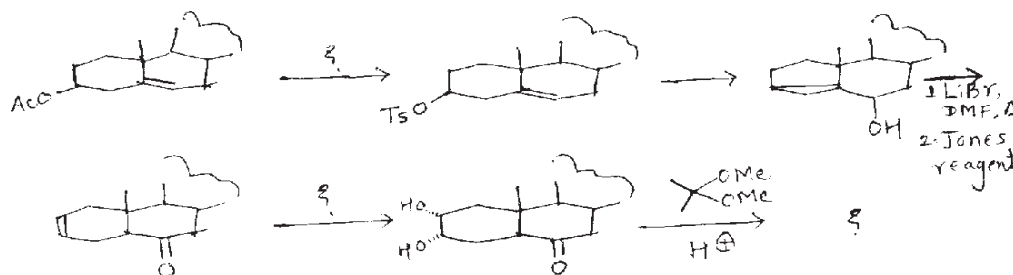
P.T.O.

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

- Give the proof for site of unsaturation in camptothecin.
- How the stereochemistry of ring fusion in hardwickiic acid is established?
- Podophyllotoxin and picropodophylline are stereoisomers. Justify.
- Discuss the utility of Shapiro reaction and Narasaka's boron template strategy in taxol synthesis.

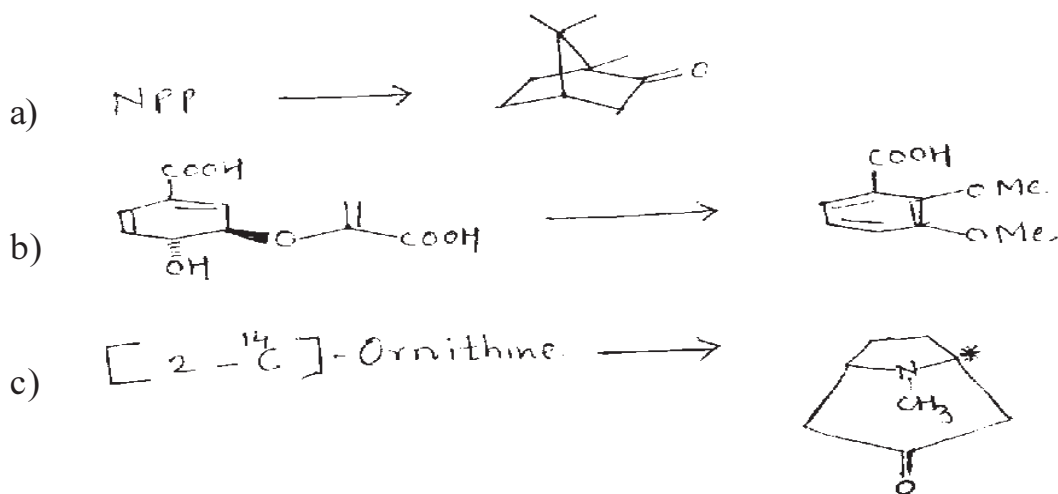
Q3) a) Answer any two of the following: [6]

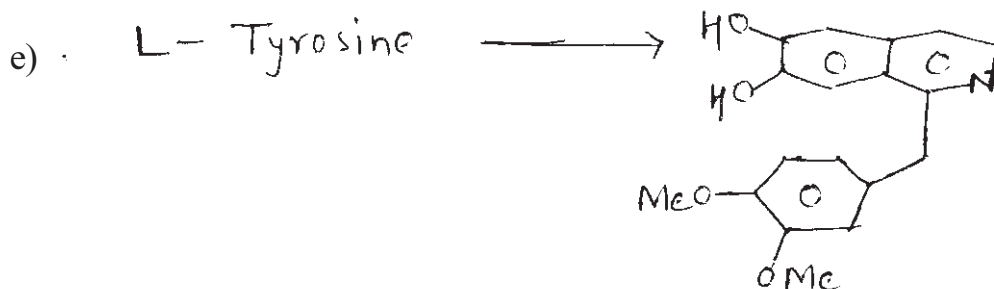
- What are the ways to establish the presence of Ketone, conjugated carboxylic acid and methoxy group in natural products?
 - How will you distinguish between the -OH group from ring B and ring D by chemical and physical methods in podophyllotoxin.
 - Explain the use of pyridine bromide perbromide in the synthesis of mifepristone from Estrone.
- b) Complete the following synthetic sequence using appropriate reagents and intermediates. [6]



SECTION-II

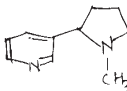
Q4) Suggest biogenetic scheme for any four of the following. [16]





Q5) Answer any two of the following.

[12]

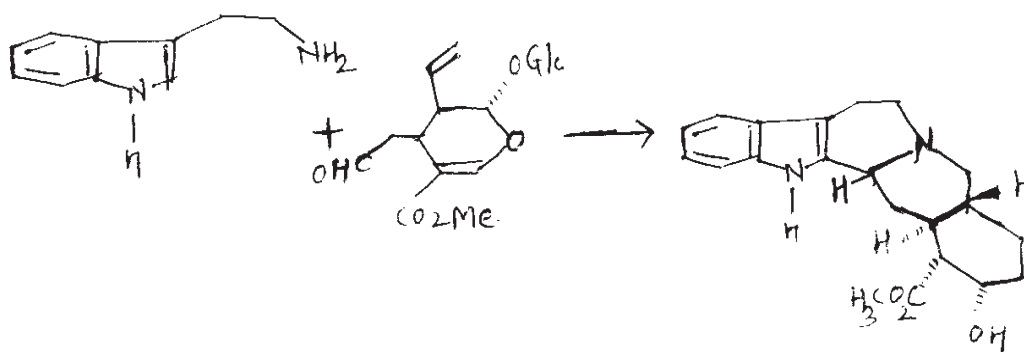
- Outline the steps involved in the conversion of FPP \rightarrow Cholesterol.
- Discuss the biogenesis of  from L-Tryptophan.
- Outline the steps with label in the following transformation.



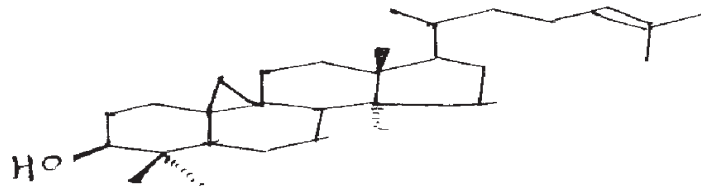
Q6) a) Answer any one of the following.

[6]

- Write all steps in the following conversion.



- ii) Outline the steps in the biogenesis of cycloartenol from Farnesyl pyrophosphate



Cycloartenol

- b) Indicate the position of label in each step and in the final product from the following biogenetic conversion. [6]



Total No. of Questions : 6]

SEAT No. :

P2150

[4823]-59

[Total No. of Pages :4

M.Sc.II

ORGANIC CHEMISTRY

CH-451:Synthetic methods in Organic Chemistry
(2008 Pattern)) (Semester-IV)

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

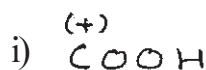
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION-I

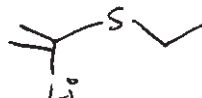
Q1) Explain any four of the following:

[12]

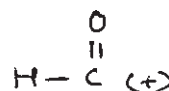
- a) Modified wittig reaction with suitable examples.
- b) Heck arylation reaction.
- c) Use of catechol borane in organic synthesis.
- d) Linear and convergent synthesis.
- e) The use of following synthons in organic synthesis.



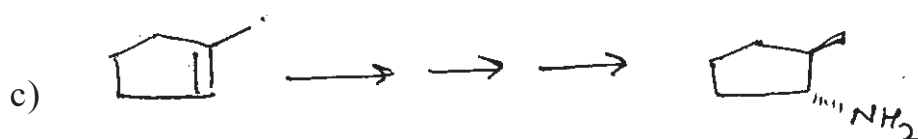
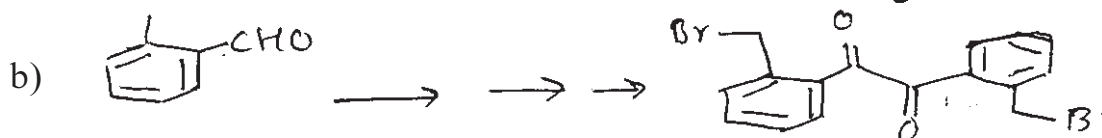
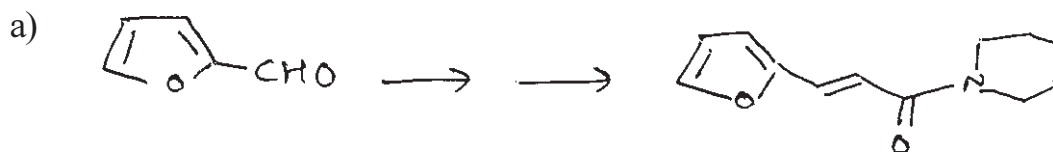
ii) b)



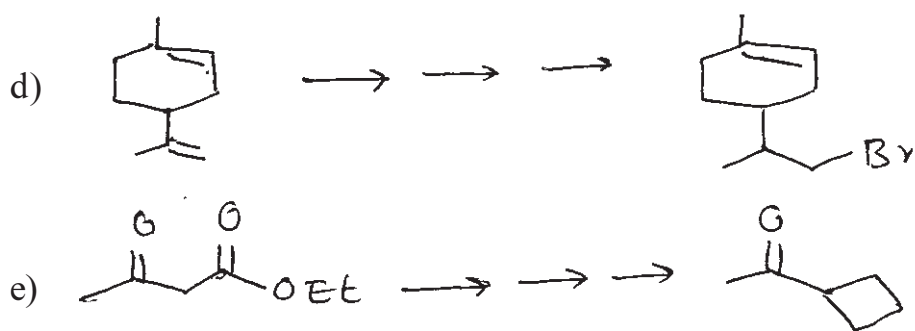
iii) c)



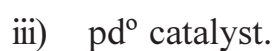
Q2) Complete any four of the following transformation and justify your answer.[12]



P.T.O.



Q3) a) Discuss the use of any two of the following reagents. [4]



b) Explain any four of the following. [12]

i) Pauson-khanel reaction with suitable example.

ii) Wacker process.

iii) Use of allylborane in asymmetric synthesis.

iv) Collmans reagent in organic synthesis.

v) Protection and deprotection of hydroxyl group.

SECTION-II

Q4) Write short notes on any four of the following. [12]

a) Stille reaction.

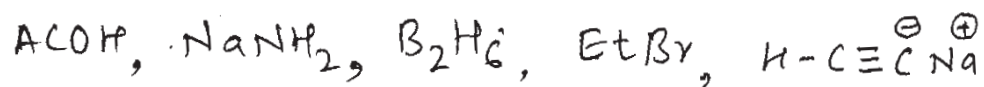
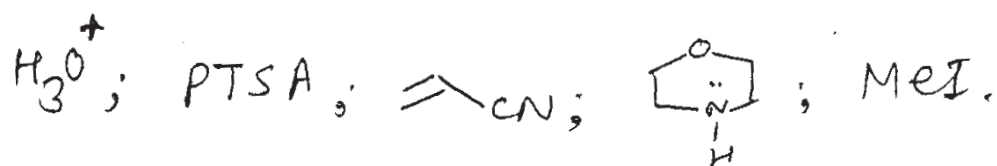
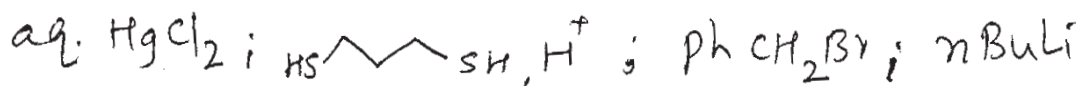
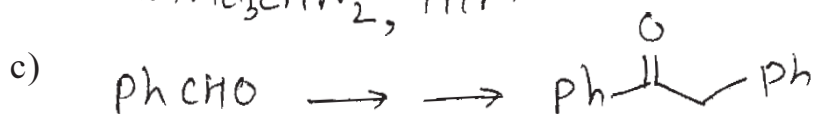
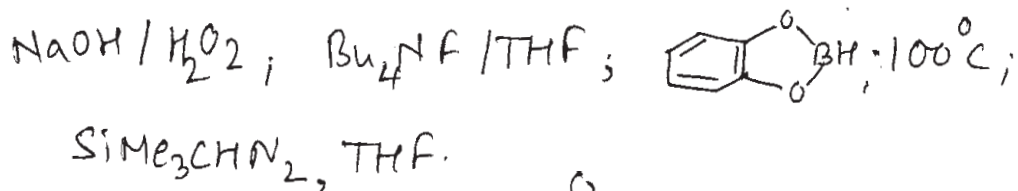
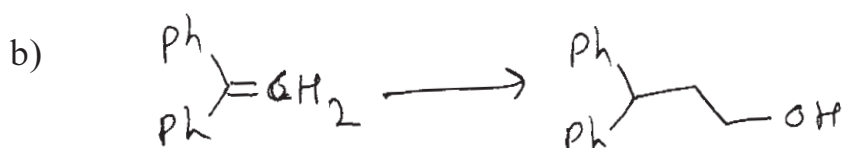
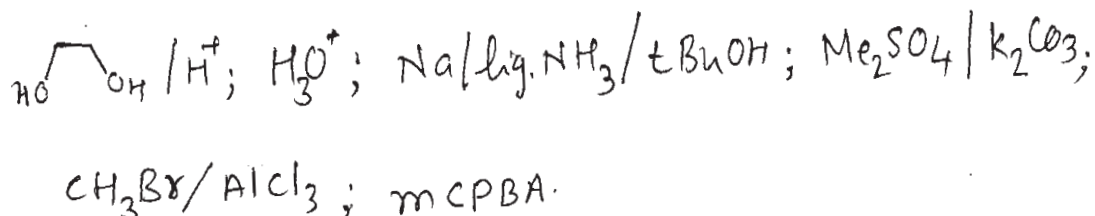
b) Grubb's catalyst.

c) Solid phase peptide synthesis.

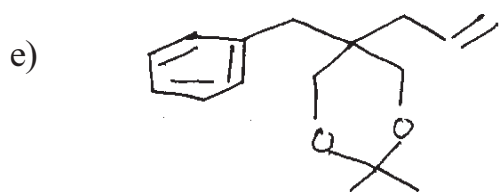
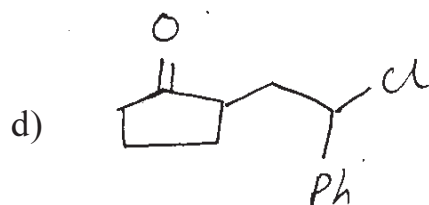
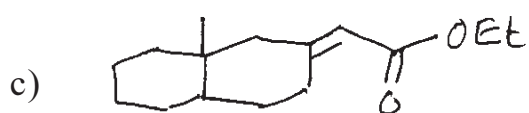
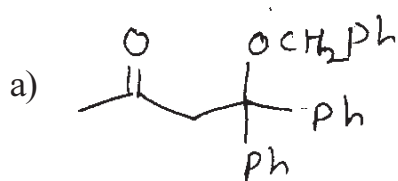
d) Organo stannane in organic synthesis.

e) Use of allylsilane in preparation of chiral alcohols.

Q5) Write the reagents and conditions in proper order to achieve the following conversions. Write the structures of the intermediates. (any four). [12]



Q6) Using retrosynthetic analysis, suggest a suitable method for the synthesis of any four of the following compounds. [16]



Total No. of Questions : 6]

SEAT No. :

P2151

[4823]-60

[Total No. of Pages :3

M.Sc.-II

ORGANIC CHEMISTRY

**CH-452:Heterocyclic Chemistry Chiron Approach and Medicinal Chemistry
(2008 Pattern) (Semester-IV)**

Time : 3 Hours]

[Max. Marks :80

Instructions to the candidates:

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

SECTION-I

Q1) Explain any four of the following:

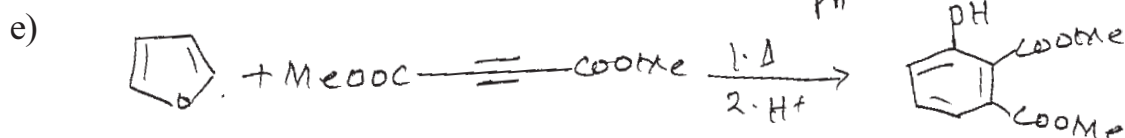
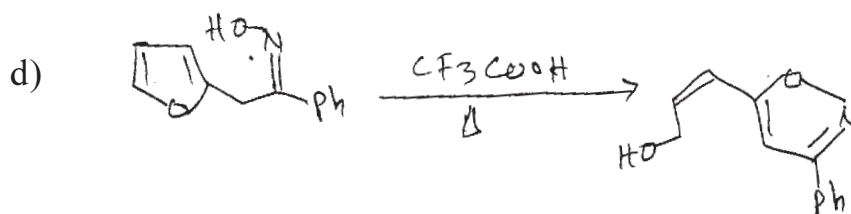
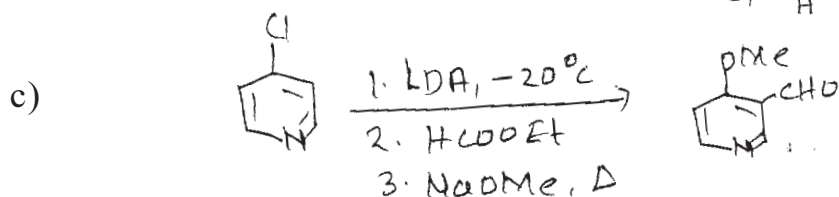
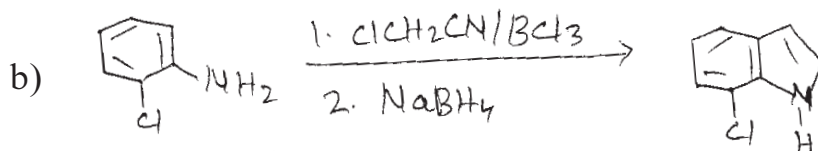
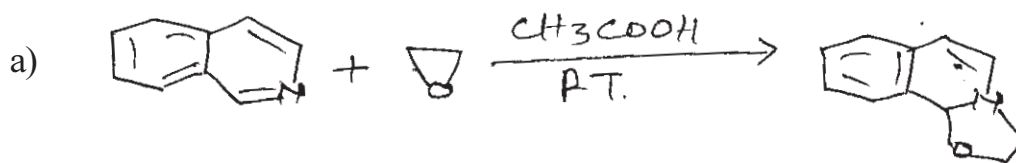
[12]

- a) Pyridine N-oxide readily undergoes electrophilic substitution at the 4-position.
- b) Indole on reaction with chloroform in alkali gives 3-chloroquinoline as one of the product.
- c) Pyrimidine is resistant to electrophilic substitution as compared to imidazole.
- d) Furan can be obtained from xylose (pentosans).
- e) The Bischler Napieralski synthesis works well if electron donating groups are present on the ring.

P.T.O.

Q2) Suggest the suitable mechanism for any four of the following.

[12]



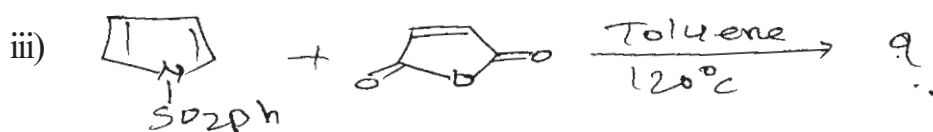
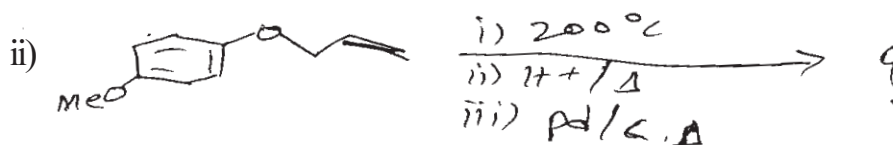
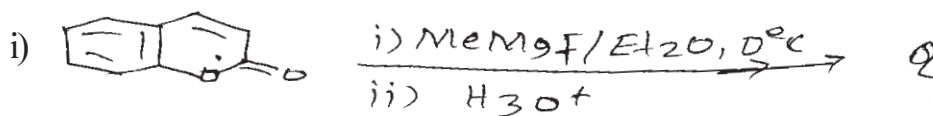
Q3) a) Write short notes on any three of the following:

[9]

- i) Hinsberg thiophene synthesis.
- ii) Skraup Quinoline synthesis.
- iii) Paat-knorr synthesis.
- iv) Biosynthesis of purines.

b) Predict the products with mechanism (any two)

[7]



SECTION-II

- Q4)** a) Explain anomeric effect with suitable example. [4]
b) Write a scheme for conversion of aldotetrose to aldopentose sugar. [4]
c) Write $1C_4$ and $4C_1$ conformation of D- mannose and L-mannose. [4]
d) Write note on Ruff degradation with suitable example. [4]

- Q5)** a) Outline synthesis of (R)-epichlorohydrin. [4]
b) Write retrosynthetic analysis of (-) shikimic acid. [4]
c) Give synthesis of (-) multistriatin. [4]

- Q6)** a) Calculate the % atom economy for following reaction. [2]



- b) Discuss the basic principles of green chemistry. [2]
c) Answer the following.(any two): [8]
i) Discuss ADME of the drug action.
ii) Give theoretical aspects of drug designing. with suitable example.
iii) Give an account of historical developments in drug designing.



Total No. of Questions : 4]

SEAT No. :

P2152

[4823]-61

[Total No. of Pages :2

M.Sc. II

ANALYTICAL CHEMISTRY

CH-481:Bioanalytical and Forensic Science

(2008 Pattern) (Semester-IV)

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 table/Non-programmable calculator is allowed.*

SECTION-I

Q1) Attempt any four of the following:

[20]

- a) How is theobromine estimated from cocoa?
- b) Outline the procedure for estimation of peroxide value.
- c) Write note on 'Sweetening tablet'
- d) Give the analytical method for determination of potassium from Jam.
- e) How HMF content from honey is estimated? Calculate HMF content- of sample of honey (100g), if absorbance of unit path length was 0.184.

Q2) Attempt any four of the following:

[20]

- a) Discuss the chemistry of vitamin A with respect to structure, source and principle of estimation.
- b) Describe Lowry's method for estimation of proteins from food sample.
- c) What are 'micronutrient's? Explain with suitable examples.
- d) What are legislation regarding the use of colours in food.
- e) The chicory content was estimated in sample of coffee. The percentage of water extract obtained from sample was 35.7%. If the average value for percentage of water extract of chicory is 64.8 and pure coffee is 22.1% respectively. Calculate the percentage of chicory in sample.

P.T.O.

SECTION-II

Q3) Attempt any four of the following:

[20]

- a) Define the terms.
 - i) Opium
 - ii) Addict
 - iii) Dutiable goods
 - iv) Alcohol.
- b) Explain the rules under narcotic and psychotropic substances related to cultivation of opium poppy and production of opium poppy straw.
- c) Write note on “Bonded manufactory”.
- d) Explain building arrangement required for bonded laboratory.
- e) Describe arrangement for storage of finished products.

Q4) Attempt any four of the following:

[20]

- a) Explain type B procedure for isolation and determination of barbiturates from urine.
- b) Explain type C procedure for isolation and determination of amphetamine from urine.
- c) State principle of determination of caffeine. Discuss its procedure in detail.
- d) Urine sample containing amphetamine was analysed by gas chromatographic method. It gave following observations.
 - i) Concentration of known amphetamine = 4.3 ug/ml.
 - ii) Peak area of drug sample = 7.3 min.
 - iii) Peak area of internal standard = 5.4 min.
 - iv) Peak area of known drug sample = 4.5 min.
 - v) Peak area of internal standard in amphetamine solution = 8.4 min.Calculate concentration of amphetamine in given solution.
- e) Discuss detail procedure for adsorption and elution of heroin from urine sample.



Total No. of Questions : 4]

SEAT No. :

P2153

[4823]-62

[Total No. of Pages :2

M.Sc. – II

ANALYTICAL CHEMISTRY
CH-490:Analytical Spectroscopy
(2008 Pattern) (Semester-IV)

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 table/Non-programmable calculator is allowed.*

SECTION-I

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

- a) State and explain the limiting law in absorption spectroscopy. Explain its instrumental cause for deviation from limiting law.
- b) What are filters? Distinguish between absorptive and interference filter. Give its limitations.
- c) Explain the origin of chemical shift in ESCA lines. Describe the use of chemical shift in quantitative analysis.
- d) Calculate the molar absorptivity of complex formed between bismuth (III) and thiourea having 4.5×10^{-5} M solution of complex, gave transmittance 78.3%. in a cell of 1.00 cm at 465 nm.
- e) The certain electron has binding energy of 1072 eV. Estimate the work function of spectrometer, if the incident radiation of Mg, K_{α} ($\lambda = 9.88 \text{ \AA}$) and the kinetic energy of measured electron is 176.7 eV.

[Given: Planck's constant = 6.625×10^{-34} Js, velocity of light = 3×10^8 m/s]

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

- a) State and explain the principle of ultraviolet photoelectron spectroscopy. Why is uv photoelectron spectroscopy not used to study core shell electron?
- b) Explain the principle of X-ray fluorescence. Describe the wavelength dispersive X-ray fluorometer with schematic diagram.

P.T.O.

- c) What is x-ray diffraction? Explain X-ray diffraction powder camera for qualitative analysis.
- d) What is chemiluminescence? Explain the use of gas phase chemiluminescence in analysis.
- e) The accelerating potential in an X-ray tube was 35.0 kV. Calculate the short wavelength cutoff of the lamp.
[Given: plancks constant= 6.625×10^{-34} Js, velocity of light = 3×10^8 m/s, charge of electron = 1.602×10^{-19} C]

SECTION-II

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

- a) Explain the concept of 2-D NMR spectroscopy.
- b) Define the term 'chemical shift'. Explain the two ways to express the chemical shift.
- c) Write a note on NMR spectroscopy of ^{31}P and ^{19}F in the field of biochemistry.
- d) Predict the splitting pattern and ratio of the peaks area in each multiplet as well as between the multiplets in the PMR spectrum of $\text{CH}_3\text{COOCH}_2\text{CH}_3$.
- e) Calculate magnetic field required to observe the NMR frequency for ^{19}F at 60 MHz.
[Given: $g_N = 5.257$ and $\beta_N = 5.05 \times 10^{-27} \text{ JT}^{-1}$]

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

- a) Discuss the principle of electron microscopy. Give it's important applications.
- b) Explain the terms: fine splitting, hyperfine splitting and super hyperfine splitting in ESR spectroscopy.
- c) Distinguish between NMR and ESR spectroscopy with reference to principle, sources, reference compounds, applied magnetic fields and detectors.
- d) Explain the following terms:
 - i) ELDOR
 - ii) ENDOR.
- e) Calculate the ratio of free electrons in the upper energetic level relative to the lower level at -27°C in the magnetic field with flux density of 1.49 T.
[Given: $g = 2.015$, Bohr magneton= $9.273 \times 10^{-24} \text{ JT}^{-1}$].



Total No. of Questions : 4]

SEAT No. :

P2154

[4823]-63

[Total No. of Pages :3

M.Sc.-II

ANALYTICAL CHEMISTRY

CH-491:Polymer Technology

(Old Course) (Semester-IV) (2008 Pattern)

Time : 3 Hours]

[Max. 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.*

SECTION-I

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

- a) Distinguish between thermoplastic and thermosetting polymers.
- b) Write a note on 'emulsion polymerisation'.
- c) Explain mechanism of 'anionic polymerisation'.
- d) Give method of preparation and uses of
 - i) PVC
 - ii) Teflon.
- e) Explain role of plasticizers and uv stabilizers used in polymer processing.

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

- a) Write a note on "vulcanisation and curing.
- b) Explain kinetics of co-polymerisation.
- c) What are inhibitors? Explain in detail.
- d) Give reasons for the following:
 - i) Molecular weight of polymer is always expressed as an average molecular weight.
 - ii) Anionic polymerisation is also called as living polymerisation.

P.T.O.

- e) 0.650 gm CTPB sample was dissolved in a mixture of ethyl alcohol and toluene and solution was titrated with 0.1012 N alcoholic potassium-hydroxide solution, the titration reading was 6.8 ml. Calculate the number-average molecular weight (\overline{mn}) of a polymer.

Given; Functionality of CTBP is 2.

Q4) Attempt any four of the following:

[20]

- a) Write in brief about the following
- i) Silicon elastomers.
 - ii) Silicon resins.
- b) Describe the cryoscopic method for molecular weight determination of a given polymer sample.
- c) Explain the term reinforcing. Give an account of "Hand lay-up technique.
- d) Explain the term sol-gel and gelation. Give a brief account of aqueous chemistry of metal oxide.
- e) Determine the percentage elongation of 10.00 cm polystyrene sample that increases in length to 10.4 cm when subjected to tensile stress.

