

Total No. of Questions :6]

SEAT No. :

**P2863**

**[5023]-101**

[Total No. of Pages : 3

**M.Sc.**

**PHYSICAL CHEMISTRY**

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

**(2013 Pattern) (Semester - I)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

- 1) *Answers to the TWO sections should be written in SEPARATE answer books.*
- 2) *ALL questions are COMPULSORY.*
- 3) *Figures to the RIGHT SIDE indicate FULL marks.*
- 4) *Use of logarithmic table/calculator is ALLOWED.*
- 5) *Neat diagrams must be drawn WHEREVER necessary.*

**Physico - Chemical Constants**

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

**P.T.O.**

## SECTION - I

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

- a) State the corollary of the third law of thermodynamics. Why is entropy called the arrow of time?
- b) Explain the inadequacy of the first law of thermo dynamics. State an application of the zeroth law.
- c) State and explain the Gibbs Duhem equation.
- d) Differentiate between Exact and Inexact differentials.
- e) Explain black-body radiation.

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

- a) Discuss the experimental evidence of the Heisenberg's lincertainy principle.
- b) Write a note on vant Hoff factor.
- c) Deduce the Clausius - Clapeyron equation.
- d) Explain the principle of steam distillation.

**Q3)** Solve any one of the following **[5]**

- a) Calculate the change in entropy when 6 g of  $N_2$  are mixed with (5 g  $O_2$  at  $20^\circ C$  [At. wts.  $N = 14$   $O = 16$ ].
- b) Evaluate the energy of an electron in a molecule of 528 pm length in the first energy level.

## SECTION - II

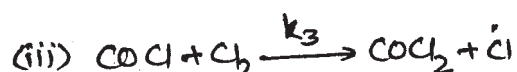
**Q4)** Attempt the following: **[10]**

- a) Calculate the half life of a second order relation for  $k = 1M^{-1} s^{-1}$  and initial concentrations 1m mol.

- b) What is steady state approximation? What are the conditions under which it can be applied?
- c) How order of a reaction be determined using differential rate laws?
- d) What is stirling approximation?
- e) How does steric factor (P) is related to entropy of activation?

**Q5) Attempt any two of the following: [10]**

- a) 'For an unimolecular gas phase reaction, its order depends on the concentration of reactant'. Support this statement using unimolecular theory for unimolecular reactions.
- b) The formation of phosgene for the reaction  $\text{CO} + \text{Cl}_2 \rightarrow \text{COCl}_2$  appears to follow following mechanism.



assuming the intermediates in steady state, find the rate law for formation of phosgene.

- c) What are consecutive reactions? Show that for such reactions the rate of formation of product depends on rate of formation of intermediate.

**Q6) Solve any one of the following [5]**

- a) Calculate rotational partition function of hydrogen molecule at 300K, moment of inertia for  $\text{H}_2$  is  $0.459 \times 10^{-40} \text{ g.cm}^2$ . [ $\sigma = 2$  for  $\text{H}_2$  molecule)
- b) Calculate  $\Delta H^*$ ,  $\Delta G^*$ , and  $\Delta S^*$  for the reaction



Given  $A = 2 \times 10^9 \text{ s}^{-1}$  and  $E_a = 111 \text{ KJ/mole}$ .



Total No. of Questions : 6]

SEAT No. :

**P2864**

**[5023]-102**

[Total No. of Pages : 4

**M.Sc. - I**

**INORGANIC CHEMISTRY**

**CHI - 130 : Molecular Symmetry and Chemistry of p-block Elements  
(Old-5 Credit System) (2013 Pattern) (Semester - I)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following:

**[10]**

- a) Define proper axis of rotation and find the principal axis in  $\text{PCl}_5$  molecule.
- b) Find improper axis of rotation in the following molecules.
  - i) Methane
  - ii)  $\text{BH}_3$
- c) List out the symmetry elements of molecule and classify it into appropriate point group.



- d) Find whether following operations are belonging to abelian or non abelian group :  $\sigma_{xz}$  and  $C_2^z$  in  $\text{H}_2\text{S}$  molecule.
- e) Find the order of group and number of classes in  $\text{Ni}(\text{CO})_4$  molecule.

**P.T.O.**

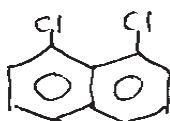
**Q2)** Attempt any two of the following:

[10]

- Prove that  $S_n^n = E$  using suitable example.
- Derive the character table for trans dichloroethylene molecule.
- Label the following irreducible representations with appropriate Mulliken symbols and justify.

$D_{3h}$	E	$2C_3$	$3C_2$	$\sigma_h$	$2S_3$	$3\sigma_v$
$T_1$	1	1	1	1	1	1
$T_2$	1	1	-1	1	1	-1
$T_3$	2	-1	0	2	-1	0
$T_4$	1	1	1	-1	-1	-1
$T_5$	1	1	-1	-1	-1	1

- Explain all symmetry elements and classify it into appropriate point group for



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

[5]

- Find irreducible representations of vibrational modes in  $SO_3$  molecule. (Given Character Table)
- Find out normalized SALC using projection operator  $A_2$  operates on  $\phi_1$  orbital of  $NO_2^-$  ion

$C_{2v}$	E	$C_2^z$	$\sigma_v^{xz}$	$\sigma_v^{yz}$
$A_2$	1	1	-1	-1

## SECTION - II

**Q4)** Answer the following: **[10]**

- a) What are electron deficient hydrides? Explain with example.
- b) Alkali metals in liquid ammonia acts as a good reducing agent. Explain.
- c) Give synthesis of higher boranes from boranes.
- d) What are allotropes of carbon? Draw the structure of diamond.
- e) What are pseudohalogens? Give two examples.

**Q5)** Attempt any two of the following: **[10]**

- a) Write a note on phosphorous nitrogen compounds.
- b) Give an account of alumino - silicates.
- c) Write a note on - Fullerenes.
- d) Write a note on - Oxoanions of sulphur.

**Q6)** Attempt any one of the following: **[5]**

- a) Explain the structure and bonding in -
  - i)  $\text{H}_2\text{O}$
  - ii)  $\text{P}_4\text{O}_{10}$
- b) Draw the structures of following:
  - i)  $\text{IF}_7$
  - ii)  $\text{B}_3\text{N}_3\text{H}_6$
  - iii)  $\text{S}_2\text{N}_2$
  - iv)  $\text{B}_4\text{H}_{10}$
  - v)  $\text{Si}_3\text{O}_9^{-6}$

Given: character table for  $D_{3h}$  point group

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



Total No. of Questions :6]

SEAT No. :

**P2865**

**[5023]-103**

[Total No. of Pages : 5

**M.Sc. - I**

**ORGANIC CHEMISTRY**

**CHO - 150 : Organic Reaction Mechanism & Stereochemistry  
(2013 Pattern) (5 Credits) (Semester - I)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1) Attempt any three of the following: [9]**

- a) Cyclooctatriene is non - aromatic. Explain.
- b)  $\text{Et-S-CH}_2\text{-CH}_2\text{-Cl}$  undergoes hydrolysis  $10^7$  times faster than  $\text{EtO-CH}_2\text{-CH}_2\text{-Cl}$ . Explain.
- c) Pyrrole exhibits acidic character, whereas pyridine shows basic character. Explain.
- d) Cis 2-amine cyclohexanol as reaction with nitrous acid give only a single product, while trans isomer gives two products. Explain.

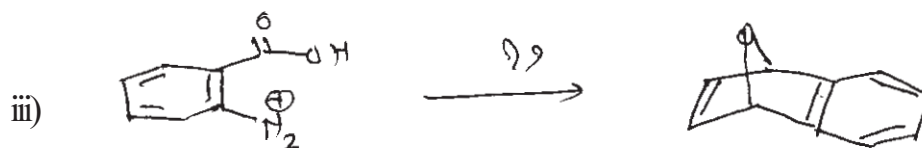
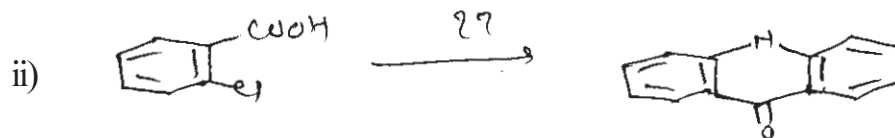
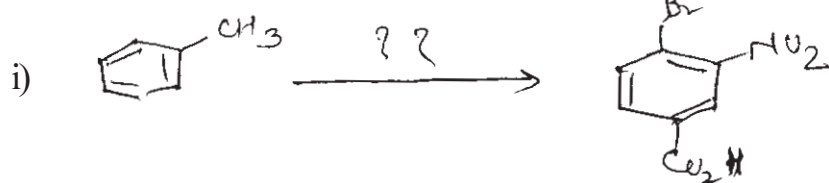
**Q2) a) Write short note on (Any two) [4]**

- i) Benzyne intermediate.
- ii) Non - Classical Carbocation.
- iii) Ipso Substitution reaction.

***P.T.O.***

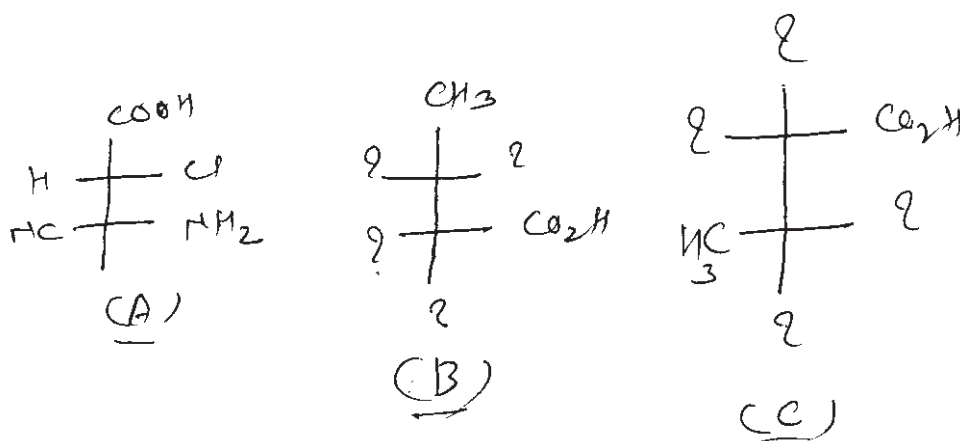


b) Write reagents for following conversions (Any Two) [4]

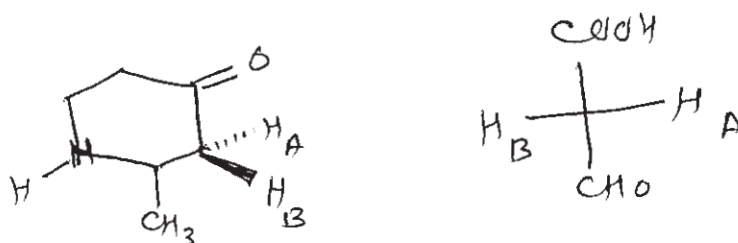


Q3) Attempt any four of the following: [8]

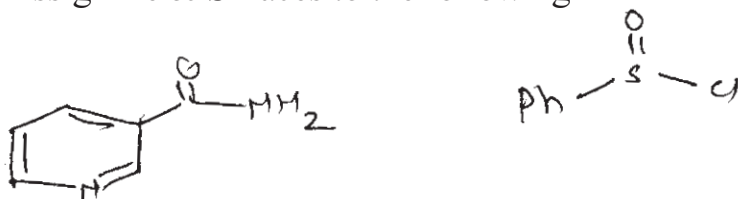
a) Write the equivalent structures B & C of the compound 'A'.



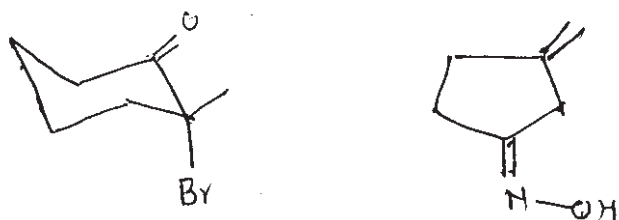
b) Assign Pro-R and Pro-S labels to  $H_A$  &  $H_B$



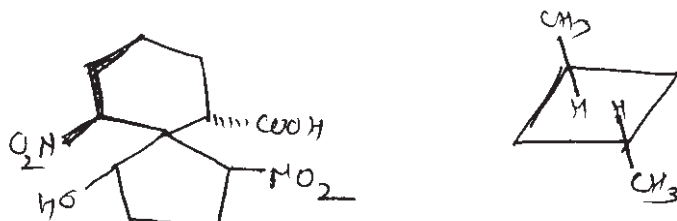
c) Assign Re & Si faces to the following



d) Assign R/S and E/Z configuration to the following.



e) Write the optical activity of the following.

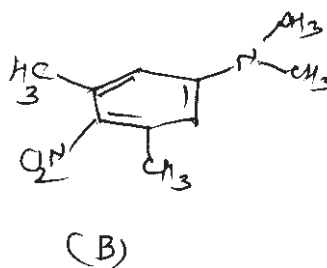
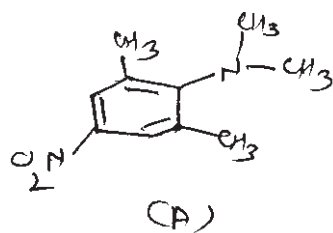


## SECTION - II

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

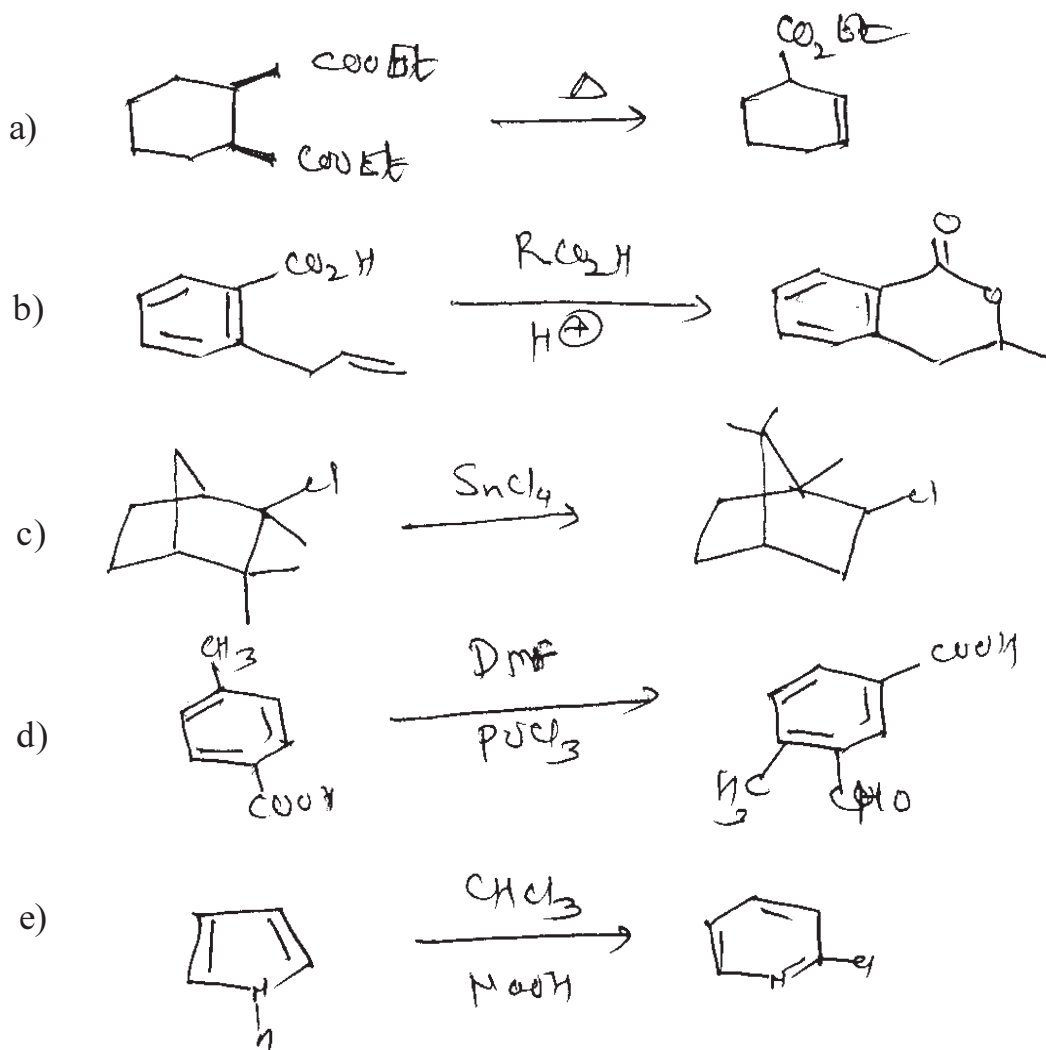
[9]

- Vinyl chloride resists hydrolysis, while allyl chloride is readily hydrolysed by  $S_N1$  mechanism.
- Explain E<sub>c</sub>b mechanism with suitable example.
- Nucleophilicity of Iodine, bromine & chlorine is in the order of  $I^- > Br^- > Cl^-$  in protic solvent, whereas the situation is reversed in an aprotic solvent. Why?
- Which of the following bases is strong? Why?



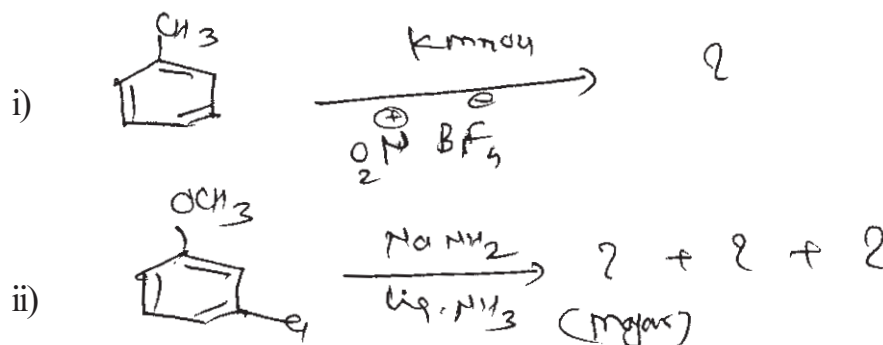
Q5) Suggest mechanism for the following (Any Four)

[8]



Q6) a) Predict the product/s

[4]



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

i) Write short note on Hoffmann elimination reaction.

ii) Explain  $S_N^i$  reaction with example.

iii) The compound (A) does not undergoes elimination reaction. Explain.



Total No. of Questions : 6]

SEAT No. :

**P2866**

**[5023]-104**

[Total No. of Pages : 2

**M.Sc. - I**

**CHEMISTRY**

**CHA - 190 : Safety in Chemical Laboratory & Good Laboratory Practices  
(Credit System) (2013 Pattern) (Semester - I) (5 Credits)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

- 1) Answer to the two sections should be written in separate answer books.*
- 2) All questions are compulsory.*
- 3) Neat diagrams must be drawn wherever necessary.*

**SECTION - I**

**Q1)** Attempt the following:

**[10]**

- a) Define chemical safety. What are precautions laid down at workplace?
- b) Explain in brief : chemical spill.
- c) Explain in short; " Physical & Chemical Hazards".
- d) Give significance of first aid kit in chemical laboratory.
- e) What are the different types of gloves? State their uses.

**Q2)** Answer any two of the following:

**[10]**

- a) Explain in detail safety showers & fire drill.
- b) Write a note on inventory management, storage & disposal methods.
- c) Give the classification of chemical waste.
- d) Give the importance full body suit in the chemical laboratory.

***P.T.O.***

**Q3)** Answer any one of the following [5]

- a) Write a note good - house keeping.
- b) What types of hazards are observed in the laboratory while handling of chemicals?

**SECTION - II**

**Q4)** Attempt the following: [10]

- a) Give the various types of fire classes & Give their significance.
- b) Distinguish between ISO & NABL.
- c) Define GLP for chemistry laboratory.
- d) Explain the principle of SOP.
- e) What are the abbreviations of NFPA & OSHA?

**Q5)** Answer any two of the following: [5]

- a) Explain the principle of any one of type of fire extinguisher.
- b) Distinguish between Do's & Dont's in laboratory.
- c) What is the importance of material safety data sheets.
- d) Explain any two methods of calibration of equipments.

**Q6)** Answer any one of the following [5]

- a) Explain the various types of materials used in laboratory for safety.
- b) Write a note on need for globally harmonized system for SDS.



Total No. of Questions : 6]

SEAT No :

P2867

[5023]-201

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

CHP-210 : Fundamentals of Physical Chemistry - II

(New) (Semester - II) (2013 Pattern)

Time : 3Hours]

[Max. Marks : 50

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

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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 = $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ = $1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
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	$\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

## SECTION -I

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

- a) Explain stokes and anti-stokes lines.
- b) State the rule of mutual exclusion.
- c) State the condition for Raman activity.
- d) State the expression for  $J_{\max}$ .
- e) Why is NMR principle used in MRI but called as MRI?

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

- a) Write a note on predissociation spectra.
- b) Find  $V_{\max}$  for  $x=0.0174$ .
- c) Explain the applications of esr spectra
- d) Discuss fortrait diagram.

**Q3)** Solve any one of the following: **[5]**

- a) The vibration frequency of the H-F molecule is  $4138\text{cm}^{-1}$ . Determine the force constant  
[At.wts. H=1 F=19]
- b) Determine the energy in  $\text{kJmol}^{-1}$  for a wavenumber of  $1\text{mm}^{-1}$

## SECTION -II

**Q4)** Attempt the following: **[10]**

- a) Give natural artificial preparation of  $^{14}\text{C}$  isotope.
- b) What are Weiss indices?
- c) Write down secular determinant for butadine and obtain its polynomial equation.
- d) Sketch the plane (111) in simple cubic cell.
- e) Define tracer and electrolyte diffusion processes.



**Q5)** Attempt any two of the following : **[10]**

- a) Discuss assumptions of Hückel molecular orbital theory.
- b) Explain the principle of isotope dilution technique. What are its applications.
- c) What is radio tracer technique? How it is used to determine surface area of a precipitate.
- d) Using Huckels molecular orbital theory obtain energy levels in cyclobutadiene.

**Q6)** Solve any one of the following : **[5]**

- a) What weight of Cu sample should be taken in mg for its activation analysis with a neutron flux of  $1 \times 10^8 \text{ n cm}^{-2} \text{ s}^{-1}$ , if the irradiation period is 6hrs and the desired activity after a cooling period of 3hrs is 80,000 dpm. [Given  $t_{1/2}$  for  $^{64}\text{Cu}$  is 12.7 hrs, % abundance is 69.17% and  $\lambda$  for the reaction is 4.5b]
- b) An element (At mass 60) having face centred cubic structure has a density of  $6.23 \text{ g cm}^{-3}$ , what is the edge length of the unit cell?



Total No. of Questions : 6]

SEAT No :

**P2868**

**[5023]-202**

[Total No. of Pages : 5

**M.Sc. -I**

**INORGANIC CHEMISTRY**

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

**(2013 Pattern) (Semester - II) ( 5 Credits)**

*Time : 3Hours]*

*[Max. Marks : 50*

*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)** Answer the following questions.

**[10]**

- a) Why aqueous solution of  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  is pink in colour while  $[\text{CoCl}_4]^{2-}$  is blue in colour.
- b) Give spin - only magnetic moment and the spectroscopic ground state term symbol of chromium ion in  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ .
- c) Explain :- Hole formalism.
- d) Give the full spectroscopic symbol for the following ions.
  - i)  $\text{Ni}^{2+}$  ( $Z = 28$ )
  - ii)  $\text{Pm}^{3+}$  ( $Z = 61$ )
- e) Calculate total degeneracy of the following states/ configurations.
  - i)  $3\ ^2T_{1g}$
  - ii)  $(t_2g)^4(eg)^2$

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

**[10]**

- a) Prepare a table of microstates and hence assign the allowed R-S terms for  $ns^1nd^1$  configuration.
- b) Write a note on 'charge transfer spectra'.
- c) Give the splitting of  $^6H$  R-S term in weak cubic field using character table for pure rotational point group and reduction formula.

**P.T.O.**

- d) For complex  $[\text{CoCl}_4]^{2-}$ ,  $\mu_{\text{eff}} = 4.87$  B.M. The  $\nu_1$  transition is observed at  $2940 \text{ cm}^{-1}$ . Calculate the spin orbit coupling constant for  $\text{Co}^{2+}$  ion in the complex.

**Q3)** Attempt any one of the following: [5]

- a) Determine the spin multiplicities of states arising from  $e_g^2$  configuration when infinitely strong octahedral field is relaxed to strong field using Bethe's method of descending symmetry correlation table and direct product table.
- b) The complex  $[\text{Ni}(\text{dMg})_6]^{2+}$ , shows three absorption bands at  $7580 \text{ cm}^{-1}$ ,  $12740 \text{ cm}^{-1}$  and  $23810 \text{ cm}^{-1}$ . Calculate the crystal field splitting parameter  $Dq$  and nephelauxetic parameters  $B$  &  $\beta$ . Comment on nature of M-L bond. (Given :  $B_0 = 1030 \text{ cm}^{-1}$ )

### SECTION -II

**Q4)** Answer the following: [10]

- a) Explain the role of calcium in biological system.
- b) Draw the structure of DNA and explain in brief.
- c) Trans - platin is not used as antitumor drug. Explain.
- d) What are metalloproteins? Give their any two important functions.
- e) Explain the structure of calmodulin.

**Q5)** Attempt Any two of the following : [10]

- a) Write a note on Na/K pump.
- b) Explain transferrin compounds.
- c) Explain role of Manganese in photosynthesis.
- d) Write a note on Zinc finger.

**Q6)** Draw structures (Any five): [5]

- a) Oxyhemoglobin
- b) Thymine
- c)  $\text{Fe}_3\text{S}_4$
- d) Porphyrin
- e) Cytosine
- f) Vit.  $\text{B}_{12}$

### Character Table for O rotational group

O	E	6C <sub>2</sub>	3C <sub>2</sub> (=C <sub>4</sub> <sup>2</sup> )	8C <sub>3</sub>	6C <sub>2</sub>	
A <sub>1</sub>	1	1	1	1	1	(R <sub>x</sub> , R <sub>y</sub> , R <sub>z</sub> ); (x, y, z)
A <sub>2</sub>	1	-1	1	1	-1	
E	2	0	2	-1	0	
T <sub>1</sub>	3	1	-1	0	-1	
T <sub>2</sub>	3	-1	-1	0	1	

$x^2 + y^2 + z^2$

$(2x^2 - x^2 - y^2)$

$x^2 - y^2$

$(xy, xz, yz)$

### Correlation Table for the Group O<sub>h</sub>

O <sub>h</sub>	O	T <sub>d</sub>	D <sub>4h</sub>	D <sub>2h</sub>	C <sub>4v</sub>	C <sub>2v</sub>	D <sub>2d</sub>	D <sub>2</sub>	C <sub>2h</sub>
A <sub>1g</sub>	A <sub>1</sub>	A <sub>1</sub>	A <sub>1g</sub>	A <sub>1</sub>	A <sub>1</sub>	A <sub>1</sub>	A <sub>1g</sub>	A <sub>1</sub>	A <sub>g</sub>
A <sub>2g</sub>	A <sub>2</sub>	A <sub>2</sub>	B <sub>1g</sub>	B <sub>1</sub>	B <sub>1</sub>	A <sub>2</sub>	A <sub>2g</sub>	A <sub>2</sub>	B <sub>g</sub>
E <sub>g</sub>	E	E	A <sub>1g</sub> +B <sub>1g</sub>	A <sub>1</sub> +B <sub>1</sub>	A <sub>1</sub> +B <sub>1</sub>	A <sub>1</sub> +A <sub>2</sub>	E <sub>g</sub>	E	A <sub>g</sub> +B <sub>g</sub>
T <sub>1g</sub>	T <sub>1</sub>	T <sub>1</sub>	A <sub>1g</sub> +E <sub>g</sub>	A <sub>1</sub> +E	A <sub>1</sub> +E	A <sub>1</sub> +A <sub>2</sub>	A <sub>1g</sub> +E <sub>g</sub>	A <sub>1</sub> +E	A <sub>g</sub> +2B <sub>g</sub>
T <sub>2g</sub>	T <sub>2</sub>	T	B <sub>1g</sub> +E <sub>g</sub>	B <sub>2</sub> +E	B <sub>2</sub> +E	A <sub>1</sub> +A <sub>2</sub>	A <sub>2g</sub> +E <sub>g</sub>	A <sub>2</sub> +E	2A <sub>g</sub> +B <sub>g</sub>
A <sub>1u</sub>	A <sub>1</sub>	A <sub>2</sub>	A <sub>1u</sub>	B <sub>1</sub>	A <sub>2</sub>	A <sub>2</sub>	A <sub>1u</sub>	A <sub>1</sub>	A <sub>u</sub>
A <sub>2u</sub>	A <sub>2</sub>	A <sub>1</sub>	B <sub>1u</sub>	A <sub>2</sub>	B <sub>2</sub>	A <sub>1</sub>	A <sub>2u</sub>	A <sub>2</sub>	B <sub>u</sub>
E <sub>u</sub>	E	E	A <sub>1u</sub> +B <sub>1u</sub>	A <sub>1</sub> +B <sub>1</sub>	A <sub>1</sub> +B <sub>2</sub>	A <sub>1</sub> +A <sub>2</sub>	E <sub>u</sub>	E	A <sub>u</sub> +B <sub>u</sub>
T <sub>1u</sub>	T <sub>1</sub>	T <sub>2</sub>	A <sub>1u</sub> +E <sub>u</sub>	B <sub>2</sub> +E	A <sub>1</sub> +E	A <sub>1</sub> +B <sub>1</sub> +B <sub>2</sub>	A <sub>1u</sub> +E <sub>u</sub>	A <sub>1</sub> +E	A <sub>u</sub> +2B <sub>u</sub>
T <sub>2u</sub>	T <sub>2</sub>	T <sub>1</sub>	B <sub>1u</sub> +E <sub>u</sub>	A <sub>2</sub> +E	B <sub>1</sub> +E	A <sub>1</sub> +B <sub>1</sub> +B <sub>2</sub>	A <sub>2u</sub> +E <sub>u</sub>	A <sub>2</sub> +E	2A <sub>u</sub> +B <sub>u</sub>

## 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  $D_{2d}$  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 :  $A \times E_1 = E_1$  irrespective of the suffix on A.

(b) For all groups except  $D_{4h}, D_{6h}, S_8$  :

$B \times E_1 = E_{21}, B \times E_2 = E_1$

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

(c) For  $D_{4d}$  :

$B \times E_1 = E_2, B \times E_2 = E_1, B \times E_3 = E_{21}, B \times E_4 = E_2, B \times E_5 = E_1$   
 irrespective of the suffix on B.

(d) For  $D_{6h}, S_8$  :

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

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  $O_h, O, T_d, D_{6h}, D_{2d}, C_{6h}, C_{3h}, C_{2v}, S_8, D_{3d}, D_{2d}, D_2, C_{2v}, C_{2h}, C_2$  :

$E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_{11}, E_1 \times E_2 = E_1 + E_2 + E_3$

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

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

(c) For  $D_{4d}$  :

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

$E_3 \times E_3 = E_4 \times E_4 = A_1 + A_2 + E_4$

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

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

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

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

(d)  $D_{32}, D_{31}, D_3, C_{32}, C_{21}, C_3$

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

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

(e) For  $D_{44}, S_4$ .

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

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

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

5. Products involving the T (or F) representations of  $O_4, O$  and  $T_4$

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

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

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

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

6. The complete results for  $O$  are:

O	$A_1$	$A_2$	E	$T_1$	$T_2$
$A_1$	$A_1$	$A_2$	B	$T_1$	$T_2$
$A_2$	$A_2$	$A_1$	B	$T_2$	$T_1$
E	E	E	$A_1 + A_2 + E$	$T_1 + T_2$	$T_1 + T_2$
$T_1$	$T_1$	$T_2$	$T_1 + T_2$	$A_1 + E + T_1 + T_2$	$A_2 + B + T_1 + T_2$
$T_2$	$T_2$	$T_1$	$T_1 + T_2$	$A_2 + B + T_1 + T_2$	$A_1 + E + T_1 + T_2$

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Total No. of Questions : 6]

SEAT No :

P2869

[5023]-203

[Total No. of Pages : 4

M.Sc - I

**ORGANIC CHEMISTRY**

**CHO-250 : Synthetic Organic Chemistry & Spectroscopy  
(2013 Pattern) (Semester - II) (5-Credit)**

*Time : 3Hours]*

*[Max. Marks : 50*

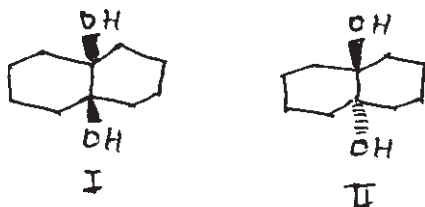
*Instructions to the candidates:*

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

**SECTION-I**

**Q1)** Answer any five of the following : **[10]**

- a) Hydroboration of 2 - pentene with  $B_2H_6/H_2O_2$ . NaOH followed by  $H_2CrO_4$  oxidative workup yields ketone at room temperature, whereas at  $160^\circ C$  an aldehyde is obtained.
- b) Reaction of organolithium reagents with carboxylic acid followed by hydrolysis gives ketone while reaction with Grignard reagent fails.
- c) Diol I reacts with  $Pb(OAc)_4/ACOH$  at  $20^\circ C$  100times faster than diol II.



- d) Comment on the migratory aptitude of p-chlorophenyl, phenyl and p-anisyl groups in Beckmann rearrangement.
- e) Nitrogen ylides are less stable than phosphorous ylides explain.
- f) Explain catalytic hydrogenation with suitable example.

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

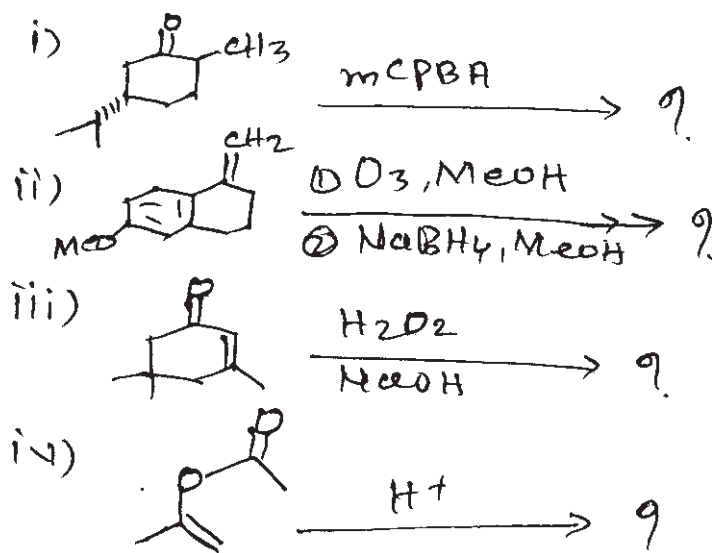
- a) Jones's reagent.
- b) Wolf rearrangement.
- c) Birch reduction.

**P.T.O.**

- d) Organo copper reagents in organic synthesis.
- e) Simmon Smith Reaction.
- f) Claisen rearrangement.

Q3) Predict the products and suggest the mechanism (Any Two).

[5]

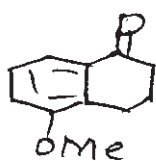


### SECTION -II

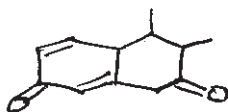
Q4) Attempt any five of the following:

[10]

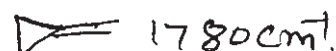
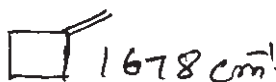
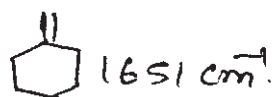
- a) Calculate the  $\lambda_{\text{max}}$  for the following compounds.



and

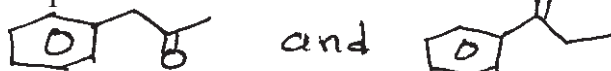


- b) Explain the double bond frequencies of following olefins.



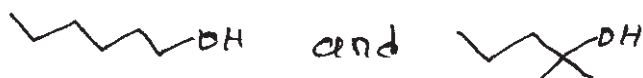
- c) Distinguish the following compound by PMR.

- d) Explain the  $\alpha$ -halo keto rule in FR.

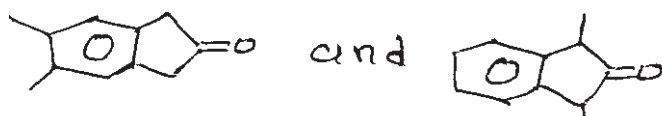




e) How will you differentiate the following compounds by MS.



f) Distinguish the following pair by CMR.



**Q5)** Deduce the structure of any five of the following compounds using spectral data and justify your answer: **[10]**

a) M.F :  $C_8H_8O_2$

U.V : 260nm

I.R : 2700-3300 Broad, 1700,1600,1500,920  $cm^{-1}$ .

PMR : 3.5 $\delta$  (s,12mm): 7.2 (s, 30mm); 12.3 (s,6mm)

b) MF :  $C_8H_8O_2$

IR : 1735, 1600, 1500  $cm^{-1}$

PMR :  $\delta$ 4.0 (s,3H); 7.3 (s,5H)

c) MF :  $C_6H_{10}O$

IR : 1700, 1620  $cm^{-1}$

PMR :  $\delta$ 1.90 (s,3H), 2.10 (s,6H), 6.0(s,1H)

d) MF :  $C_8H_7OCl$  IR : 1750, 1600, 1500  $cm^{-1}$

CMR : 26.0q, 128d, 129d,135s, 140s, 177s

Mass : 154/156 ( $M^+$ 3:1), 139/141, 111/113.

e) Two isomeric hydrocarbons A & B of  $C_5H_{10}$  shows the following  $^{13}C$  data. Deduce the structures from given data

Isomer A : 13(q), 17(q), 26(q), 118(d), 132(s) ppm.

Isomer B: 13(q), 22(q), 31(t), 108(t), 147(s) ppm.

f) M.F :  $C_5H_{11}Br$

U.V : transparent above 200nm.

IR : No significant peak

PMR: 1.02 (d, J = 6 Hz, 24 mm);

1.66 (m, 4 mm)

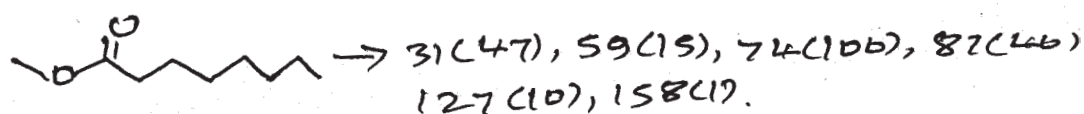
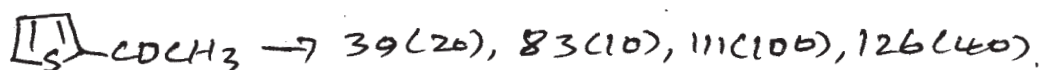
1.85 (q, 8 mm)

3.40 (t, J = 6 Hz, 8 mm)

Q6) Attempt any two of the following :

[5]

a) Give the genesis of the following compounds



b) Select the structure which is most consistent with the given spectroscopic data.



CMR : 27.5(q), 29.5(t), 32.3(s), 41.3(t), 46.6(d), 211.5(s).

c) Explain the term diamagnetic anisotropy with suitable example.

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Total No. of Questions : 3]

**P3778**

SEAT No. :

[Total No. of Pages : 12

**[5023]-204**

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

**Analytical Chemistry**

**CHA - 290 : General Chemistry - II**

- Part - A - Modern Separation methods and hyphenated techniques (2.5 credits / 25 marks)
- Part - B - Basic Biochemistry (5.0 Credits / 50 marks)
- Part - C - Concept of Analytical Chemistry (2.5 credits / 25 marks)
- Part - D - Industrial Methods of analysis (2.5 credits / 25 marks)
- Part - E - Organometallic and Inorganic Reaction mechanism (2.5 credits / 25 Marks)
- Part - F - Mathematics for chemists (2.5 credits / 25 marks)
- Part - G - Pericyclic, photochemistry and free radical reactions (2.5 credits / 25 marks)

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

- 1) All questions of respective section / part are compulsory.*
- 2) Figures to right hand side indicate fullmarks*
- 3) Neat labelled diagrams must be drawn wherever necessary.*
- 4) Use of log table / non-programmable calculator is allowed.*
- 5) Students should attempt any two parts from Part A,C,D,E,F and G or full paper of biochemistry (Part - B)*
- 6) Write the answers of two parts on separate answer books.*

**P.T.O.**

## PART - A

### **Modern Separation methods and hyphenated techniques**

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

- a) Enlist different types of stationary phases used in gas chromatography.
- b) What is metastable ion in MS.
- c) Give the principle of size exclusion chromatography
- d) Explain the process of photoionization and thermal ionization in Ms.
- e) What are the characteristics of an ideal detector in HPLC?

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

- a) Enlist different pressure pumps used in HPLC. Explain the working of any one in detail.
- b) Draw schematic diagram of mass spectrometer. Explain its working in detail.
- c) Compare the GC and HPLC with respect to the following points.
  - i) Principle
  - ii) Sample injection system
  - iii) Column
  - iv) Detector
  - v) Application
- d) Compare the normal phase and reverse phase chromatography.

Q3) Attempt any one of the following :

[5]

- a) The following data was obtained by gasliquid chromatography on a 40cm packed column.

Compound	$t_R$ (min)	W(min)
i) Air	1.8	-
ii) X	12.2	0.67
iii) Y	14.7	0.85
iv) Z	15.2	0.92

Calculate :

- i) An average number of plates
  - ii) The plate height
  - iii) The column resolution
- b) Give a detailed account of classification of different chromatographic techniques. What is the fundamental difference between adsorption and partition chromatography.



**PART - B**  
**Basic Biochemistry**

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer any three of the following : **[9]**

- a) Give a brief account of
  - i) Amino acid therapy
  - ii) Lysosomes
- b) Classify proteins
- c) Discuss reactions of proteins with :
  - i) Ninhydrin
  - ii) Formaldehyde
- d) What are the different types of fatty acids? Give examples.

**Q2)** Attempt any two of the following : **[8]**

- a) Give the structure, functions and composition of biomembrane
- b) What are homopolysaccharides? Explain the structure and functions of glycogen
- c) Describe the structure and function of Golgi apparatus and mitochondria.

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

- a) Comment on
  - i) Aromatic amino acids
  - ii) Sickle cell anaemia
- b) Discuss the reactions of TCA cycle.
- c) Write a short note on facilitated transport of ions through cell membrane.

## SECTION - II

**Q4)** Answer any three of the following : **[9]**

- a) What are double reciprocal plots? Explain their significance.
- b) What are the characteristics of genetic code?  
Give a brief account of wobble hypothesis
- c) Classify enzymes and give suitable examples
- d) Comment on
  - i) Lagging strand synthesis
  - ii) Gene expression

**Q5)** Attempt any two of the following : **[8]**

- a) Discuss the structure and chemical functions of fat soluble vitamins A,D,E,K,
- b) Write a short note on manufacture of medicinal compounds by enzymatic reactions.
- c) What diseases are caused due to nutritional deficiencies? Give examples.

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

- a) Define
  - i) Nucleosides
  - ii) Replication
  - iii) Genome
- b) What are the factors affecting enzyme activity? Describe the effect of substrate concentration on enzyme activity?
- c) Write a short note on genetic disorder.



**PART - C**  
**Concept of Analytical Chemistry**

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

- a) Differentiate between batch extraction and continuous extraction.
- b) Enlist applications of nano-materials
- c) What is a significant error? Give example.
- d) Define
  - i) Analytical sample
  - ii) Confidence limit
- e) Give the principle of ion-exchange chromatography

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

- a) Explain the terms
  - i) Instability constant
  - ii) Stepwise formation constant
  - iii) Limiting reactants
- b) Give a brief account on rejection of result in the 'Q-test'
- c) Describe the synthesis of nano materials by so-gel method.
- d) Describe the following
  - i) Separation by precipitation
  - ii) Separation by distillation

**Q3)** Attempt any one of the following : **[5]**

- a) Give a descriptive account of characterization of nanomaterials using XRD and SEM-EDAX.
- b) The following results were obtained in the replicate determination of the arsenic content in waste water samples : 0.552, 0.551, 0.550, 0.551, 0.554 ppm. Calculate the mean and standard deviation of this set of data.





**PART - D**  
**Industrial Methods of Analysis**

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

- a) How is common ion effect useful in qualitative analysis.
- b) Mention various bulk properties used in process analyzer.
- c) Explain the terms ppm and ppb.
- d) What is instability constant?
- e) Calculate number of millimoles present in 0.5g of NaCl. (Given : Atomic weight Na = 23 Cl = 35.5)

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

- a) Write a note on industrial process analyzer.
- b) What is a basic buffer? Explain its action with a suitable example.
- c) Explain different quality systems in chemical laboratory
- d) Define
  - i) Limiting reactants
  - ii) Gram mole
  - iii) Theoretical yield

**Q3)** Answer any one of the following : **[5]**

- a) What is chromatography? Explain the technique of gas chromatography.
- b) 0.310g of stainless steel sample was dissolved by acid treatment. The solution was diluted to 100ml. An 25 ml aliquot was taken from which Fe(III) ions are precipitated as  $\text{Fe}(\text{OH})_3$ . The ppt. of  $\text{Fe}(\text{OH})_3$  was ignited and it gave 0.091 g of  $\text{Fe}_2\text{O}_3$ . Calculate the percentage of Fe in the sample.

(Given : At.wt. Fe = 55.85 O = 16)



## PART - E

### Organometallic and Inorganic Reaction mechanism

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

- a) Determine the valence electron counts for the transition metals in the following complexes
  - i)  $[\text{Mn}(\text{CO})_6]^+$
  - ii)  $[\eta^5 - \text{C}_5\text{H}_5] \text{Fe}(\text{CO})_2]$
- b) Define and explain
  - i) Hydride elimination reaction
  - ii) Abstraction reaction
- c) Give the rate law for interchange reaction mechanism
- d) Which of the following obey the  $18e^-$  rule
  - i)  $\text{Re}(\text{PPh}_3)_2 \text{Cl}_2 \text{N}$
  - ii)  $\text{Cl Mn}(\text{CO})_5$
- e) Predict the type of reaction
$$\text{H}_3\text{C} - \text{Mn}(\text{CO})_5 + \text{CO} \rightarrow \text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{Mn}(\text{CO})_5$$

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

- a) Explain the conjugate base mechanism in substitution reactions.
- b) Write a note on 'Wacker process'.
- c) Explain the importance of CO as a  $\pi$ -acid ligand in organometallic chemistry.
- d) Write a note on inner sphere reactions.

**Q3)** Attempt any one of the following : **[5]**

- a) Explain the role of NMR spectroscopy in spectral analysis and characterization of organometallic compounds.
- b) Give an account of polymerization using Zeiglar Natta Catalyst.



**PART - F**  
**MATHEMATICS FOR CHEMISTS**

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

- a) Define : conjugate of a complex matrix with suitable example
- b) Differentiate w.r.t.x :
  - i)  $y = x \sin x$
  - ii)  $y = \frac{2+x}{2-x}$
- c) Enlist properties of a determinant
- d) i) If  $A = \begin{bmatrix} 5 & 2 & 3 \\ 1 & 5 & 6 \end{bmatrix}$   $4A = ?$ 
  - ii) Add the following matrices  $\begin{bmatrix} 4 & 1 \\ 5 & 6 \end{bmatrix} \begin{bmatrix} 1 & 7 \\ 8 & 9 \end{bmatrix}$
- e) Give the product rule and the chain rule of differentiation

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

- a) Three dice are thrown together. Find the probability of getting a total of at least 6.
- b) Solve the following:
  - i)  $5^{-1/2}$  ii)  $(6 \cdot 2)^2$
  - iii)  $12^{-1}$  iv)  $2^3 \cdot 2^5$
  - v)  $25^{1/3}$
- c) Solve the following :
  - i)  $\int \left( \frac{1}{x^3} + \frac{1}{x^2} + \frac{1}{x} + 1 \right) dx$
  - ii)  $\int \tan^2 x dx$
- d) Write a short note on series solution method for differential equations.

**Q3)** Answer any one of the following :

**[5]**

- a) The readings recorded on a polarograph for diffusion current are given below. What is the average error, most probable error and mean square error.

24.3, 24.5, 24.7, 24.8, 24.9, 24.6

- b) Discuss any two differential equations in physical chemistry.



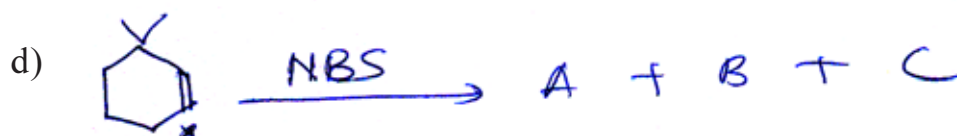
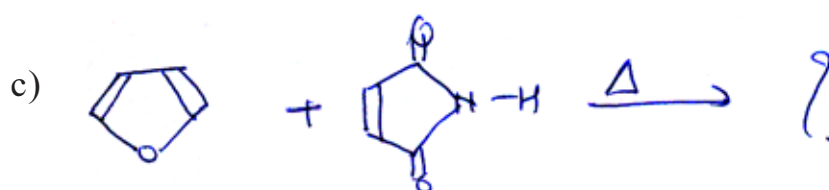
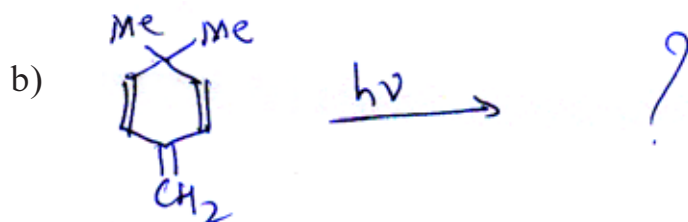
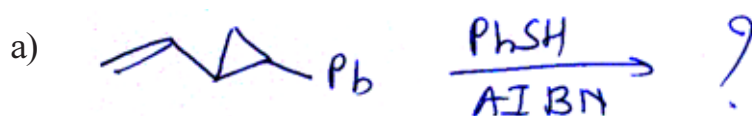
## PART - G

### Pericyclic, Photochemistry and free radical reactions

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

- a) Irradiation of 2,2,5,5 – tetraphenyl cyclopentanone gives two products. Explain.
- b) Explain sandmeyer reaction with suitable example
- c) Discuss stepwise mechanism of alder-ene reaction
- d) Define :
  - i) Photosensitization
  - ii) Photoenolization
- e) Write the mechanism of claisen rearrangement with suitable example.

**Q2)** Predict the product/products indicating mechanism in any two of the following : [10]



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

**[5]**

- a) Explain free radical cyclisation reactions in organic synthesis
- b) Write brief account of
  - i) Correlation diagram
  - ii) Jablonski diagram
- c) Explain photoenolisation reaction with suitable examples.



Total No. of Questions : 6]

SEAT No :

P2870

[5023]-301

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

CHP-310 : Quantum Chemistry and Solid State Chemistry

(2013 Pattern) (Semester - III) (New)

Time : 3Hours]

[Max. Marks : 50

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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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 precisely the following : **[10]**

- a) State the condition for the acceptable wave function.
- b) Define Hermitian operator giving example.
- c) Explain, what is term symbol?
- d) Are the following operators meet the requirements for a quantum-mechanical operator that is to represent a physical quantity : i)  $\frac{d^2}{dx^2}$  and ii)  $i\left(\frac{d}{dx}\right)$ ? Why?
- e) Write the Schrodinger time - dependent equation. State the significance of the terms involved in it.

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

- a) Apply the variation method to the system of He atom to calculate its energy.
- b) Construct the Hamiltonian operator for  $\text{Be}^{+2}$  ion in atomic units. State the terms involved in it.
- c) Show that  $[\hat{L}_x, \hat{L}_y] = i\hbar\hat{L}_z$  for a set of angular momentum operators  $\hat{L}_x, \hat{L}_y$  and  $\hat{L}_z$ .
- d) Explain Hückel approximations. What is their need?

**Q3)** Attempt any one of the following: **[5]**

- a) If  $g = \hat{A}F$ , find g for each of the following choices of  $\hat{A}$  and F.
  - i)  $\hat{A} = \frac{d}{dx}$  and  $F = \cos(x^2+1)$
  - ii)  $\hat{A} = 5$  and  $F = \sin x$
  - iii)  $\hat{A} = ( )^2$  and  $F = \sin x$
  - iv)  $\hat{A} = \frac{d^2}{dx^2}$  and  $F = \ln 3x$
  - v)  $\hat{A} = \exp$  and  $F = \ln x$



- b) Sketch the MO's for butadiene on the basis of HMO theory. Deduce the energies of these orbitals on the basis of secular determinant.

### SECTION -II

**Q4)** Attempt precisely the following: **[10]**

- a) Write the equation for Frenkel defects and explain the terms involved in it.
- b) State the third power law of Debye for solids.
- c) Define induction period for the decomposition reaction of a single solid.
- d) What is Van-Arkel process?
- e) Give steps in the photographic process.

**Q5)** Attempt Any Two of the following : **[10]**

- a) Discuss the mechanism of diffusion in solids.
- b) Explain the mechanism of the following solid-solid reactions:
  - i)  $\text{MgO(s)} + \text{Al}_2\text{O}_3\text{(s)} \rightarrow \text{MgAl}_2\text{O}_4\text{(s)}$
  - ii)  $\text{AgCl(s)} + \text{NaI(s)} \rightarrow \text{AgI(s)} + \text{NaCl(s)}$
- c) State and explain Kirkendall effect.
- d) What is a colour centre? Explain the origin of colour centers in halide crystals.

**Q6)** Attempt any one of the following : **[5]**

- a) How deep will Aluminium penetrate in silicon at 1450°C in one hour?  
[Given :  $\Delta H = 73$  Kcal/mole,  $D_0 = 1.55$  cm<sup>2</sup>/s]
- b) A certain alkali halide ( $\text{A}^+ \text{X}^-$ ) with molecular weight 74.6 has the NaCl structure. If the interionic distance  $\text{A}^+ - \text{X}^-$  is 0.32nm, calculate the density of the salt for the 0.1% Frenkel defects.



Total No. of Questions : 6]

SEAT No :

P2871

[5023]-302

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

CHP-311 : Nuclear, Radiation and Photochemistry

(Semester - III) (2013 Pattern)

Time : 3 Hours]

[Max. Marks : 50

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

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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 the following : **[10]**

- a) Explain the role of Tl in NaI(Tl) detector.
- b) What is spontaneous fission? Enlist spontaneous fission neutron sources.
- c) What is the function of coolant and moderator in a nuclear reactor?
- d) Explain the terms spin and parity.
- e) What are intrinsic and extrinsic semiconductors?

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

- a) Draw an experimental setup for PIXE measurements. What are the advantages of PIXE technique?
- b) What are the salient features of a liquid drop model?
- c) Write a note on fission fragments and their mass distribution.
- d) Give classification of nuclear reactors and write a note on Oklo reactor.

**Q3)** Attempt any one of the following: **[5]**

- a) Assuming the energy released per uranium fission is 200MeV, compute the number of uranium atoms that must fission per second, such that the power generated equals 1000 MW.
- b) Calculate the binding energy of the last two neutrons in  $^{37}\text{Cl}$ .

Given: mass of  $^{35}\text{Cl} = 34.96885$  amu

$^{37}\text{Cl} = 36.96590$  amu

$n = 1.008665$  amu

## SECTION -II

**Q4)** Attempt precisely the following: **[10]**

- a) State the law of photochemical equivalence.
- b) Explain the terms stimulated emission and spontaneous emission.
- c) Define the terms dark reactions and photochemical reactions. Give their examples.
- d) Explain the terms luminescence and incandescence.
- e) Explain lifetimes of excited electronic states of atoms and molecules.

**Q5)** Answer any Two of the following : **[10]**

- a) Discuss Einstein's treatment on absorption and emission phenomena.
- b) Describe photophysical kinetics of unimolecular processes.
- c) Explain the mechanism of delayed fluorescence.
- d) Deduce the Stern-Volmer equation for the kinetics of collisional quenching.

**Q6)** Attempt any one of the following : **[5]**

- a) Explain the Jablonski diagram depicting various photophysical processes.
- b) For the photochemical reaction :  $A \rightarrow B$ ,  $2 \times 10^{-5}$  moles of B were formed on absorption of  $7.8 \times 10^7$  erg at  $1200 \text{ \AA}$ . Calculate the quantum yield.

☆ ☆ ☆

Total No. of Questions : 6]

SEAT No :

P2872

[5023]-303

[Total No. of Pages : 3

M.Sc.

**PHYSICAL CHEMISTRY**

**CHP-312 : Physicochemical Methods of Analysis (New)  
(Semester-III) (2013 Pattern)**

*Time : 3Hours]*

*[Max. Marks : 50*

*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 and calculator is allowed.*
- 5) *Neat diagrams must be drawn wherever necessary.*

**Physico - Chemical Constants**

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13. Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$

*P.T.O.*

## SECTION -I

**Q1)** Answer precisely the following : **[10]**

- a) What is Bremsstrahlung?
- b) Define absorptive edge. What is its use?
- c) What are the ways by which the excited ion relax in ESCA technique?
- d) Draw a neat labeled diagram of an ESCA spectrometer.
- e) What is meant by thermal analysis? Enlist the various methods of thermal analysis.

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

- a) Discuss the applications of TGA technique.
- b) State the principle of DTA. Explain the factors which affect differential thermal analysis.
- c) Enlist the analyzers used in ESCA. Explain any one of them with a neat labeled diagram.
- d) What is X-ray fluorescence? Draw a neat labelled diagram of wavelength - dispersive and energy-dispersive instrument used for fluorescence.

**Q3)** Solve any one of the following: **[5]**

- a) Estimate the thickness of foil of alloy having mass absorption coefficient  $601.5 \text{ cm}^2/\text{g}$  at  $0.436 \text{ nm}$  if the detector recorded  $10,848 \text{ counts/min}$  of transmitted X-rays when foil was not in the path of x-rays and  $1023 \text{ counts/min}$  when foil was placed in the path. The density of alloy is  $8.0122 \text{ g/cm}^3$ .
- b) TGA of plaster of paris showed mass loss of about 6.2% of original sample mass for complete dehydration of plaster of paris at about  $100^\circ\text{C}$ . Determine the number of water molecules present in plaster of paris. [At .Wt. of Ca=40, S=32, O=16 and H=1] **[5]**

## SECTION -II

**Q4)** Attempt precisely the following: **[10]**

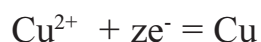
- a) Explain the effect of temperature on photoluminescent intensity.
- b) Define luminescent efficiency.
- c) State the characteristics of plasma.
- d) What are the fundamental requirements to perform coulometric titrations?
- e) Write the equation for limiting current in hydrodynamic voltammetry. Explain the terms in it.

**Q5)** Attempt any Two of the following : **[10]**

- a) Explain 'S' route and 'T' route mechanisms in electrochemiluminescence.
- b) Discuss the applications of ICP technique.
- c) How are neutralization titrations performed by constant - current coulometry?
- d) Discuss briefly the technique of pulse voltammetry with its advantages.

**Q6)** Solve any one of the following : **[5]**

- a) A controlled-potential coulometric assay of 25ml  $\text{Cu}^{2+}$  solution was performed with the following electrochemical reaction.



If the area under the current - time curve is 19.6 mA.min, calculate the concentration of  $\text{Cu}^{2+}$  in the solution.

[At Wt of Cu = 63.5]

- b) An electroactive species yielded a wave with a limiting current of 15.2  $\mu\text{A}$  at an rde which was rotated at 10.0 r/s. What limiting current would be expected at 1800 r/min? **[5]**



Total No. of Questions : 6]

SEAT No :

P2873

[5023]-304

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

CHP-313 : Polymer Chemistry

(2013 Pattern) (Semester - III) (New)

Time : 3Hours]

[Max. Marks : 50

Instructions to the candidates:

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

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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 the following : **[10]**

- a) Give two advantages of homopolymers over co-polymers.
- b) Deduce relation between  $T_g$  and  $T_m$  where  $T_g$  is glass transition temperature.
- c) Define viscosity and give its SI unit.
- d) Define polydispersity index.
- e) Distinguish between elasticity and plasticity.

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

- a) Differentiate among Newtonian flow and non-ideal flow. Define rubber elasticity.
- b) Explain the Krigbaum theory for polymer solutions.
- c) Write a note on applications of Ziegler - Natta catalysts.
- d) Compare biological and non-biological polymers.

**Q3)** Attempt any one of the following: **[5]**

- a) Three moles of 1,3- butadiene and two moles of vinyl chloride co-polymerize. Find the polymer composition.  
[Monomer reactivity ratios : 8.8 and 0.35 respectively]  
C=12 H=1 Cl = 35.5 At.wts.
- b) Compare Voigt and Maxwell viscoelasticity models.

## SECTION -II

**Q4)** Attempt the following: **[10]**

- a) What are the advantages of small angle scattering in XRD analysis of polymers?
- b) Define calendaring.
- c) Distinguish between hue and glaze.
- d) What is a conducting polymer?
- e) Define birefringence.

**Q5)** Attempt any Two of the following : **[10]**

- a) Compare NMR and ESR spectroscopy in polymer analysis.
- b) Write a note on melt spinning.
- c) Describe compression molding.
- d) How are IR spectra use ful in polymer analysis?

**Q6)** Attempt any one of the following : **[5]**

- a) Write the relation between intrinsic viscosity and molecular at of a polymer.  
How is the molecular weight determined from viscosity?
- b) Compare textile properties and fabric properties of polymers.



Total No. of Questions : 6]

SEAT No :

P2874

[5023]-305

[Total No. of Pages : 3

M.Sc.

PHYSICAL CHEMISTRY

CHP-314 : Modern Trends in Physical Chemistry

(Semester - III) (2013 Pattern)(Optional)(New)

Time : 3Hours]

[Max. Marks : 50

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 diagram must be drawn wherever necessary.

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13. Mass of an electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

## SECTION -I

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

- a) Explain the term component with example.
- b) Define the term lower critical solution temperature. Give its example.
- c) Write the charge balance for 0.01M  $\text{NaH}_2\text{PO}_4$ .
- d) Write the mass balance on potassium and oxalate in 0.1M  $\text{K}_2\text{C}_2\text{O}_4$ .
- e) Write the proton condition for  $\text{H}_2\text{Se}$ .

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

- a) Calculate pH and concentration of all the species in 0.1M  $\text{Na}_2\text{CO}_3$  [Given :  $K_{a_1} = 4.47 \times 10^{-7}$ ,  $K_{a_2} = 5.62 \times 10^{-11}$ ]
- b) Discuss the one component system with a neat labelled diagram.
- c) Explain the temperature-composition diagram for distillation of an ideal mixture with one component more volatile than the other.
- d) Define 'upper consolute temperature'. Discuss the phase diagrams for palladium and palladium hydride.

**Q3)** Solve any one of the following: **[5]**

- a) Draw a logarithmic concentration diagram for 0.01N acetic acid [Given :  $K_a = 1.8 \times 10^{-5}$ ]
- b) The pH of 0.1M solution of a salt succinic acid is 6.8. Find the fractions of  $\text{C}_6\text{H}_6\text{O}_4$ ,  $\text{C}_6\text{H}_5\text{O}_4^-$  and  $\text{C}_6\text{H}_4\text{O}_4^{2-}$  [Given :  $\text{p}K_{a_1} = 4.19$ ,  $\text{p}K_{a_2} = 5.48$ ]

## SECTION -II

**Q4)** Answer the following: **[10]**

- a) Write the Debye-Hückel equation. Explain the terms involved in it.
- b) How are secondary electrons generated in SEM?
- c) What are aerogels? Give their properties.
- d) What is piezoelectric ceramics?
- e) Define ferrofluids & magnetorheological fluids.

**Q5)** Answer any Two of the following : **[10]**

- a) Write a note on smart gel.
- b) Discuss the treatment of biological specimen used in SEM.
- c) What are active smart materials? Explain with two examples.
- d) Write a note on ceramics,

**Q6)** Answer any one of the following : **[5]**

- a) Write the applications of nanomaterials in various fields.
- b) Describe briefly electron beam lithography.



Total No. of Questions : 4]

SEAT No :

**P2875**

**[5023]-306**

[Total No. of Pages : 2

**M.Sc - II**

**INORGANIC CHEMISTRY**

**CHI-326 : Organometallic Chemistry and Homogeneous Catalysis  
(2013 Pattern) (Semester - III)**

*Time : 3Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *Neat diagrams must be drawn wherever necessary.*

**Q1)** Answer the following :

**[20]**

- a) What is the advantage of homogeneous catalyst over heterogeneous catalyst.
- b) What are the prerequisite conditions for asymmetric catalysis.
- c) List the various biphasic systems.
- d) Discuss regioselectivity with suitable example.
- e) Explain the term  $\pi$  - acid ligand.
- f) What is hapticity? Explain with example.
- g) Explain reductive elimination reaction.
- h) Arrange the metal carbonyls according to decreasing order of CO stretching frequency. Justify.
  - i) MCO
  - ii)  $M_2CO$
  - iii)  $M_3CO$
- i) Which of the following complexes obey 18 is Rule.
  - i)  $CH_3Mn(CO)_5$
  - ii)  $Co(\eta^5-C_5H_5)_2$

**P.T.O.**

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

- Give an account of chemical structure and bonding of  $\pi$ -allyl complex of transition metals.
- Explain with the help of suitable example the role of organometallic compound as a protecting agent.
- What is Tolman cone angle? How they are determined. Explain their importance in catalysis.
- Discuss different general features of homogeneous catalysis.

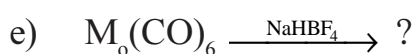
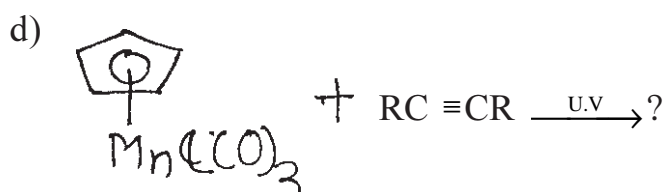
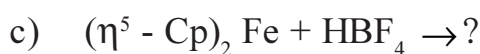
**Q3)** Attempt any two of the following. [10]

- Give synthesis, bonding and properties of cyclobutadienes compounds.
- Give an account of transition metal atom clusters.
- Discuss mechanism of Suzuki coupling reaction.
- Discuss in detail various olefin metathesis reactions.

**Q4) A)** Write note on (any one) [5]

- Importance of chiral ligands in Asymmetric catalyst.
- Use of metallocene catalyst for polymerisation reaction.

**B)** Complete the following reactions. [5]



☆ ☆ ☆

Total No. of Questions : 4]

SEAT No :

P2876

[5023]-307

[Total No. of Pages : 2

M.Sc - II

**INORGANIC CHEMISTRY**

**CHI-330 : Inorganic Reaction Mechanism, Photochemistry and  
Magnetic Properties of Coordination Compounds  
(2013 Pattern) (Semester - III) (4 Credit)**

*Time : 3Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**Q1)** Attempt the following :

**[20]**

- a) Thermodynamically stable complexes could be kinetically inert or labile. Illustrate with suitable example.
- b) How do following modifications affect the rate of substitution in square planer complexes.
  - i) Adding bulky substituent to the cis ligand.
  - ii) Increasing positive charge on metal complex.
- c) Which of the following octahedral substitution reaction is faster? Why?
  - i)  $[\text{Ni}(\text{NH}_3)_5 \text{Cl}]^{2+} + \text{H}_2\text{O} \rightarrow [\text{Ni}(\text{NH}_3)_5 \text{H}_2\text{O}]^{2+} + \text{Cl}^-$
  - ii)  $[\text{Ni}(\text{H}_2\text{O})_5 \text{Cl}]^{2+} + \text{H}_2\text{O} \rightarrow [\text{Ni}(\text{H}_2\text{O})_6]^{2+} + \text{Cl}^-$
- d) List out the characteristics of outer sphere electron transfer reactions.
- e) Suggest the mechanism for following reaction  
 $[\text{Co}(\text{NH}_3)_5 \text{NO}_2]^{2+} \rightarrow [\text{Co}(\text{NH}_3)_5 \text{ONO}]^{2+}$
- f) Describe the phenomenon of phosphorescence.
- g) Find out R.S. Term symbol for  $\text{Ni}^{2+}$  and  $\text{Ti}^{3+}$
- h) Arrange the following metal complexes according to the increasing order of rate of aquation. Justify your answer  $\text{trans}-[\text{Co}(\text{en})_2\text{Cl}_2]^+$ ,  $\text{trans}-$

**P.T.O.**





- i) Describe the mechanism for halogenation of coordinated nitrogen atom.
- ii) Define the term
  - 1) Ferromagnetism
  - 2) Antiferromagnetism

**Q2)** Answer the following (any two): **[10]**

- a) Compare  $\text{SN}^1$  and  $\text{SN}^2$  Mechanism in octahedral substitution reactions.
- b) Discuss the stability of metal complexes in solution and Explain factors affecting on it.
- c) Explain the nucleophilic behaviour of coordinated ligands.
- d) What do you mean by quenching of orbital angular momentum? provide the explanation with the help of VBT and CFT.

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

- a) What is  $\text{SN}^1\text{C}^b$  mechanism? Explain with suitable example.
- b) Discuss the mechanism of cis-trans isomerism in octahedral complexes with suitable example.
- c) Predict the magnetic exchange which occurs via the  $90^\circ$  exchange pathway in the system  $d^1-d^1$ ,  $d^2-d^2$ ,  $d^3-d^3$ ,  $d^8-d^8$ ,  $d^9-d^9$ .
- d) Explain the mechanism of Inner sphere electron transfer reaction with suitable example.

**Q4)** Write a short note on (any Two) **[10]**

- a) Oxidative addition and reductive elimination.
- b) Photo chemistry of Cr(III) complexes.
- c) Complementary and noncomplementary reactions.
- d) Magnetic properties of mixed valence compounds.



Total No. of Questions : 4]

SEAT No. :

**P2877**

**[5023]-308**

[Total No. of Pages : 3

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CHI - 331 : Physical Methods in Inorganic Chemistry  
(2014 Pattern) (Semester - III) (4 Credit Pattern)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of log tables & calculator is allowed.*
- 4) *Draw neat and labelled diagrams wherever necessary.*

**Q1)** Attempt the following questions:

**[20]**

- a) Define unit cell.
- b) State the principle of XPS.
- c) Define isomer shift and quadrupole splitting.
- d) Predict the number of lines expected in ESR of a  $^{59}\text{V}$  nucleus.
- e) Explain magnetic splitting and isomer shift in Mössbauer spectroscopy.
- f) What is 'g' value in ESR, list the factors affecting 'g' value.
- g) What is the role of supporting electrolyte in CV?
- h) Which Mössbauer nucleus will be required to determine the structure of
  - i)  $\text{Fe (II) (Phen)}_2 (\text{NCS})_2$  and
  - ii)  $\text{Na}_2\text{S}_n\text{F}_6$
- i) Which changes can be detected by DTA?
- j) Draw the following planes in cubic cell :  $[221]. [121]$ .

**P.T.O.**

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

- a) How is DSC useful in characterization of metal complexes, liquid crystals and super conductors?
- b) Explain with the help of suitable example Kramer degeneracy in ESR.
- c) Determine the type of electron transfer reaction and calculate the rate constant of a reaction using following data

$$i_{pa} = 2.5 \times 10^{-6} \text{A}$$

$$i_{pc} = 0.6 \times 10^{-6} \text{A}$$

$$E_{pc} = 0.28 \text{ V}$$

$$\nu = 0.05 \text{ V/sec}$$

$$A = 0.2826; F = 96500, R = 2; T = +25^\circ\text{C}; C = 0.001\text{M}$$

- d) An element with FCC or BCC crystal structure showed following diffraction pattern at following  $2\theta$  angles:  
36.6, 55.71, 69.7, 82.55, 95.00, 107.67, 69.7. The wavelength of incoming radiation is  $0.154 \text{ \AA}$ . Determine crystal structure and lattice constant of the element.

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

- a) The Bragg's angle for the reflection from the [110] plane in BCC iron is  $22^\circ$  for X-ray of wavelength  $1.54 \text{ \AA}$ . Calculate the cubic edge and density of iron.  
(At. wt. of iron is 55.8)
- b) Explain with suitable examples the effect of various experimental factors on TGA of a substance.
- c) Cyclic voltammogram of an antibiotic is recorded in a 0.1M acetate solution with carbon electrodes at a scan rate 325 mv/sec. Explain the cyclic voltammogram and interpret the redox mechanism.
- d) Discuss the thermal decomposition of hydrate calcium oxalate when heated from 30 -  $700^\circ\text{C}$  in air. Give the appropriate reactions and draw the thermogram.

**Q4)** Attempt any two of the following:

**[10]**

- a) X-ray photoelectron spectroscopy-principles and applications.
- b) Applications of thermal techniques.
- c) Applications of ESR.
- d) 10 mg of mixture of  $\text{MgCO}_3$  and  $\text{SrCO}_3$  is subjected to TG analysis. There is loss of 3.138 mg upto  $500^\circ\text{C}$  and further loss of 1.192 mg is obtained above temperature  $900^\circ\text{C}$ . Find out the % composition of  $\text{MgCO}_3$  and  $\text{SrCO}_3$  in the mixture.



Total No. of Questions : 4]

SEAT No. :

**P2878**

**[5023]-309**

[Total No. of Pages : 2

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CHI - 332 : Bioinorganic and Inorganic Medicinal Chemistry  
(Semester - III) (2013 Pattern) (4 Credits)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**Q1)** Answer the following questions:

**[20]**

- a) What is MRI?
- b) Give representation of the interaction between DNA and zinc finger protein.
- c) Give four copper related pathological disorders.
- d) Give any two biological role of cytochrome - c oxidase.
- e) Explain mutase activity of coenzyme B<sub>12</sub>.
- f) Write any two reactions which is catalyzed by Nitrogenase.
- g) Draw the structure of Vit B - 12.
- h) Which metal complexes are mostly used for heart and brain imaging?
- i) Write two important reactions of Vit B - 12.
- j) Give the names and functions of two molybdenum containing enzymes.

***P.T.O.***

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

- a) Give role of tyrosinase or dopamine  $\beta$ -mono oxygenase in oxidation of phenylalamine.
- b) Give uptake and reduction of chromate in different cellular compartments.
- c) Explain bone imaging agents.
- d) Give details about 2<sup>nd</sup> and 3<sup>rd</sup> generation platinum anticancer drug.

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

- a) Explain role of Mo-model complex in oxygen transfer from dimethylsulfoxide to triphenylphosphine.
- b) Write in short three applications of radiopharmaceuticals in details.
- c) Why is Tc considered as best nucleus in radiopharmaceuticals?
- d) Explain with suitable example leaching of precious metals by micro-organism.

**Q4)** Attempt the following: [10]

- a) Draw the structures (any five):
  - i) Zinc Finger.
  - ii) GAL 4 (Yeast transcription factor).
  - iii) Blue copper protein.
  - iv) Type - 2 Non-blue Cu-protein.
  - v) Azurin.
  - vi) Model complex of Mo.
  - vii)  $F_4S_4$  protein.
- b) Write a short note on purple acid phosphatase.



Total No. of Questions : 6]

SEAT No. :

P2879

[5023]-310

[Total No. of Pages : 3

M.Sc. - II

**ORGANIC CHEMISTRY**

**CHO - 350 : Organic Reaction Mechanism  
(2013 Pattern) (Semester - III) (New) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 50

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**

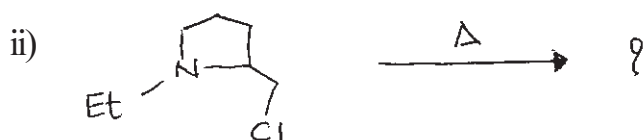
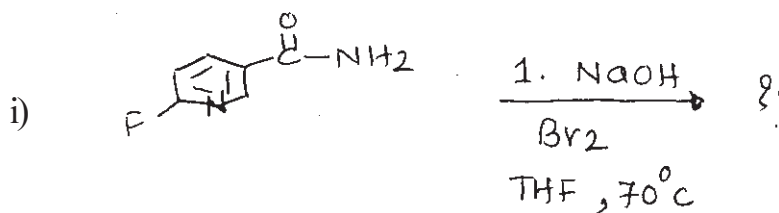
Q1) Answer the following:

[10]

- a) Explain the neighbouring group participation by alkene with a suitable example.
- b) Discuss the factors influencing the stability of carbanions.
- c) Give any two applications of carbenes.
- d) Explain the role of nitrene in any two name reactions.
- e) Give the advantages of enamine over other methods.

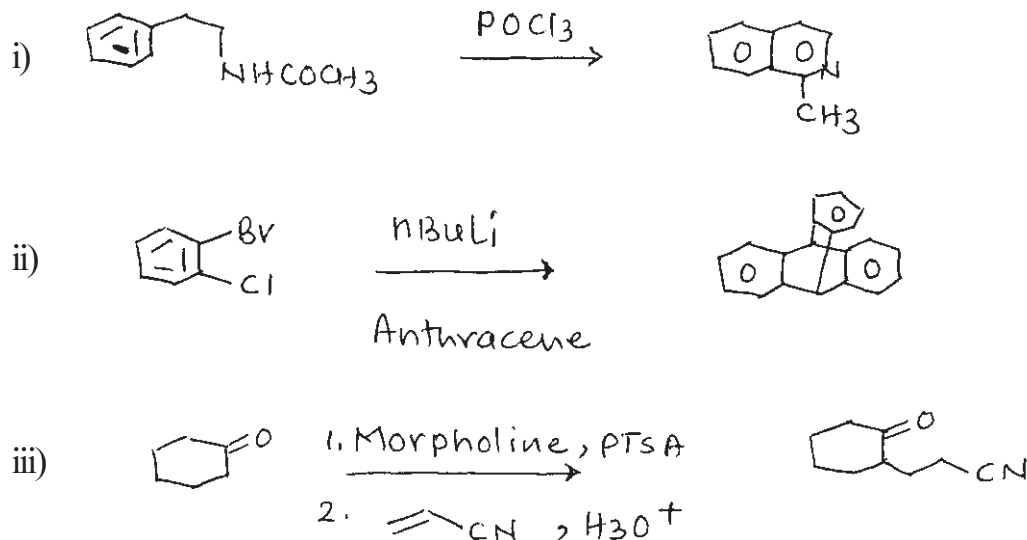
Q2) a) Predict the products in any two of the following:

[5]



P.T.O.

b) Suggest the Mechanism for any two of the following: [5]

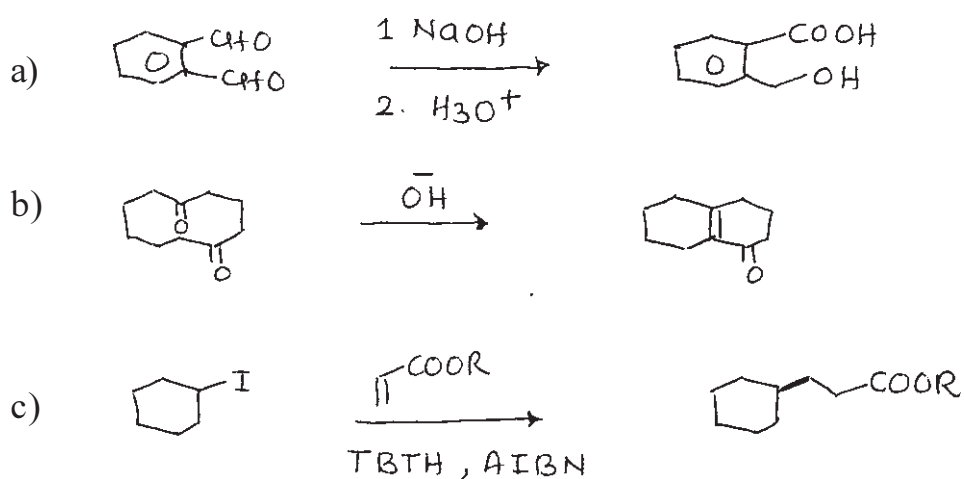


Q3) Write short notes on any two of the following: [5]

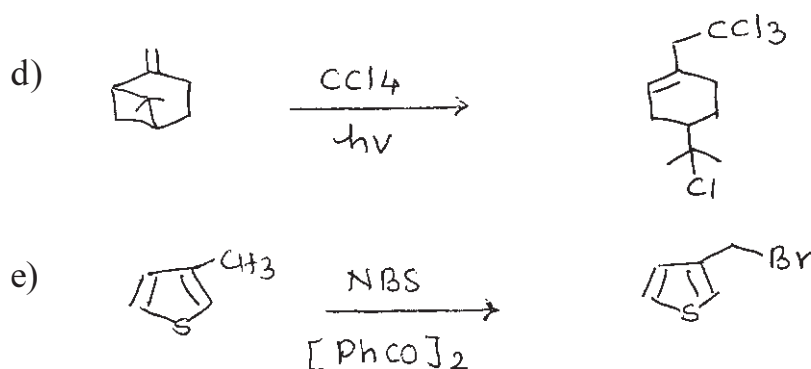
- Role of biotin as a carbon dioxide carrier.
- Benzoin condensation.
- Curtius rearrangement

### SECTION - II

Q4) Suggest the Mechanism for the following: [10]







**Q5) a)** Answer any two of the following: [5]

- i) Write a short note on  $S_NAr$  reaction.
- ii) Discuss the role of PEP as a nature's acyl anion equivalent.
- iii) Explain phenolic oxidative coupling with a suitable example.

**b)** Answer any two of the following: [5]

- i) Explain Perkin condensation reaction with a suitable example
- ii) Predict, which member in the following pair is the stronger acid. Justify.



- iii) Write a note on Sandmeyer reaction.

**Q6)** Attempt any two of the following: [5]

- a) Explain in brief the various methods for the generation of free radicals.
- b) Write a note on patterno - Büchi reaction.
- c) Explain Mannich reaction with an example.



Total No. of Questions : 6]

SEAT No. :

P2880

[5023]-311

[Total No. of Pages : 6

M.Sc. - II

**ORGANIC CHEMISTRY**

**CHO - 351 : Spectroscopic Methods in Structure Determination  
(2013 Pattern) (4 - Credits) (Semester - III)**

Time : 3 Hours]


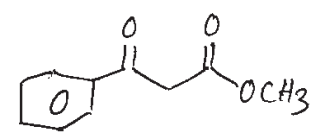
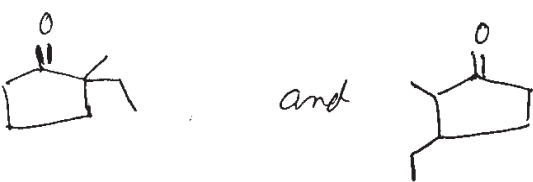
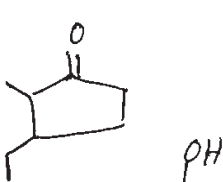
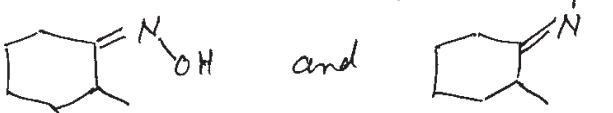
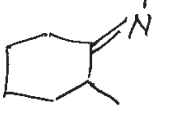
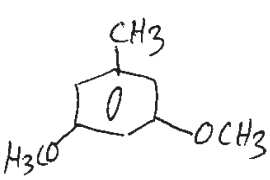
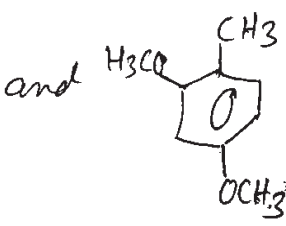
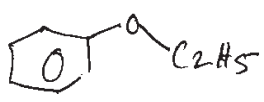
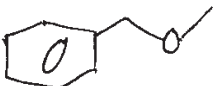
[Max. Marks : 50

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) Distinguish between the following pairs by using the indicated spectral method. [5]

- a)  and  PMR
- b)  and  Mass
- c)  and  CMR
- d)  and  PMR
- e)  and  CMR

P.T.O.

**Q2)** Derive the structure from given spectral data. (Any two):

**[10]**

- a) MF :  $C_{15}H_{14}O$   
IR :  $1680\text{ cm}^{-1}$   
PMR ( $\delta$ ) : 2.4 (6H, s), 7.2 (4H, d,  $J = 8\text{Hz}$ )  
7.7 (4H, d,  $J = 8\text{Hz}$ )  
CMR ( $\delta$ ) : 21, 129, 133, 136, 141, 190
- b)  $C_{10}H_{12}O_2$   
IR : 3400 (br),  $1600\text{ cm}^{-1}$   
PMR ( $\delta$ ) : 1.85 (3H, d,  $J = 6\text{Hz}$ )  
3.8 (3H, s)  
5.0 (1H, bs, exch)  
6.0 (1H, dq,  $J = 18$  and  $6\text{Hz}$ )  
6.2 (1H, d,  $J = 18$  and  $1\text{Hz}$ )  
6.75 (1H, d,  $J = 8\text{Hz}$ )  
6.8 (1H, s)  
6.9 (1H, d,  $J = 8\text{Hz}$ )
- c)  $C_9H_{10}O_3$   
IR = 3400,  $1680\text{ cm}^{-1}$   
PMR ( $\delta$ ) : 7.8 (1H, d,  $J = 8\text{Hz}$ )  
7.0 (1H, d,  $J = 8\text{Hz}$ )  
6.5 (1H, s)  
5.8 (1H, bs, exch)  
3.9 (3H, s)  
2.3 (3H, s)
- d)  $C_9H_{14}O$   
M/z : 138, 95 (100%), 81, 79  
IR : 3290, 2115,  $1710\text{ cm}^{-1}$   
PMR( $\delta$ ) : 1.12 (6H, s)  
2.02 (1H, t,  $J = 3\text{Hz}$ )  
2.15 (3H, s)  
2.20 (2H, d,  $J = 3\text{Hz}$ )  
2.50 (2H, s)

**Q3)** Write short notes on any two of the following:

[10]

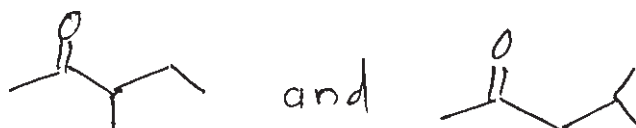
- 2D - resolved spectroscopy - COSY.
- Soft ionization techniques.
- Mc-Lafferty rearrangement.
- Methods of simplification of NMR.

### SECTION - II

**Q4)** Answer any five of the following:

[5]

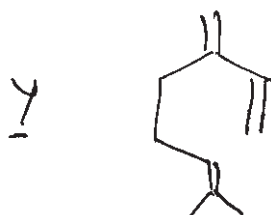
- A hydrocarbon with molecular formula  $C_7H_{12}$  ( $M^+$  peak at  $m/z$  96) shows intense peak at  $(M - 15)$  and  $m/z$  54. Deduce the structure.
- How could the following pairs of isomeric compounds be differentiated by mass spectrometry?



- Explain the genesis of Fragments in compound X.

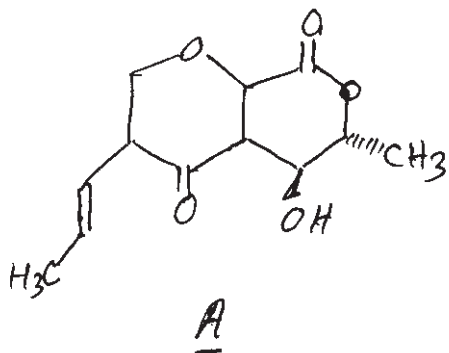


- The mass spectrum of compound Y exhibits peaks at  $m/z$  93, 69, 67. Explain.



- Explain the genesis of peaks at  $m/z$  137, 135 and 85 in the mass spectrum of 1-bromohexane.
- In the mass spectrum of  $Ph-CH_2-CH_2-OH$ , the peak at  $m/z$  91 is more intense than peak at  $m/z$  31, while in case of  $Ph-CH_2-CH_2-NH_2$ , the peak at  $m/z$  30 is more intense than the peak at  $m/z$  91.

**Q5) a)** The PMR of compound A shows following signals. Assign signals to different protons using decoupling experiment. Justify your answer. [6]

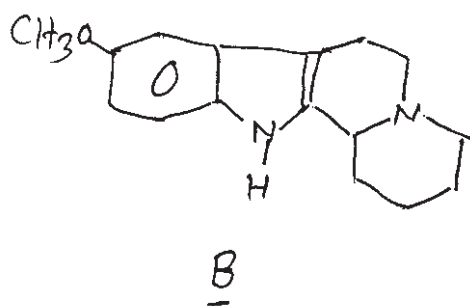


- 1.65 (3H, d,  $J = 7\text{Hz}$ )
- 1.97 (3H, dd,  $J = 1.5$  and  $7\text{ Hz}$ )
- 3.86 (1H, bs, exch)
- 3.92 (1H, d,  $J = 5\text{Hz}$ )
- 4.32 (1H, dq,  $J = 5$  and  $7\text{ Hz}$ )
- 5.87 (1H, d,  $J = 2\text{Hz}$ )
- 6.06 (1H, ddq,  $J = 1, 1.5, 2, 16\text{Hz}$ )
- 6.99 (1H, dq,  $J = 6$  and  $16\text{Hz}$ )

Spin decoupling experiment

Irradiation at	Change at
i) 6.06	5.87 (s) 1.97 (d, $J = 6\text{Hz}$ ) 6.99 (q, $J = 6\text{Hz}$ )
ii) 3.92	4.32 (q, $J = 7\text{Hz}$ )

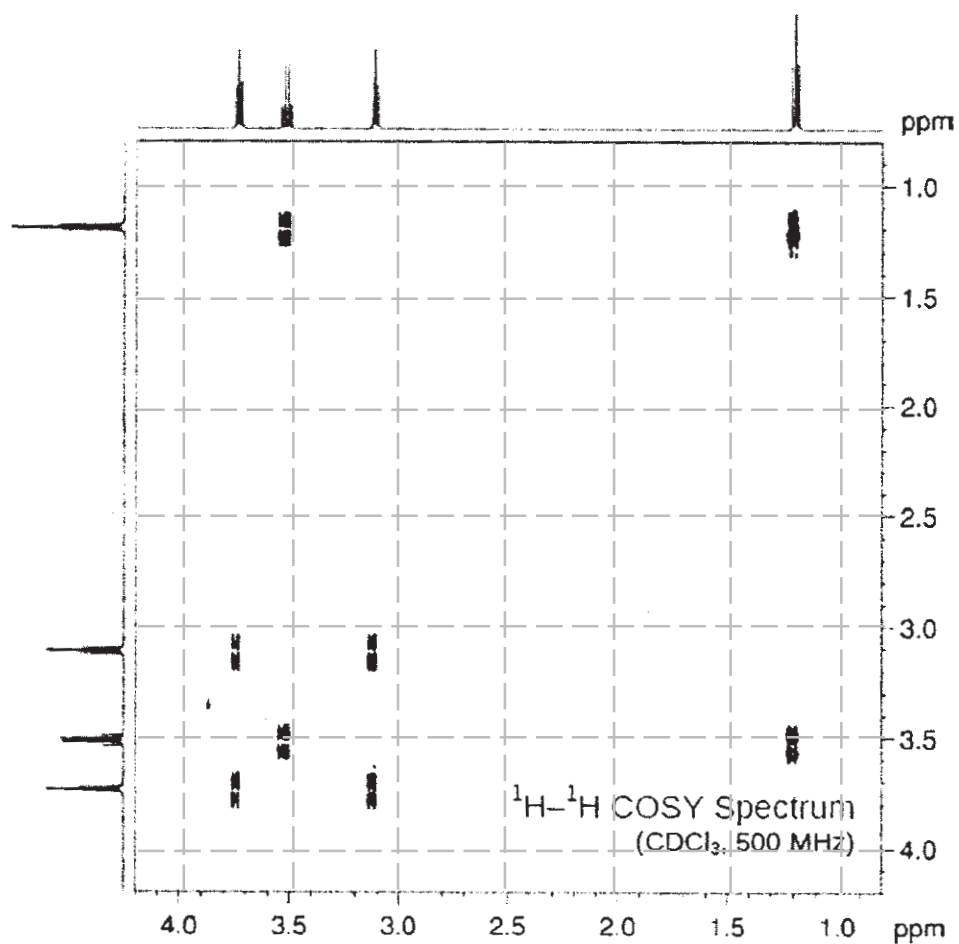
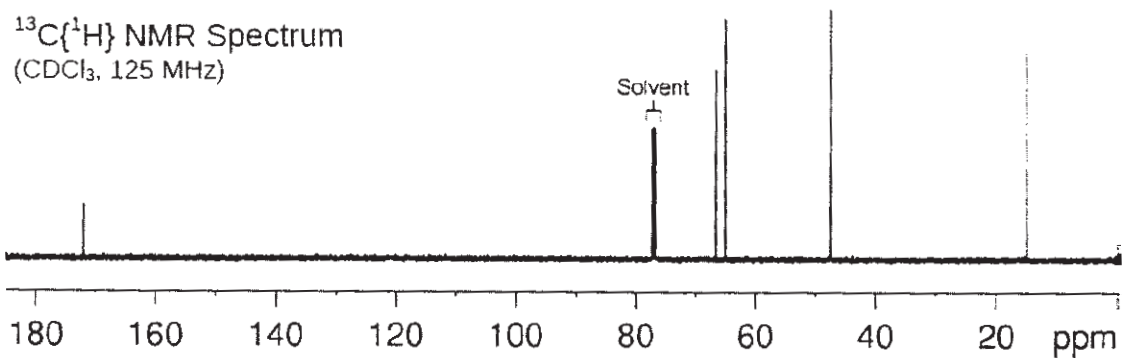
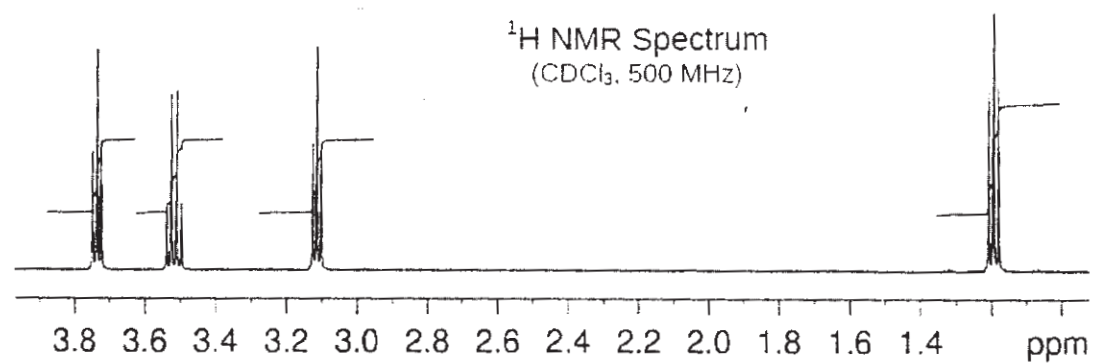
**b)** Assign CMR signals to the various carbons of compound B and justify your answer. [4]



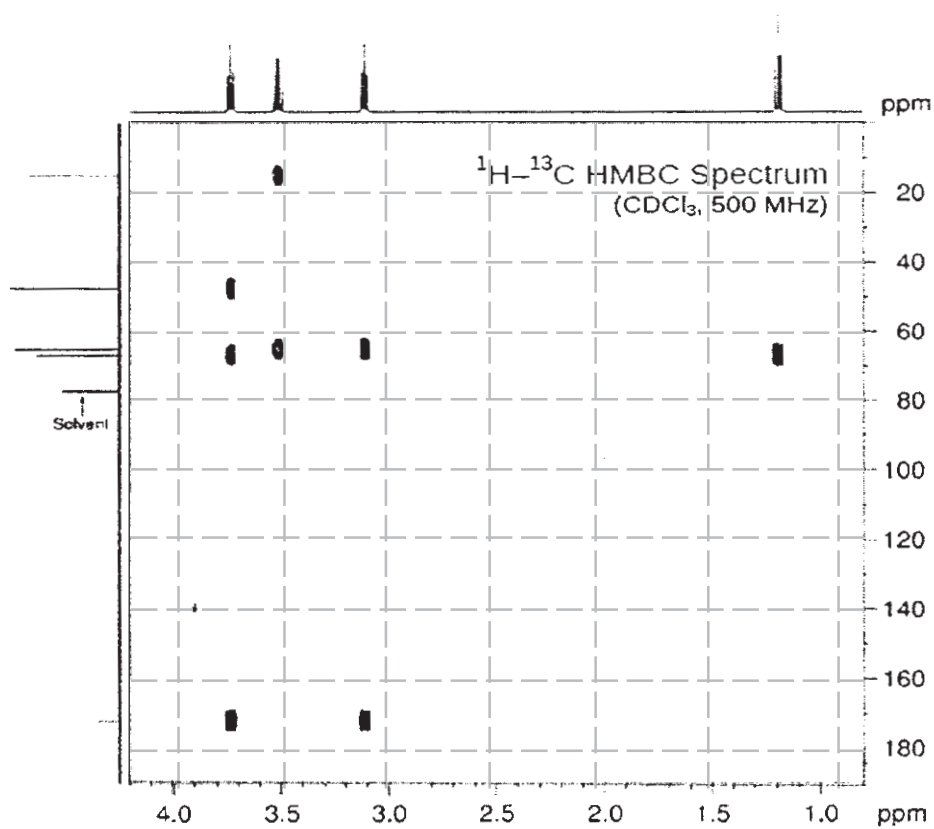
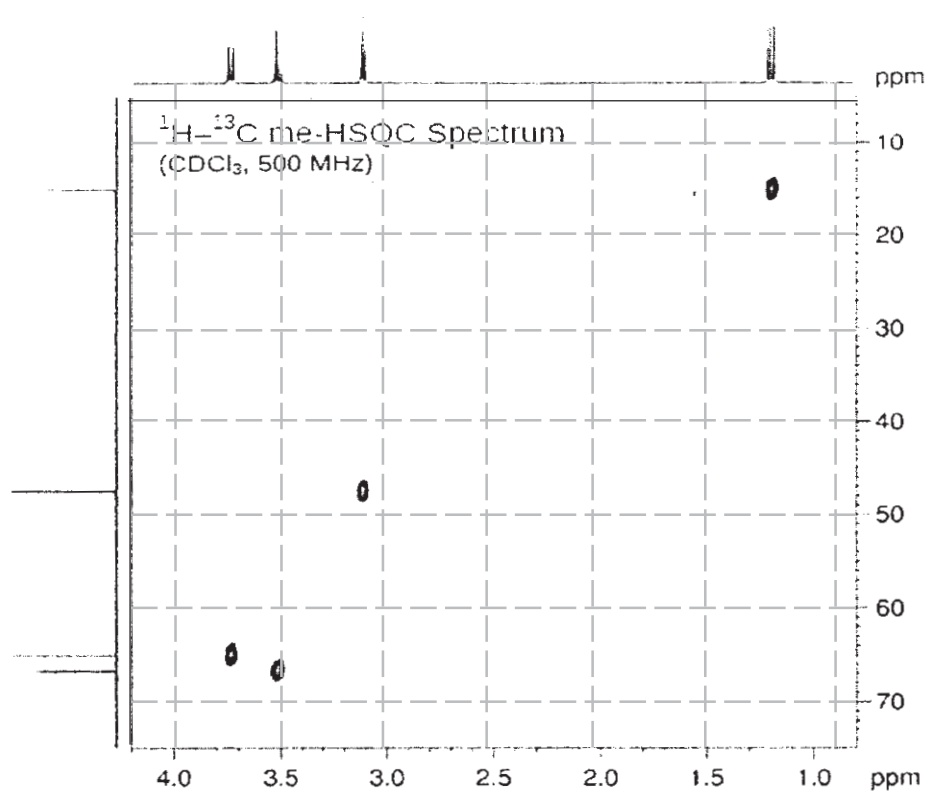
- 137 (s), 136 (s), 128(s), 121(d)
- 118(d), 117(d), 111(d), 106(s)
- 61(d), 56(t), 55(q), 54(t)
- 30(t), 26(t), 25(t), 22(t).

**Q6)** The spectra of an unknown compound are shown on the adjacent page. Analyze the spectra and use the data to arrive at a structure with justification. [10]

Molecular Formula:  $C_5H_9ClO_2$



[5023]-311



Total No. of Questions : 6]

SEAT No. :

P2881

[5023]-312

[Total No. of Pages : 4

M.Sc.

**ORGANIC CHEMISTRY**

**CHO - 352 : Organic Stereochemistry  
(2013 Pattern) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

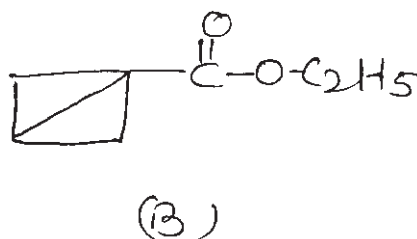
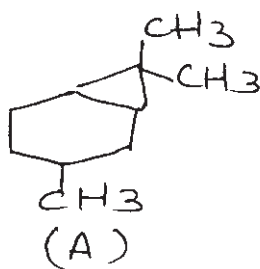
- 1) *All questions are compulsory.*
- 2) *Figures to the right indicates full marks.*
- 3) *Answers to the two sections should be written in separate answer books.*

**SECTION - I**

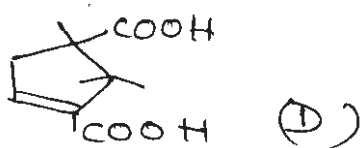
**Q1)** Answer the following:

**[10]**

- a) Draw the stable conformation of Trans-1, 3-di-t-butylcyclohexane. Why it is more stable?
- b) Draw the structure of paracyclophane and comment on the anomalous nature of its UV-spectrum.
- c) Write the IUPAC names of the compounds (A) and (B) with the following structures.



- d) Unsaturated camphanic acid (D) undergoes dehydration to form an anhydride only under vigorous conditions with migration of double bond. Explain.



**P.T.O.**



- e) During acetolysis compound with structure (E) reacts faster than compound with structure (F). Justify.



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

- Neomenthyl chloride on exposure to alkali reacts 200 times faster to give 3-menthene while menthylchloride under similar conditions reacts slowly and gives 2-menthene. Justify.
- The energy difference between cis and trans isomers of 9- Methyldecalin is less in comparison to the difference between cis and trans decalins. Explain.
- Draw the conformations of Trans-anti-trans and cis-anti-trans perhydroanthracenes. calculate their energies and comment on their stabilities.
- Predict the product/s formed by reaction of nitrous acid with cis and trans-2-aminocyclohexanols. Justify the answer with mechanism.

**Q3)** Answer any one of the following: **[5]**

- Predict the major product formed by reaction of 4-t-butylcyclohexanone with
  - Hydrogen, Ni and
  - $\text{LiAlH}_4$ .Justify with proper mechanism.
- Write short notes on:
  - Von-Auwer rule
  - 2-Alkylketone effect

## SECTION - II

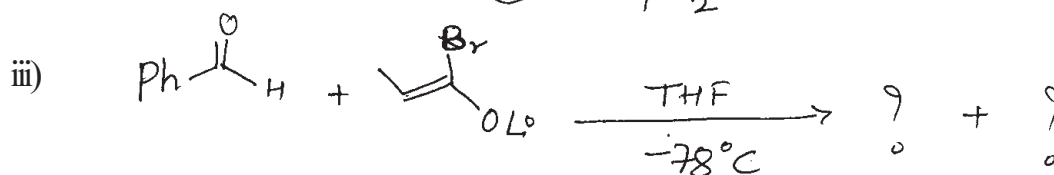
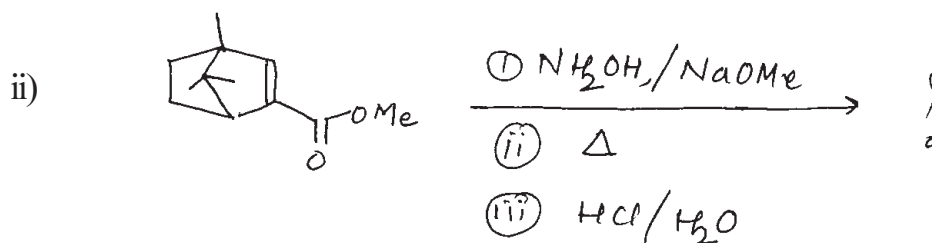
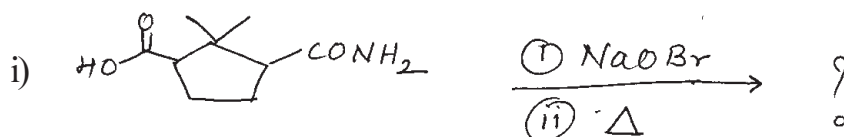
**Q4)** Answer Any Three of the following: [9]

- a) Describe resolution modification by formation of Diastereoisomers.
- b) Explain the term "Circular dichroism" with example.
- c) Explain the method of resolution for aminoacids.
- d) How infrared and Raman spectral studies helps in determination of configuration of Olefins.

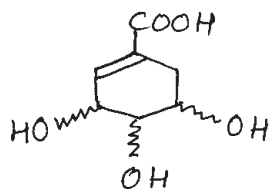
**Q5)** Answer Any Four of the following: [8]

- a) Explain the stereochemical principle involved for electrophilic addition reaction.
- b) Describe the method of resolution via molecular complexes.
- c) Explain the use of N.M.R. spectroscopy study for conformational changes.
- d) Explain the term "Optical purity" with example.
- e) Malic acid on treatment with  $\text{PCl}_5$  gives (+) chlorosuccinic acid while on treatment with  $\text{SOCl}_2$  gives (-) chlorosuccinic acid. Explain.

**Q6)** a) Predict the product /s in Any Two of the following and explain stereochemical principles involved. Justify. [4]



- b) Organic acid ① shows the following spectral data. Draw the correct stereostructure of organic acid ① and explain all the structural details and stereo chemistry with the help of spectral data. [4]



organic acid. ①

$^{13}\text{C-NMR}$ -172.9, 140, 132.5, 75, 69, 68, 33.1

$^1\text{H-NMR}$ : 2.23 (ddd,  $J = 18.6.5, 1.9\text{Hz}$ , 1H)

2.74 (ddd,  $J = 18, 5.3, 1.8\text{Hz}$ , 1H)

3.78 (dd,  $J = 9, 4.4\text{ Hz}$ , 1H)

4.04 (ddd,  $J = 9, 6.5, 5.3\text{ Hz}$ , 1H)

4.46 (dd,  $J = 4.4, 4.2, \text{Hz}$ , 1H)

6.83 (ddd,  $J = 4.2, 1.8, 1.9, \text{Hz}$ , 1H)



Total No. of Questions : 6]

SEAT No. :

P2882

[5023]-313

[Total No. of Pages : 4

M.Sc. - II

**ORGANIC CHEMISTRY**

**CHO - 353 : Photochemistry, Pericyclic Reactions and Heterocyclic Chemistry**  
**(Semester - III) (2013 Pattern)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*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.*

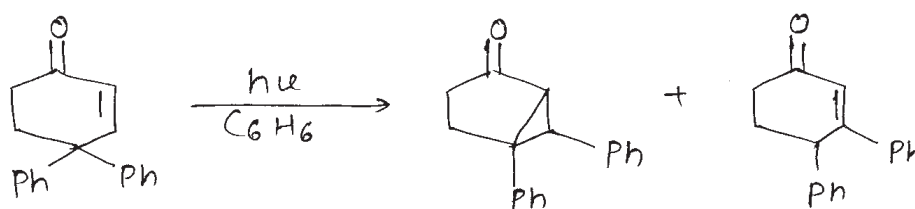
**SECTION - I**

**Q1)** Explain the following (all sub questions are compulsory): **[10]**

- a) Predict the structure of the 2, 4-heptadiene produced by the thermal ring opening of Cis - 3 - ethyl - 4 - methyl cyclobutene.
- b) Explain 1, 3- photoaddition of benzene.
- c) What is “endo-rule” as applied to Diels-Alder reaction.
- d) Synthetic application of Barton reaction.
- e) Cyclobutanone undergoes three type of photo reactions.

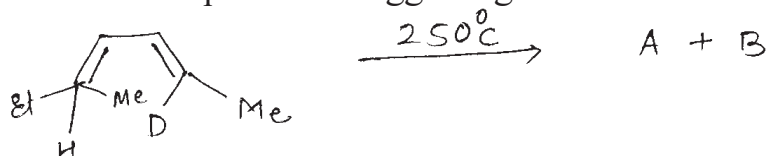
**Q2)** Answer the following (any two): **[10]**

- a) i) Irradiation of 4, 4-diphenyl cyclohexanone yields a mixture of two products.

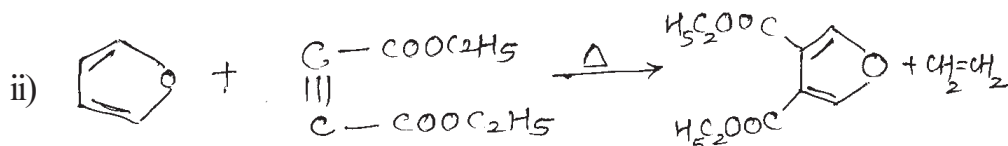
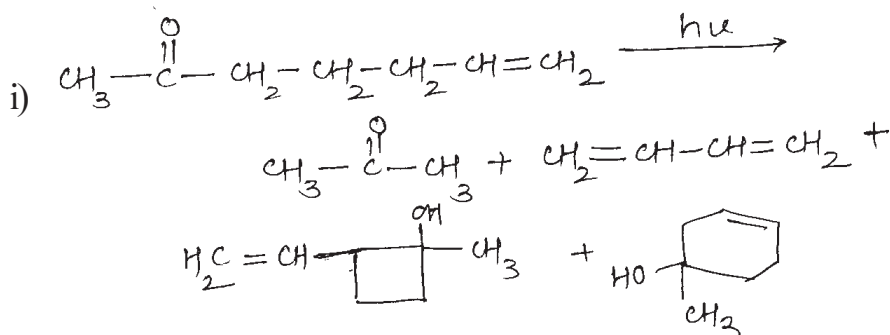


**P.T.O.**

ii) Predict the product/s suggesting mechanism.

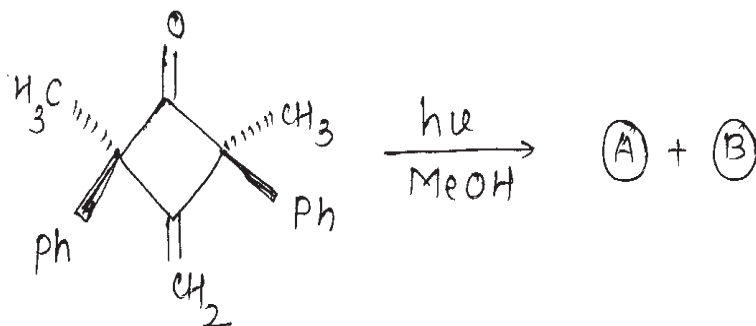


b) Suggest the mechanism for the following reactions:

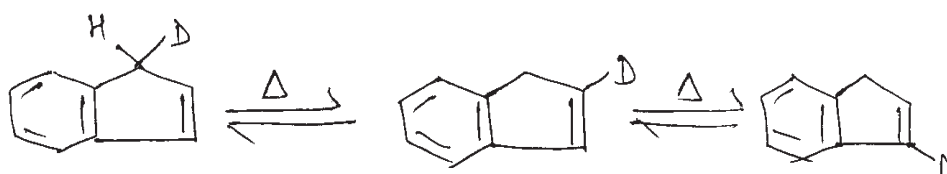


c) i) Draw the molecular orbital of pentadienyl system. Comment on their symmetry with respect to C<sub>2</sub> axis of symmetry.

ii) Predict the product with suitable mechanism.



d) Suggest mechanism for following reactions:



**Q3)** Write notes on any two: [5]

- a) 2-chloro-5-methylanisole + 6 - methyl hept - 5 - en - 2 - one.
- b) Claisen rearrangement.
- c) Sensitised Cis-Trans isomerisation.

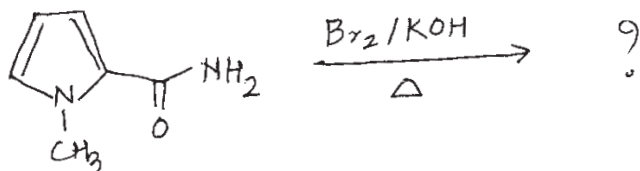
### SECTION - II

**Q4)** Answer all the questions in brief: [10]

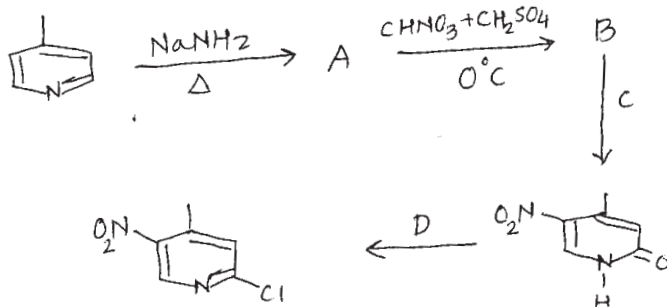
- a) 4-chloro-3-nitropyridine hydrolyses readily under milder conditions.
- b) Electron donating groups on the ring involved in Bischler-Napierlaski synthesis favors the synthesis.
- c) Furan can not be directly alkylated under Friedel Crafts alkylation conditions.
- d) Imidazole is more acidic than pyrrole.
- e) The diazines are more resistant to electrophilic attack than pyridine.

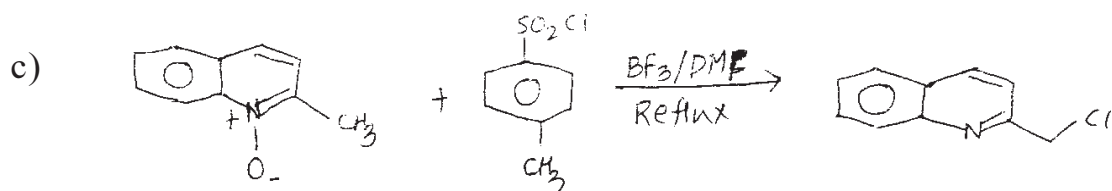
**Q5)** Do as directed Any two of the following: [10]

- a) Predict the product in the following reaction giving detail mechanism.

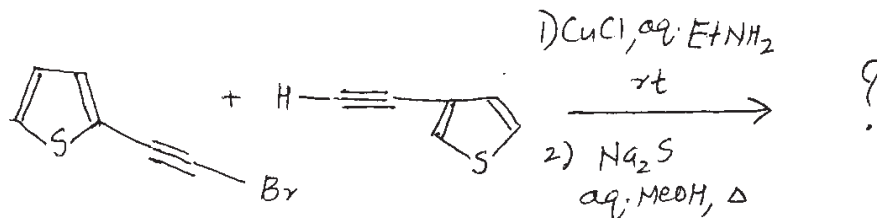


- b) Identify A, B, C, D from the following sequence





d) Identify the product in the following reaction:



Q6) Write a note on any one of the following:

[5]

- Hantzsch synthesis.
- Madelung Indole synthesis.
- Knorr pyrrole synthesis.



Total No. of Questions : 6]

SEAT No. :

**P2883**

**[5023]-314**

[Total No. of Pages : 3

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CHA - 390 : Electroanalytical and Radioanalytical Methods of  
Analysis**

**(2013 Pattern) (Credit System) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following:

**[10]**

- a) Give advantages and limitations of amperostatic coulometry.
- b) Differentiate between streamlined flow and turbulent flow.
- c) Explain the use of suppressor in polarography.
- d) State different types of excitation signals in pulse polarography.
- e) Enlist any two applications of hydro dynamic voltammetry.

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

**[10]**

- a) Explain quasi reversible and irreversible cyclic voltammetry.
- b) Explain the use of stripping method in detection of lead from tap water.
- c) Sketch and explain the amperometric titration curve when only analyte is reduced.
- d) A 10 mL aqueous solution of the biochemical compound flavin adenine dinucleotide (FAD) was assayed by controlled potential coulometry at  $-0.8V$  versus SCE  $FAD + 2H^+ + 2\bar{e} = FADH_2$

The area under the current curve was 33.7 mA.min. Determine the concentration of FAD in the sample.

**P.T.O.**



**Q3)** Attempt any one of the following: [5]

- a) Explain the voltammogram obtained during a constant current coulometric study.
- b) At a potential on the plateau of a polarographic wave for the two electron reduction of a metal ion  $M^{2+}$  to the metal M,  $m$  and  $t$  were respectively equal to 1.46 mg/s and 4.29 S. Polarograms of the series of standard  $M^{2+}$  solutions were recorded and the diffusion current were plotted as a function of concentration. The slope of the plot was  $4.92 \mu A/mM$ . Calculate the diffusion coefficient of the ion.

### SECTION - II

**Q4)** Answer the following: [10]

- a) Give the applications of neutron activation analysis.
- b) Give the different applications of isotope dilution analysis.
- c) Explain the radiometric titration curve for the estimation of ions from their mixture.
- d) State and explain the principle of differential thermal analysis.
- e) Explain the thermogram of quantitative analysis of  $CuSO_4 \cdot 5H_2O$ .

**Q5)** Attempt any two of the following: [10]

- a) Give the advantages, disadvantages and limitations of neutron activation analysis.
- b) Describe the technique of direct isotope dilution analysis.
- c) Distinguish between DTA and DSC.
- d) A 0.5 mL of a sample solution containing 1 microcurie radioactivity due to tritium is injected into the blood stream of a laboratory animal. After sufficient time for circulatory equilibrium to be established a 0.1 mL of a blood was found to have an activity of 125 dpm. Calculate the blood volume in the body of an animal.

(Initial activity = 20,000 dpm for 0.1 mL)

**Q6)** Attempt any one of the following:

**[5]**

- a) Write a critical note on thermometric titration.
- b) On a TGA apparatus a mixture of crystalline barium chloride and a thermally stable salt was analysed. Initially the weight of mixture was 1.248 g at room temperature and at 200°C temperature, loss in weight was 65 mg due to dehydration of crystalline salt. Determine the percentage composition of the mixture.

(Given: At wt. Ba = 137.32, Cl = 35.5, Na = 23, O = 16 and H = 1).



Total No. of Questions : 6]

SEAT No. :

**P2884**

**[5023]-315**

[Total No. of Pages : 2

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CHA - 391 : Pharmaceutical Analysis**

**(2013 Pattern) (Credit System) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following:

**[10]**

- a) Define limit test. Give suitable example.
- b) What is wet sterilization?
- c) What is systematic error?
- d) Define:
  - i) Drug.
  - ii) Cosmetic.
- e) Give the principle of biological assay.

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

**[10]**

- a) What is test of sterility? Suggest any one method for it.
- b) What is the principle of microbial assay? Give the method for two level factorial assay.
- c) What are requirements of water for pharmaceutical purposes?
- d) Give the limit tests for Iron and Arsenic.

**P.T.O.**

**Q3)** Attempt any one of the following: [5]

- a) Write brief account on development of new drugs.
- b) Give biological assay for Tetanous antitoxin.

### SECTION - II

**Q4)** Answer the following: [10]

- a) What is aromatic water? How is it prepared?
- b) Explain different types of tablets.
- c) What is foreign organic matter?
- d) Write a note on types of powders used in pharmaceutical preparations.
- e) Give advantages of aerosols in pharmaceuticals.

**Q5)** Attempt any two of the following: [10]

- a) Give the various sources of impurities in pharmaceuticals.
- b) Write a short note on determination of shelf life of pharmaceutical products.
- c) Give an account of ointments and creams.
- d) 0.42g Ibuprofen sample [ $C_{13}H_{11}O_2$ ] was dissolved in 100 ml alcohol which was previously neutralised using phenolphthalein. It was then titrated with 0.1N NaOH and required 19.9 ml of NaOH. Calculate the percentage of Ibuprofen in given solution.

**Q6)** Attempt any one of the following: [5]

- a) What are capsules? Explain different methods of preparation of soft and hard capsules.
- b) A 0.3g sample of paracetamol [ $C_8H_9NO_2$ ] was dissolved in 30 ml 2N  $H_2SO_4$ . This solution was titrated with 0.1N ceric ammonium sulphate using ferroin sulphate as indicator. This gave a burette reading 8.2 ml. Calculate percentage of paracetamol.

[At. wt C = 12, H = 1, N = 14, O = 16].



Total No. of Questions : 6]

SEAT No. :

**P2885**

**[5023]-316**

[Total No. of Pages : 2

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CHA - 392 : Advanced Analytical Techniques  
(2013 Pattern) (Credit System) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following questions:

**[10]**

- a) Why should stopcock be opened between each inversion of separating funnel?
- b) What is end capping?
- c) What are the main advantages of laboratory of an online-SPE procedure?
- d) How might preservation of organic compounds on the SPME fibre taken place?
- e) What causes the heating effect of microwaves on samples?

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

**[10]**

- a) Explain "Purge and Trap" technique for volatile organics in aqueous samples.
- b) Discuss SPE formats and apparatus.
- c) Give the application of Normal phase SPE.
- d) Give the application of SFE techniques.

***P.T.O.***

**Q3)** Attempt any one of the following: [5]

- a) Explain process of SPME with figure.
- b) Give the applications of microwave assisted extraction.

**SECTION - II**

**Q4)** Attempt the following: [10]

- a) Explain the role of plasma in atomic emissive spectrometry.
- b) How wavelength will be selected in atomic fluorescence spectrometry?
- c) Give any two applications of ICPMS.
- d) Distinguish between FES and AAS.
- e) Explain the interferences observed in laser enhanced ionization spectroscopy.

**Q5)** Attempt any two of the following: [10]

- a) Explain the phenomenon of atomic fluorescence.
- b) Write a note on double focusing mass analyzer.
- c) Mention importance of micronutrients for growth of plants. Describe suitable method for the determination of copper for soil.
- d) Explain the principle of laser and phenomenon involved in it.

**Q6)** Solve any one of the following: [5]

- a) A soil sample was analyzed for determination of Fe at 535 nm in air-acetylene flame by AAS. Observations are as follows:

Fe(ppm)	0.00	0.2	0.4	0.6	0.8	1.0	Sample
Absorbance	0.009	0.0657	0.1314	0.1974	0.2630	0.3290	0.1560

Calculate the concentration of Fe in ppm present in soil sample.

- b) Calculate the magnetic flux density that is required to focus a  $C_4Hg^+$  ion on the detector in a mass spectrometer in which the accelerating potential is fixed at 2.00 KV and the radius of curvature of the focused ionic beam at the exit slif is 30.0 cm.



Total No. of Questions : 9]

SEAT No. :

**P2886**

**[5023]-317**

[Total No. of Pages : 3

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CHA - 380 : I - Analytical Method Development and Validation.**

**II - Geochemical and Alloy Analysis**

**III - Laboratory Automation and Sensor Based Techniques**

**(2013 Pattern) (Credit System) (Semester - III)**

*Time : 3 Hours]*

*[Max. Marks : 50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following:

**[10]**

- a) Explain the term, random error.
- b) Define and explain the term, limit of detection.
- c) What parameters are affect on the dissolution studies?
- d) Explain, How experimental design can help to achieve certain objectives?
- e) Enlist different topics selected for initial harmonisation.

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

**[10]**

- a) Explain the terms: accuracy, precission and linearity with suitable example.
- b) Discuss the inter-laboratory qualification process of assay validation.
- c) Define mean deviation and standard deviation. How to reduce the standard deviation?
- d) The mean of five determinations of the nickel content of a sample of an alloy was 7.28% with a standard deviation of 0.25%. Calculate the 95% confidence limit for the true value.

[Given : t table = 2.78 for 4 degree of freedom]

**P.T.O.**

**Q3)** Attempt any one of the following: [5]

- a) What is selectivity? Explain the effect of impurity levels on chromatographic resolution.
- b) The percentage of chloride in  $\text{CaCl}_2$  was reported by different person as follows: 32.04, 32.14, 32.54 and 32.61%. Calculate mean deviation, relative mean deviation and standard deviation.

## **SECTION - II**

### **(Geochemical and alloy Analysis)**

**Q4)** Answer the following: [10]

- a) What is an ore? Give two examples.
- b) Explain cation exchange capacity of soil.
- c) Give the principle of estimation of carbonate from soil.
- d) What are major and minor constituents of monazite and ilmenite ore?
- e) State the principle of estimation of nickel from Nichrome alloy.

**Q5)** Attempt any two of the following: [10]

- a) Discuss the method used for determination of tin from solder alloy.
- b) Give the method used for determination of copper from Bronze alloy.
- c) Outline the analytical procedure used for estimation of iron from haematite ore.
- d) 0.190 gm of bauxite are was disintegrated using suitable method. The filtrate containing  $\text{Al}^{3+}$  ions was diluted to 100 ml. An align of 10 ml required 17 ml of 0.015 M EDTA solution for complete reaction. Calculate the percentage of  $\text{Al}_2\text{O}_3$  in the given sample.

[Given - Atomic mass  $\text{g mol}^{-1}$  Al = 26.98, O = 15.99]



**Q6)** Attempt any one of the following: [5]

- a) How Uranium is separated from monazite ore?
- b) 0.225 gm brass sample was dissolved in 20 ml con. HCl and was diluted to 100 ml. A 10 ml of aliquot for the filtrate was withdrawn and 5%, 10 ml KI was added to it. The liberated iodine was titrated with 0.025 N  $\text{Na}_2\text{S}_2\text{O}_3$  solution and the titre value obtained was 9.6 ml. Calculate the percentage of copper in the sample.

[Given At. mass  $\text{g mol}^{-1}$ :- Cu = 63.54, O = 15.99, I = 127.0, Na = 23.0, S = 32.0]

### SECTION - III

**Q7)** Answer the following: [10]

- a) Give advantages of automation.
- b) Why ceramics are used in sensors?
- c) Explain surface acoustic wave sensors.
- d) State the four criteria of sensors.
- e) Explain use of biosensors in chemical analysis.

**Q8)** Attempt any two of the following: [10]

- a) Explain the design of fiber optics sensor.
- b) Draw a schematic diagram of discrete sample analyzer and explain the working of its components.
- c) What is flow injection analyzer? Explain it with a flow diagram.
- d) Explain the concept of Minaturized analytical systems.

**Q9)** Attempt any one of the following: [5]

- a) Define Microfabrication. Explain silicon and glass micromatching.
- b) Explain continuous flow analyzer with labeled diagram.



Total No. of Questions :6]

SEAT No. :

**P2887**

**[5023]-401**

[Total No. of Pages :3

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 410: Molecular Structure and Spectroscopy**

**(New) (2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

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

**P.T.O.**

## SECTION -I

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

- a) Define shielding of magnetic nuclei.
- b) Briefly state NOE.
- c) Explain magic angle in esr.
- d) State principle of PAS.
- e) What is the concept of quadrupole coupling constant in nqr.

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

- a) What is chemical shift? Discuss the factors affecting the chemical shift in nmr spectra.
- b) Describe the instrumentation used in esr spectroscopy with a suitable diagram.
- c) State and explain Bragg's diffraction law.
- d) Distinguish between  $^{13}\text{C}$  nmr spectroscopy and esr spectroscopy.

**Q3)** Solve any one of the following: **[5]**

- a) A free electron resonates at 9.8 GHz at a magnetic field strength 0.33 T. At what frequency will resonance occur if the magnetic field is 1.5 T.
- b) Predict the intensity distribution in the hyperfine lines of the esr spectrum of the radicals  $\cdot\text{CH}_3$  and  $\cdot\text{CD}_3$ .

## SECTION -II

**Q4)** Answer precisely the following: **[10]**

- a) Define the terms - magnetic susceptibility per unit volume, mass susceptibility, atomic susceptibility and antiferromagnetism.

- b) State the equation for the susceptibility of a powdered solid relative to a liquid reference and explain the terms involved in it.
- c) State the assumptions made by Van Vleck to calculate susceptibility.
- d) Explain the terms constructive and destructive interferences observed in X-ray diffraction.
- e) Which are the methods used to overcome the phase problem to some extent in X-ray diffraction.

**Q5)** Attempt any two of the following: **[10]**

- a) What are the methods used to detect X-rays. Describe any one method?
- b) Explain Gouy experiment to determine gram susceptibility of a sample.
- c) Derive the Wierl equation for a diatomic homonuclear molecule.
- d) Draw a neat labelled diagram of neutron spectrometer and explain its working.

**Q6)** Solve any one of the following: **[5]**

- a) X rays ( $\lambda=1.54 \text{ \AA}$ ) are used to calculate the spacing of (0 0 2) planes in aluminium. The Bragg angle for first order reflection is  $22.39^\circ$ . What is the size and volume of the aluminium crystal?
- b) Using Pascal's constants and constitutive corrections, calculate the molar susceptibility of m-xylene ( $C_8H_{10}$ ).

Pascal's constants in CGS unit:  $C = -6.00 \times 10^{-6}$

$H = -2.93 \times 10^{-6}$

Constitutive correction:  $C \text{ in ring} = -0.24 \times 10^{-6}$ .

*EEE*

Total No. of Questions :6]

SEAT No. :

**P2888**

**[5023]-402**

[Total No. of Pages :3

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 411: Surface Chemistry and Electrochemistry**

**(New) (2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer books.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of 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	$\beta_e$	=	$-9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	$\beta_n$	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	$m_e$	=	$9.11 \times 10^{-31} \text{ kg}$

**P.T.O.**

## SECTION -I

**Q1)** Answer precisely the following: **[10]**

- a) Write Gibbs equation and enlist the methods of its verification.
- b) What is capillary condensation? Write the Kelvin's equation.
- c) What are micelles? Give their types.
- d) Define differential and integral energy of adsorption.
- e) What is hysteresis of adsorption?

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

- a) Describe the microtome method for verification of the Gibbs equation.
- b) Derive Langmuir's equation for monolayer adsorption. At what condition it gets reduced to Freundlich's equation?
- c) Give critical comparison of various multilayer models for adsorption.
- d) Describe the modelless method of determination of a pore size.

**Q3)** Solve any one of the following: **[5]**

- a) The following table gives the number of multilitres (v) of nitrogen adsorbed per gram of active carbon at 0°C at a series of pressures:

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

Plot the data according to Langmuir isotherm and determine the constants K and  $V_m$ .

- b) The acid  $\text{CH}_3(\text{CH}_2)_{13}\text{COOH}$  forms a nearly perfect gaseous monolayer on water at 25°C. Calculate the weight of acid per 100 cm<sup>2</sup> required to produce film pressure of 10<sup>-3</sup> Nm<sup>-1</sup>. [mol. wt of acid = 242].

## SECTION -II

**Q4)** Answer precisely the following: **[10]**

- a) State the postulates of Debye-Huckel theory.
- b) Explain the term 'Born charging contribution'.
- c) Write the Einstein relation for the movements and drifts of ions, atoms and molecules. Explain the terms involved in it.
- d) What is meant by a low temperature and a high temperature fuel cells?
- e) Define ionics and electrodictics.

**Q5)** Attempt any two of the following: **[10]**

- a) Discuss the Gouy-Chapman diffuse-layer theory.
- b) Derive the Nernst-Einstein equation which relates the diffusion coefficients of ions and equivalent conductivity.
- c) Derive the equation for thickness of ionic atmosphere.
- d) Write a note on lithium-ion battery.

**Q6)** Attempt any one of the following: **[5]**

- a) The drift velocity of an univalent ion is  $4 \times 10^{-8} \text{ cms}^{-1}$ , under potential gradient of  $0.5 \text{ mV cm}^{-1}$ . Calculate the absolute ionic mobility and conventional ionic mobility of ion.
- b) 200 ml 0.2 M  $\text{MnCl}_2$  is mixed with 100 ml 0.04 M  $\text{kBr}$ . Calculate the ionic strength of solution assuming complete dissociation.

*EEE*

Total No. of Questions :6]

SEAT No. :

**P2889**

**[5023]-403**

[Total No. of Pages :3

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 412: Materials Chemistry and Catalysis**

**(New) (2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*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	=	$8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ $= 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ $= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7. Faraday Constant	F	=	$96487 \text{ C equiv}^{-1}$
8. Speed of light	c	=	$2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
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12. Nuclear magneton	$\beta_n$	=	$5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	$m_e$	=	$9.11 \times 10^{-31} \text{ kg}$

**P.T.O.**



## SECTION -I

**Q1)** Answer precisely the following: **[10]**

- a) Define 'anyzotropy'.
- b) Give the applications of Langmuir - Blodgett films.
- c) Give the structure and example of 2 - 1 - 4 superconductor.
- d) Define transistor and give its types.
- e) What is positive photolithography.

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

- a) Describe the properties of perovskites.
- b) Discuss pseudogap in cuprate superconductors.
- c) Explain the sol-gel method to prepare thin films.
- d) Describe the types of pairing mechanism in high temperature superconductors.

**Q3)** Solve any one of the following: **[5]**

- a) At a temperature 20°C, a light bulb with a carbon filament has a resistance of 150Ω. The power supply has zero resistance. What is the temperature of this filament?

[Given: Temperature coefficient of resistivity for carbon is  $-5 \times 10^{-4} \text{C}^{-1}$  at  $t_0 = 20^\circ\text{C}$ ]

- b) The fraction of nonreflected light that is transmitted through a 200 mm thickness of glass is 0.98. Calculate the absorption coefficient of the material.

## SECTION -II

**Q4)** Answer precisely the following: **[10]**

- a) Define the terms - promotor and inhibitor.
- b) What is catalyst deactivation?
- c) Differentiate between homogeneous and heterogeneous catalysis.
- d) What are auto-exhaust catalyst? Give one example.
- e) State the properties of zeolites.

**Q5)** Answer any two of the following: **[10]**

- a) Discuss the mechanism of chemisorption on metal oxides.
- b) Describe the hydrothermal method for preparation of catalysts.
- c) How is the characterization of a catalyst done by using XPS technique?
- d) Write a note on homogeneous catalysis.

**Q6)** Solve any one of the following: **[5]**

- a) The adsorption of oxygen on tungsten surface is described by Langmuir isotherm with  $K = 0.45 \text{ kPa}^{-1}$ . Calculate the fractional surface coverage at a pressure of 1.5 kPa.
- b) The following table gives the data for adsorption of methane on one gram of charcoal at  $0^\circ\text{C}$  which obeys the Langmuir isotherm. Determine the constants,  $K$  and  $V_m$  in the Langmuir equation.

P (mm of Hg)	100	200	300	400
V( $\text{cm}^3$ )	9.75	14.5	18.2	21.4

*EEE*

Total No. of Questions :6]

SEAT No. :

**P2890**

**[5023]-404**

[Total No. of Pages :3

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 413: Biophysical Chemistry**

**(New) (2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

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

**P.T.O.**

## SECTION -I

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

- a) Give the colour tests for proteins.
- b) State the Bragg equation.
- c) What is the role of mitochondria in a biological cell?
- d) Differentiate between secondary and tertiary proteins.
- e) Write the significance of ferritin in metabolism.

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

- a) Explain denaturation of proteins.
- b) Discuss the classification of proteins.
- c) Explain the gel electrophoresis technique.
- d) Discuss the types of electrophoresis.

**Q3)** Attempt any one of the following: **[5]**

- a) Calculate the standard free energy of the reaction Dihydroxy acetone phosphate  $\xrightleftharpoons{\text{catalyst}}$  Glyceraldehyde 3 phosphate. At equilibrium, the ratio of glyceraldehyde 3 phosphate to dihydroxy acetone phosphate is 0.0475 at 25°C and 7pH.
- b) Discuss the reactions related to hydrolysis of ATP.

## SECTION -II

**Q4)** Answer precisely the following: **[10]**

- a) What is a nerve? State its types with examples.
- b) Define depolarization and repolarization in generation of an impulse.

- c) Enlist the factors affecting enzyme activity.
- d) Explain the term 'flow birefringence'.
- e) What is reversible enzyme inhibition?

**Q5)** Answer any two of the following: **[10]**

- a) Explain how ions are transported through a cell membrane.
- b) Give the classification of biopolymer particles based on shapes. What are fibrous and globular proteins?
- c) Explain irreversible enzyme inhibition with examples.
- d) Discuss the theory of optical rotatory dispersion.

**Q6)** Solve any one of the following: **[5]**

- a) A polymer sample contains equal number of molecules with molecular weight 10,000 and 20,000. Calculate  $\bar{M}_n$  and  $\bar{M}_w$ .
- b) 1.0 g of a polyester in 100 cm<sup>3</sup> methyl ethyl ketone required 13.5 cm<sup>3</sup> of  $5 \times 10^{-3}$  m alcoholic KOH for neutralization. Calculate the molecular weight of the polymer.

*EEE*

Total No. of Questions :6]

SEAT No. :

**P2891**

**[5023]-405**

[Total No. of Pages :3

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CHP - 414: Special Topics in Nuclear and Radiation Chemistry**

**(New) (2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*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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13. Mass of an electron	$m_e$	=	$9.11 \times 10^{-31} \text{ kg}$

**P.T.O.**

## SECTION -I

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

- a) What are the special features of photonuclear reactions?
- b) What are the after effects of chernobyl accident?
- c) Distinguish between somatic and genetic effects of radiations.
- d) What are the ideal properties on a radionuclides used for diagnostic purposes?
- e) Which precautions are to be taken while handling the radioactivity?

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

- a) Write a note on thermonuclear reactions.
- b) Explain the working of Cockroft - Walton accelerator.
- c) Describe how external radiation hazards can be controlled?
- d) Enlist various personal dosimeters. Explain the details of any one of them.

**Q3)** Solve any one of the following: **[5]**

- a)  $^{14}\text{N}$  has an excited state at 12.8 MeV. at which energy of incident particle would resonance capture occur in case of  $^{10}\text{B} (\alpha, n) ^{13}\text{N}$  reaction. Given, atomic mass of  $^{10}\text{B} = 10.012931$ ,  $\alpha = 4.002604$   $^{14}\text{N} = 14.003\ 074$  amu.
- b) Find out the dose due to 300 mCi  $^{60}\text{Co}$  source at a distance of 3 meters. Given: Gamma energy = 1170 & 1330 KeV.

## SECTION -II

**Q4)** Attempt the following: **[10]**

- a) Explain the term premordial nucleosynthesis.
- b) What are the sources of high level radioactive waste generation?
- c) What are the products of radiolysis of aromatic hydrocarbons?
- d) Discuss the general principle of radiometric titration.

**Q5)** Attempt any two of the following: [10]

- a) Write a note on pulse radiolysis.
- b) What are the reactions in C,N,O burning?
- c) Write a note on radiometric titrations based on back scattering of  $\beta^-$  particles.
- d) Write a note on radiolysis of benzene.

**Q6)** Solve any one of the following: [5]

- a) 25 ml of K\*I was titrated with 0.01 m AgNO<sub>3</sub> radiometrically. Addition of 2ml of AgNO<sub>3</sub> showed loss in activity from 24000 counts per 4 minutes to 2000 counts /5 min. Find the amount of KI. [Given: At.wts. k=39.9, I = 127].
- b) Find the thickness of Pb required to reduce the activity from 20000 cpm to 4000 cpm.  
[Given:  $\mu_e = 0.211 \text{ b/e}^-$ ,  $Z = 82$ ,  $A = 207$ , density = 1.35 g/cm<sup>3</sup>]

EEE



Total No. of Questions :4]

SEAT No. :

**P2892**

**[5023]-406**

[Total No. of Pages :2

**M.Sc. -II**

**INORGANIC CHEMISTRY**

**CHI-430: Inorganic Polymers and Heterogeneous Catalysis  
(2013 Pattern) (Semester - IV) (4 Credits)**

*Time :3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

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

**Q1)** Answer the following:

**[20]**

- a) Define porous material? Give its classification.
- b) What are the desired properties of heterogeneous catalysts?
- c) How promoters affects the performance of catalyst? Illustrate with suitable example.
- d) What do you mean by PBU & SBU? How they are formed?
- e) How temperature and time influences during zeolite synthesis?
- f) How do you prepare Ni/Al<sub>2</sub>O<sub>3</sub> catalyst by wet impregnation method?
- g) What is photocatalysis? List out the metal oxides used as photocatalysts.
- h) Give physical properties of Scheelite structure.
- i) Draw the structure of [Nb<sub>6</sub>O<sub>19</sub>]<sup>8-</sup>.
- j) What do you mean by Inorganic polymer? Mention any two important properties of them.

**P.T.O.**

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

- a) Give an account of different types of heterogeneous reactions along with suitable example of each.
- b) List out various methods for characterisation of zeolite and explain any one method in detail.
- c) Define chemical reactor. Give its different types. Explain construction, working, merits & demerits of stirred tank reactor.
- d) Discuss the role of support in supported metal catalyst.

**Q3)** Attempt the following (Any two): [10]

- a) Give an account of use of intercalated clays as a catalyst.
- b) How temperature programmed techniques are useful in characterisation of heterogeneous catalysts?
- c) Discuss in brief about origin of different types of acidic sites on zeolite framework structure.
- d) Give an account of heteropolyanions of Mo. and W.

**Q4)** Write a short note on (Any two): [10]

- a) Perovskite type oxides as a catalysts.
- b) SOD and LTA type of zeolites.
- c) Catalytic converter.
- d) S-N compounds.

*EEE*

Total No. of Questions :4]

SEAT No. :

**P2893**

**[5023]-407**

[Total No. of Pages :2

**M.Sc. -II**

**INORGANIC CHEMISTRY**

**CHI-431: Material Science - I**

**(Solid State & Other Inorganic Materials)**

**(2013 Pattern) (New 4 Credits) (Semester - IV)**

*Time :3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

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

**Q1)** Answer the following questions:

**[20]**

- a) What is point defect? Explain its types.
- b) Explain the origin of magnetism.
- c) What are Hard and Soft ferrites?
- d) Explain High T<sub>c</sub> Superconductors.
- e) Explain the intermetallic superconductors.
- f) A piece of wood containing moisture weighed 165.3 gm and after oven drying showed constant weight is 147.5 gms. Calculate the moisture content.
- g) What is the effect temperature on magnetic susceptibility value on paramagnetic materials? Explain with graphical representation.
- h) What are ceramic materials? Explain with suitable examples.
- i) What are Biomaterials? Explain with suitable examples.
- j) Explain set-retardars & accelerators with suitable examples.

**P.T.O.**

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

- a) State and explain Fick's laws of diffusion.
- b) Derive the expression for the Curie law.
- c) Explain orthopaedic & dental applications of biomaterials.
- d) Explain the cement making process with flowsheet diagram.

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

- a) What are different types of magnetism?
- b) Explain Bardeen-Cooper- Schrieffer theory of superconductivity.
- c) What are superconductors? Discuss the properties & applications of superconductors.
- d) Saturation magnetisation of simple cubic iron is 1600 kA/m. Calculate the net magnetic moment of simple cubic iron atom. [Given Lattice parameter is  $2.87 \text{ \AA}$ .]

**Q4)** Write short notes on (Any two): **[10]**

- a) Sol- gel process.
- b) Fiber - reinforced plastics.
- c) i) Oil-well cement.  
ii) Macrodefect free cement.
- d) Hard and Soft wood.

*EEE*

Total No. of Questions :4]

SEAT No. :

**P2894**

**[5023]-408**

[Total No. of Pages :2

**M.Sc. -II**

**INORGANIC CHEMISTRY**

**CHI-432: Material Science - II (Nano Materials)**

**(2013 Pattern) (4 Credit) (Semester - IV)**

*Time :3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

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

**Q1)** Answer the following:

**[20]**

- a) What do you mean baise, Forward baise and backward baise.
- b) Complete the following reaction:  
$$4\text{Fe}^{3+} + 3[\text{BH}_4]^- + 9\text{H}_2\text{O} \rightarrow ? + ? + ? + 6\text{H}_2 \uparrow$$
- c) What is carbon nanotube? Classify the carbon nanotubes.
- d) Give one example of targeted drug delivery using metal nanoparticles.
- e) Explain hot-spot mechanism in synthesis of nanoparticles.
- f) Write in brief different types of sensors and their applications.
- g) How SEM is useful in characterization of nanoparticles.
- h) List out important applications of nanoparticles.
- i) Define piezoelectricity and pyroelectricity.
- j) How silver nanoparticles are prepared. Give the chemical reaction involved in it.

**P.T.O.**

**Q2)** Answer the following ( any two): **[10]**

- a) Discuss the modification of nanostructured metal oxides films with dyes.
- b) Explain arc discharge and laser ablation method for synthesis of carbon nanotubes.
- c) How nanoparticles are synthesized by solvothermal method?
- d) Discuss the classification of nanomaterials.

**Q3)** Answer the following ( any two): **[10]**

- a) Explain the mechanism of fluorescence and phosphorances with the help of energy level diagram.
- b) What is sonochemistry? Give sonochemical fabrication of nanomaterials.
- c) What are semiconducting nano materials? Give method of preparation of semiconducting metal sulphides.
- d) Give any five applications of nanomaterials.

**Q4)** Answer the following ( any two): **[10]**

- a) Give comparison between SEM and TEM.
- b) Explain the spectral and electrical properties of nanoparticles.
- c) Discuss the zero valent Fe- Cu bimetallic nanoparticles.
- d) How Raman spectroscopy is useful in characterise nanoparticles.

*EEE*

Total No. of Questions :9]

SEAT No. :

**P2895**

**[5023]-409**

[Total No. of Pages :3

**M.Sc. -II**

**INORGANIC CHEMISTRY**

**CHI - 445: Inorganic Chemistry: Applications in Industry, Environment  
and Medicine**

**(2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*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 indicates full marks.*
- 5) Neat diagram must be drawn wherever necessary.*
- 6) Use of logarithmic table/calculator is allowed.*

**SECTION -I**

**(Applications in Industry)**

**Q1)** Attempt the following:

**[10]**

- a) What is the difference between pigment and dye?
- b) Give, the methods for electroplating of precious metals.
- c) Give the properties of carbon black.
- d) What is the composition of Lithopone?
- e) What is 'Tridentate Azo dyes? Give the examples.

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

**[10]**

- a) Explain the manufacturing process of titanium dioxide.
- b) Give an account of preparation of copper dyes from O-hydroxy diaryl azo compounds and O-halogeno - O-hydroxy diaryl azo compounds.
- c) Explain two methods of electroplating of tin.
- d) Explain in brief manufacturing process of metallic lead pigment.

***P.T.O.***

**Q3)** Write a note on any one: **[5]**

- a) Use of polymers in the electroplating industry.
- b) Food colour.
- c) Animal and plant pigments.

**SECTION -II**

**(Environment)**

**Q4)** Attempt the following: **[10]**

- a) List any four ways in which water can become polluted.
- b) What is meant by grab and composite sample?
- c) What is gasohol?
- d) What is a 'Powerball'? How is the powerball manufactured?
- e) Define the following for the safe Drinking Water Act?
  - i) Primary standard
  - ii) Secondary standard

**Q5)** Attempt any two of the following: **[10]**

- a) List the trace element pollution in natural water with sources, effect and significance.
- b) Name the instrumental method for the determination of Hg, Cd, As, Pb. Explain X-ray fluorescence (XRF) method for the determination of lead from polluted water.
- c) What are the oxygen consuming waste? Name typical sources. Describe how to do BOD test on a water sample.
- d) Compare aerobic treatment process with an anaerobic treatment process.

**Q6)** Write a note on any one: **[5]**

- a) Biorefractory organic pollutant.
- b) Energy sources for the 21<sup>st</sup> century.
- c) Primary and secondary sludge.



### SECTION -III

#### (Applications of Metal ions in Medicine)

**Q7)** Answer the following: **[10]**

- a) Name the different metal - DNA interactions. Draw skeletal diagrams.
- b) What are the full forms of NSAIDS and RIDS? Where are they used?
- c) Name and draw structures of two model compounds of vanadium.
- d) Define - “prodrug” and give suitable examples.
- e) Name the Bismuth salts used in medicine. What is the oxidation state of Bismuth in them?

**Q8)** Answer any two: **[10]**

- a) Explain the mechanism of inhibition of the bacterium H pylori by Bismuth salts.
- b) Discuss the therapeutic role of lithium.
- c) Discuss the role of cis-platin as an anti-cancer drug.

**Q9)** Write a note on (any one): **[5]**

- a) Toxicity of Vanadium compounds.
- b) Gold complexes in medicine.

*EEE*

Total No. of Questions :6]

SEAT No. :

P2896

[5023]-410

[Total No. of Pages :5

M.Sc. -II

ORGANIC CHEMISTRY

CHO - 450: Chemistry of Natural Products

(2013 Pattern) (Semester - IV)

Time : 3 Hours]

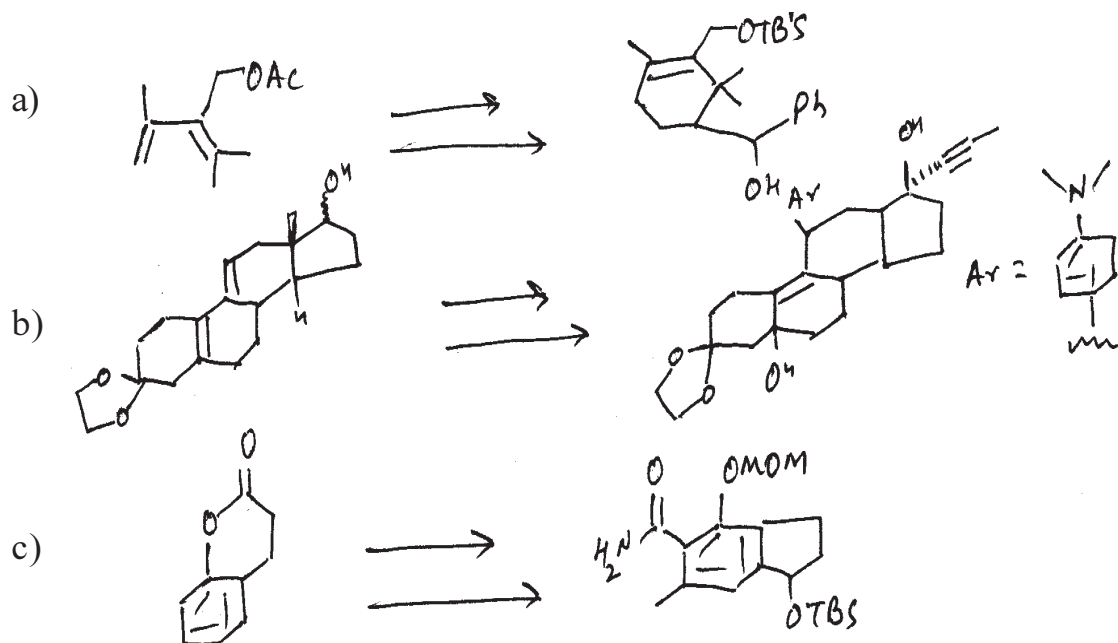
[Max. Marks :50

Instructions to the candidates:

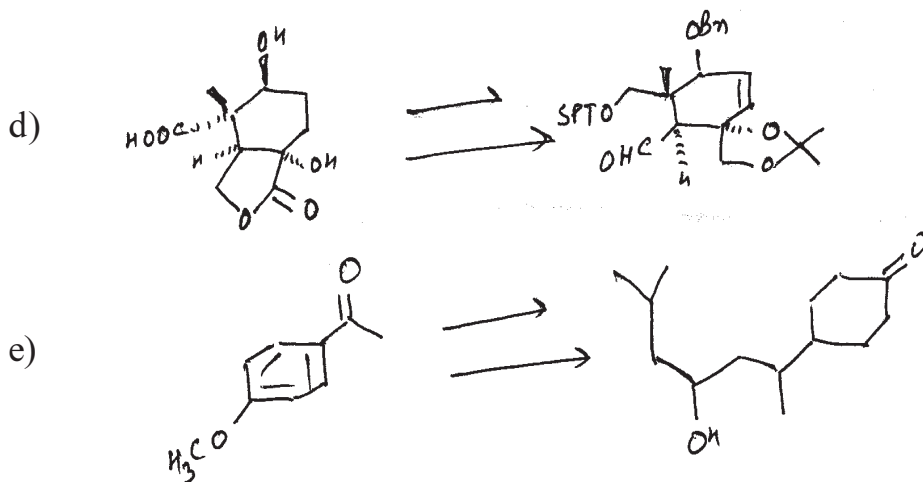
- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Answers to the two sections should be written in separate answer books.

SECTION -I

Q1) Outline the steps involved in the following synthetic sequence. Indicate the reagent used and discuss the mechanism and stereochemistry. [10]



P.T.O.



Q2) Answer the following (any two):

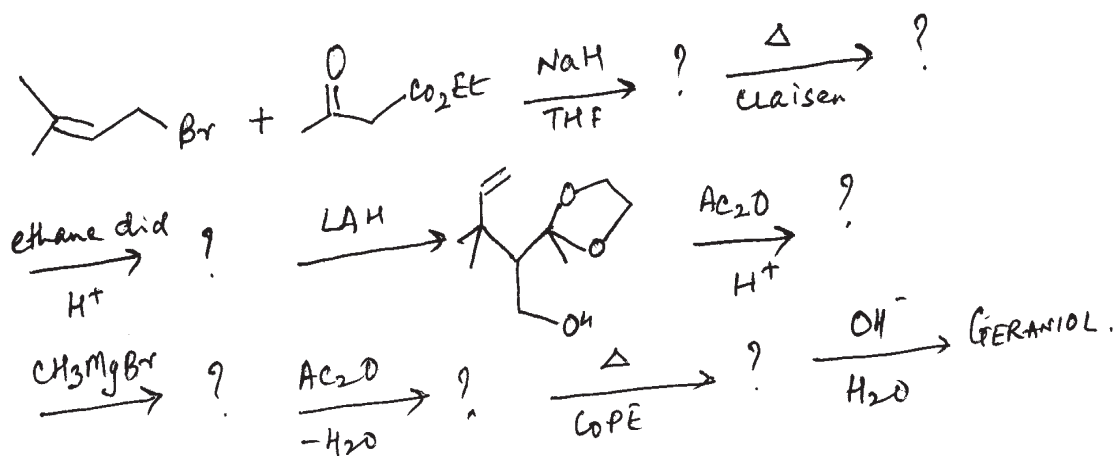
[10]

- Give evidences to establish the presence of  $\beta$ -substituted furan ring and conjugated acid in Hardwickiic acid.
- Write an account for the presence of  $\text{ArCH}_2\text{NCO}$ ,  $\text{ArCH}_2\text{OCO}^-$  and  $\text{CH}_3\text{CH}_2\text{C}(\text{OH})\text{R}_2$  in camptothecin.
- Discuss relative stereochemistry between normal and epi-isomers of podophyllotoxin and picropodophyllotoxin.

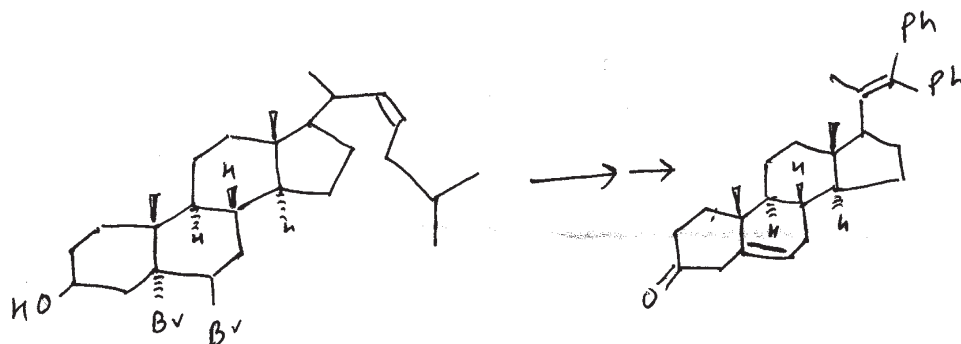
Q3) Attempt any one of the following:

[5]

- Complete the following synthetic steps. Explain the mechanism of each step:



- b) How is the following conversion explained by using the reagents given below?



- i)  $\text{PhMgBr}$
- ii)  $\text{C}_2\text{H}_5\text{OH}/\text{HCl}$
- iii)  $\text{Zn}/\text{AcOH}$
- iv)  $\text{H}^+$
- v)  $\text{O}_3$  followed by oxidative workup
- vi)  $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$

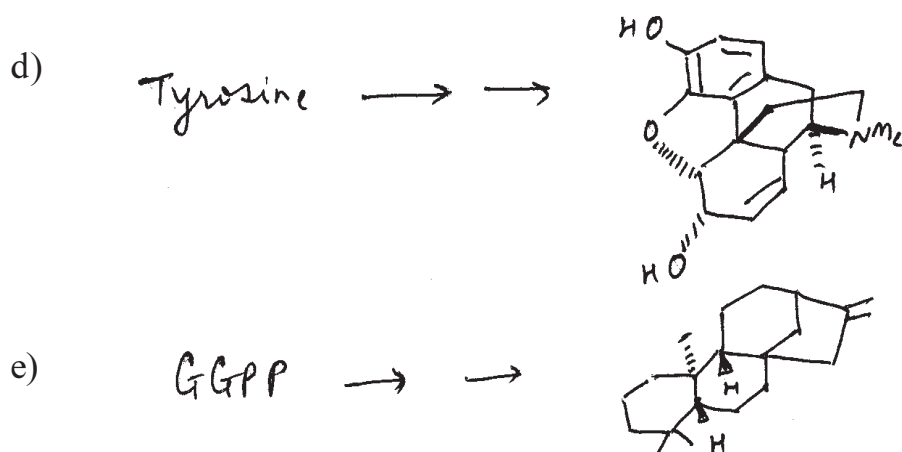
### SECTION -II

**Q4)** Suggest biogenesis of the following:

[10]

- a) Shikimic acid  $\longrightarrow \longrightarrow$  P- Amino Benzoic acid

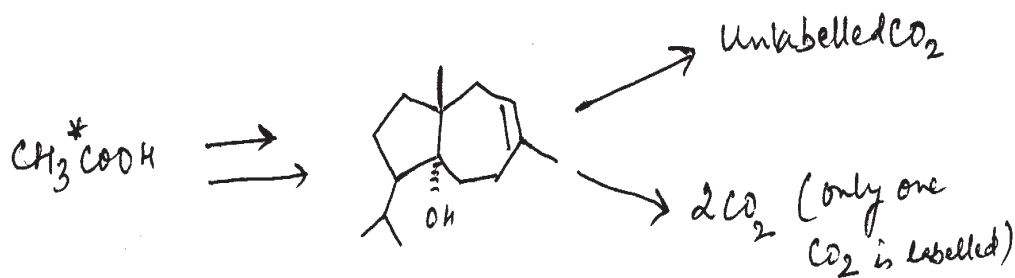




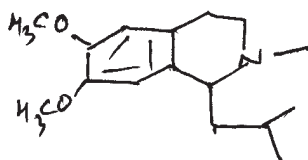
Q5) Answer the following (any two):

[10]

- a) Complete the biogenesis of carotol from FPP as shown below  $\text{CH}_3^*\text{COOH}$  gives carotol with six labelled carbons. Explain how following experiments help to establish the position of label at respective carbon atoms.



- b) L-DOPA and DMAPP are involved in the biogenesis of following alkaloid. Explain the biogenesis.

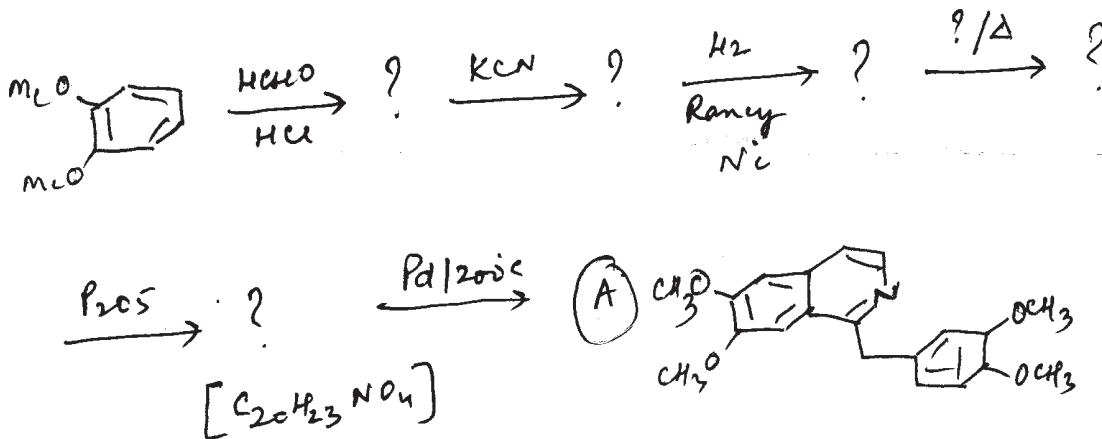


- c) Suggest a biogenesis of phenyl alanine and tyrosine from shikimic acid.

Q6) Attempt any one of the following:

[5]

- a) Write an account on importance of pyridoxal phosphate in the biogenesis of alkaloids.
- b) Give the structures of the intermediates in the synthesis of papaverine (A)



EEE

Total No. of Questions : 6]

SEAT No. :

P2897

[5023]-411

[Total No. of Pages : 4

M.Sc. - II

**ORGANIC CHEMISTRY**

**CHO - 451 : Advanced Synthetic Organic Chemistry  
(2013 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 50

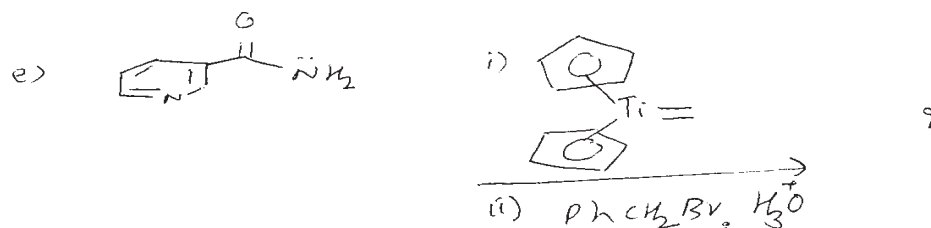
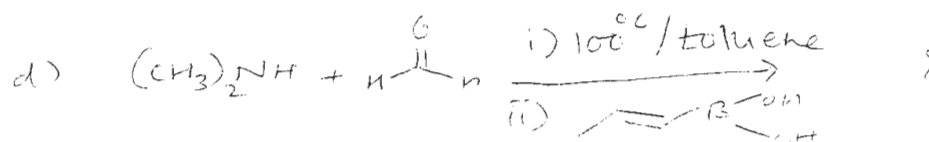
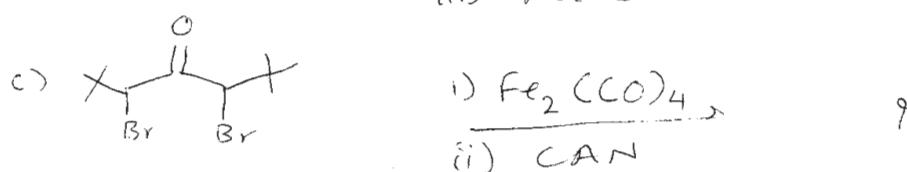
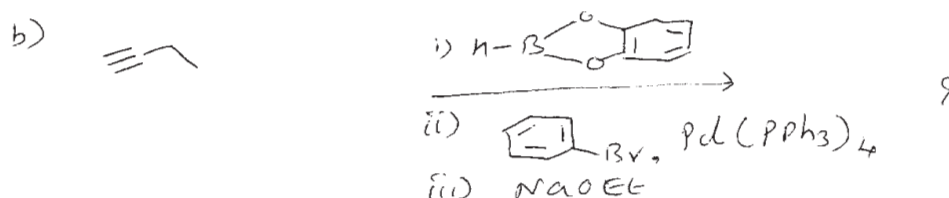
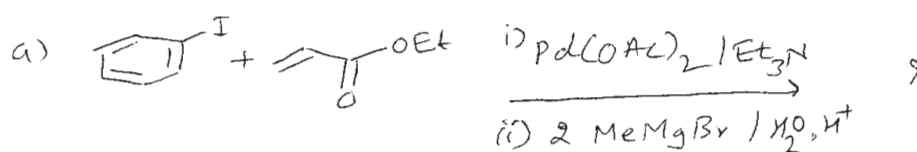
Instructions to the candidates:

- 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) Predict the product/s of the following:

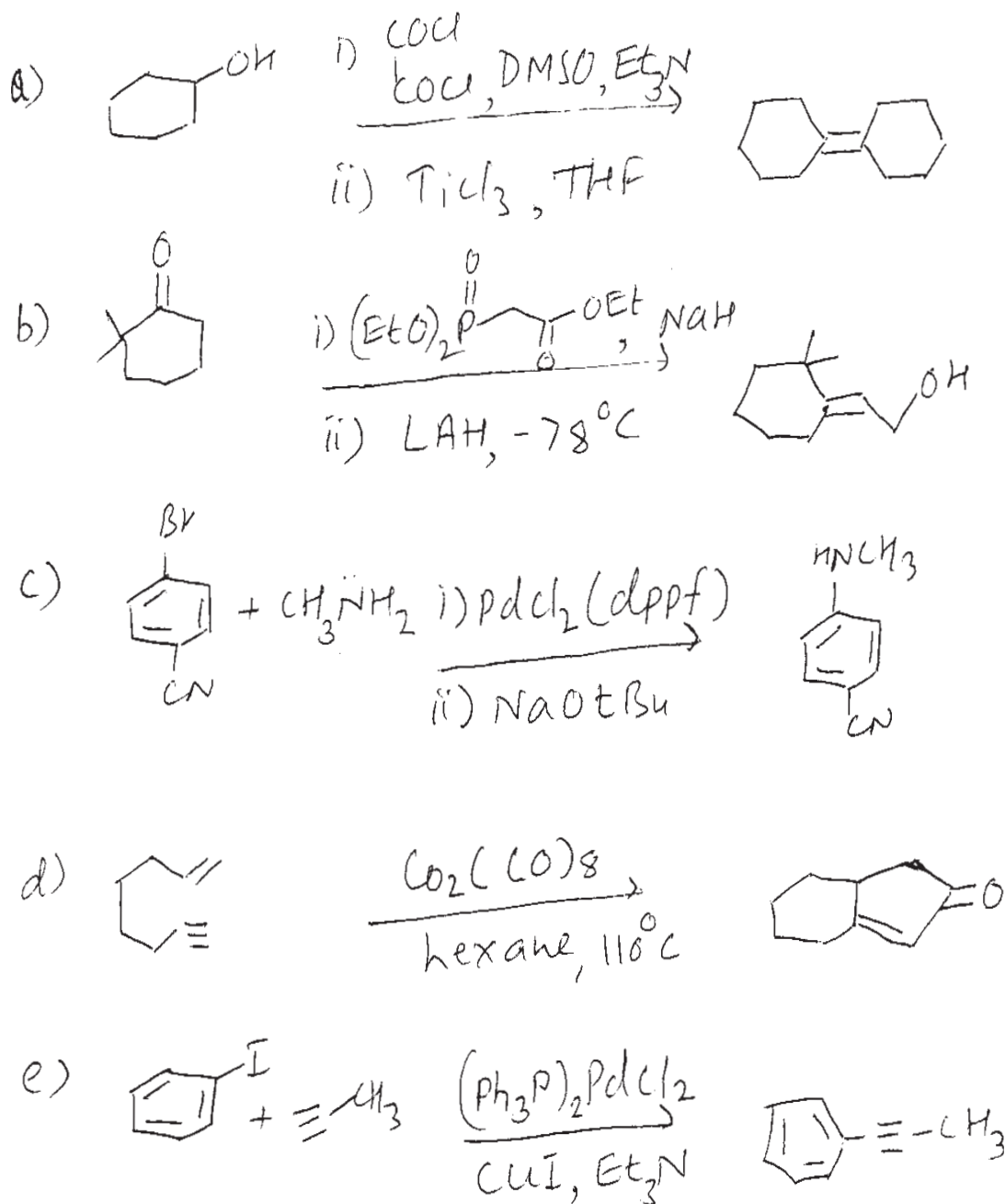
[10]



P.T.O.

Q2) Suggest the mechanism in any four of the following:

[10]



Q3) Answer any two of the following:

[5]

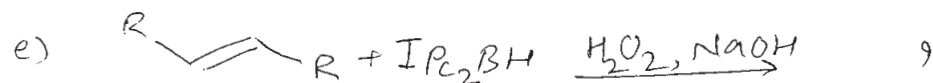
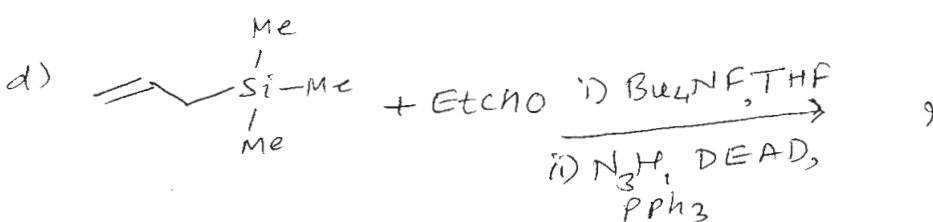
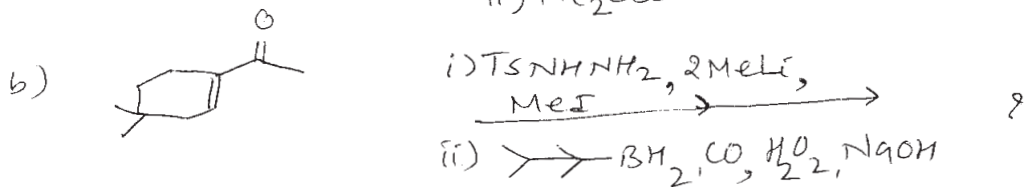
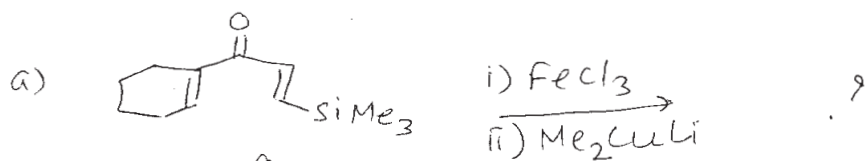
- Discuss the role of  $\text{Pd}(0)$  in Negishi coupling.
- Short note on Julia-Lythgoe olefination.
- Discuss Hiyama coupling.



**SECTION - II**

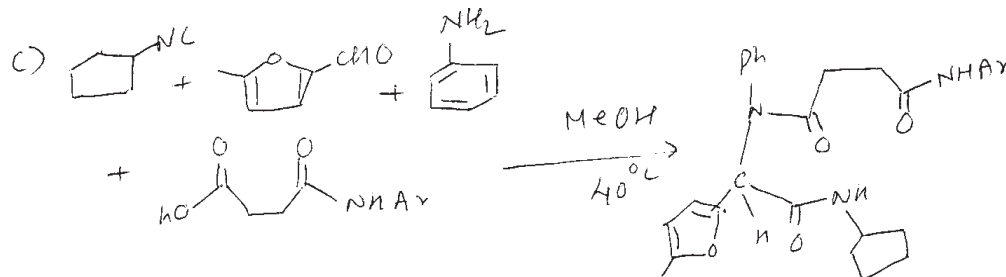
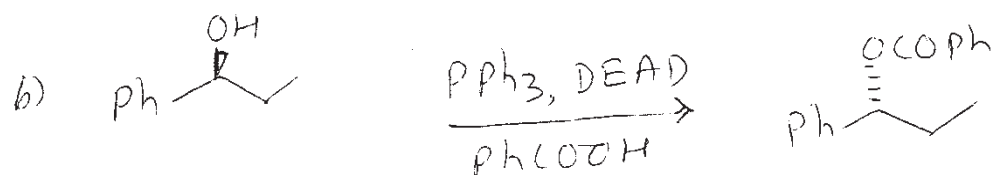
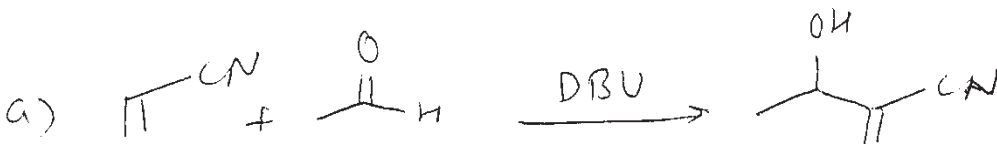
**Q4)** Predict the product/s of the following:

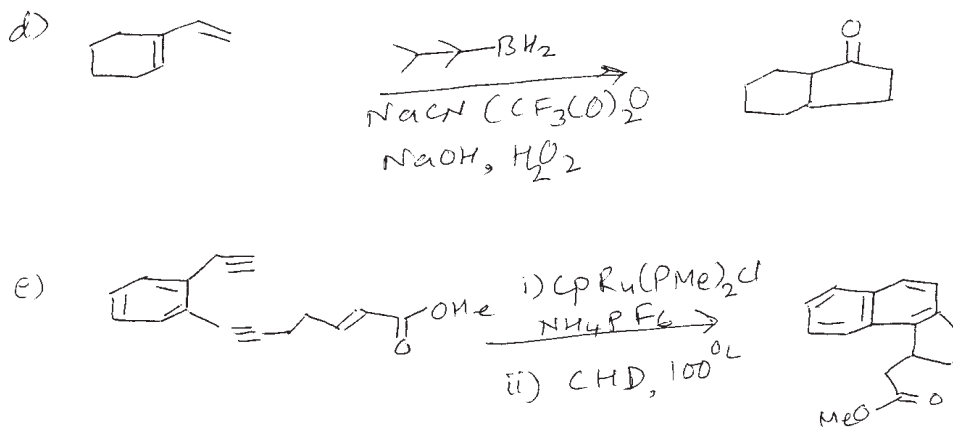
[10]



**Q5)** Suggest the Mechanism any four of the following.

[10]





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

**[5]**

- Discuss Mannich reaction.
- Write a note on ring closing and ring opening metathesis.
- Application of disamyl borane in organic synthesis.

**x x x**

Total No. of Questions : 6]

SEAT No. :

P2898

[5023]-412

[Total No. of Pages : 3

M.Sc.

**ORGANIC CHEMISTRY**

**CHO-452: Carbohydrate, Chiron Approach, Chiral Drugs and Medicinal Chemistry**  
**(Semester - IV) (2013 Pattern) (New Course)**

Time : 3 Hours]

[Max. Marks : 50

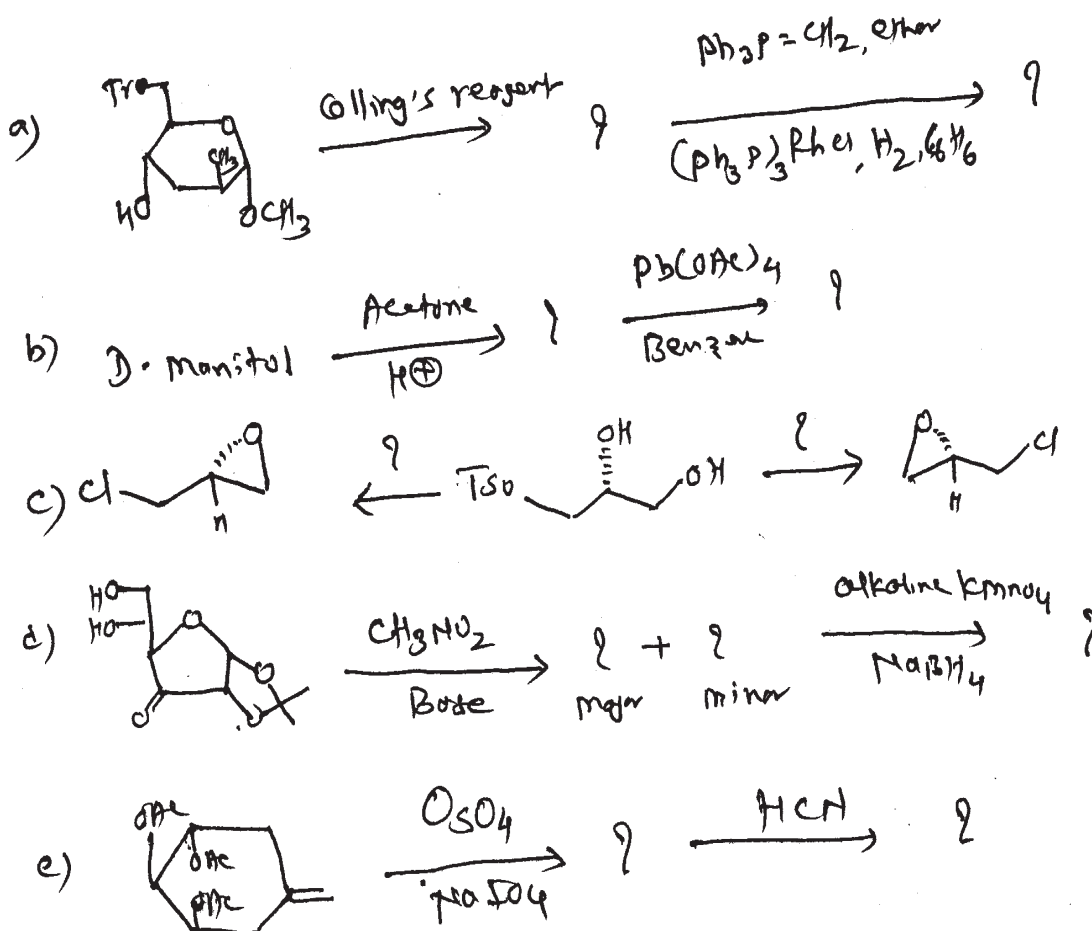
Instructions to candidates:

- 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) Complete the following reactions. Give mechanism. (Any Four)

[10]



P.T.O.

**Q2) Solve the followings (Any Five) [10]**

- a) i) Explain the terms distomer & eutomer.  
ii) What is endosmotic ratio.
- b) Give the synthesis of ephedrine.
- c) Explain the pharmacological activities of ( $\pm$ ) metoprolol.
- d) Give the synthesis of S- Captopril.
- e) Give uses of Ibuprofen.
- f) Give the retro synthesis of ( $-$ ) Shikimic acid.

**Q3) Answer the followings (Any Two) [5]**

- a) Give the reaction sequence for the conversion of aldohexose to aldopentose.
- b) Write  ${}^1C_4$  and  ${}^4C_1$  conformations of L-and D-Glucose. Explain the stability.
- c) Write short note on "Mutarotation".

### **SECTION - II**

**Q4) Solve Any - 5 [10]**

- a) What are antimetabolites? Explain with an example.
- b) Discuss SAR of cephalosporins.
- c) What are Tetracyclins.
- d) Explain the mechanism of action of chloramphenicol.
- e) How sulphonamides exhibit selective toxicity to bacterial cell.
- f) What are Macrolides.

**Q5) Solve Any - 2 [10]**

- a) i) What are  $\beta$ - lactum antibiotics? Explain their mode of action.  
ii) Comment on development of penicillins with respect to their structural changes and properties.
- b) i) What are antifungal agents? Give two examples of antifungal agents.  
ii) How selective toxicity can be achieved in case of antifungal agents.

- c) i) Give a brief account on enzyme inhibitors as drugs.
- ii) Describe in short Antiviral agents.

**Q6) Solve Any - 1**

**[5]**

- a) i) Give a brief account of pharmacokinetics of drug action.
- ii) Discuss classification of antibiotics on the basis of their mode of action.
- b) i) Discuss various types of bonding involved in Drug - Receptor interactions.
- ii) What are anti - malarial agents?

**x x x**

Total No. of Questions : 6]

SEAT No. :

P2899

[5023]-413

[Total No. of Pages : 4

M.Sc. - II

**ORGANIC CHEMISTRY**

**CHO-453: Designing Organic Synthesis and Asymmetric Synthesis  
(2013 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 50

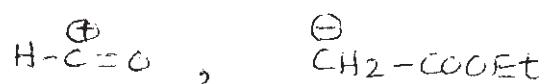
Instructions to the candidates:

- 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.

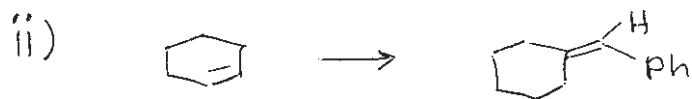
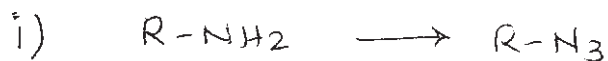
**SECTION - I**

**Q1)** Answer the following. **[10]**

- a) Explain the role of organosilicons as a protecting group for alcohols.
- b) Discuss the role of 1,3 - dithiol in umpolung reactions.
- c) Trityl chloride can be used for selective protection. Explain.
- d) Benzyloxy carbonyl protection is better than benzoyl protection for amino group in peptide synthes is. Justify.
- e) Give synthetic equivalents for the following synthons.

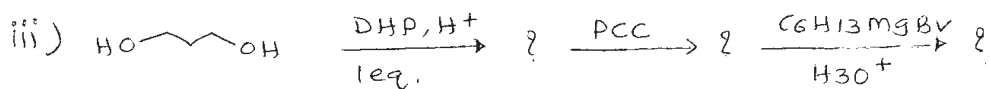
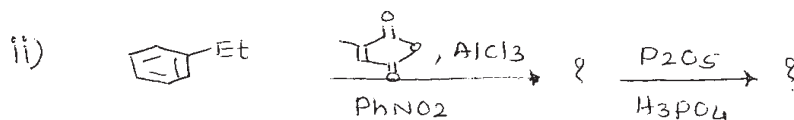
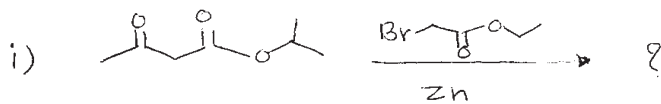


**Q2) a)** How will you effect the following conversions? [any two] **[5]**



**P.T.O.**

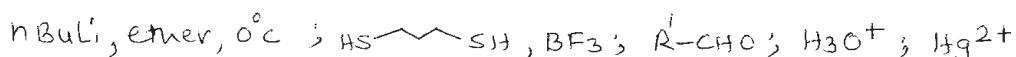
b) Predict the products in any two of the following. [5]



Q3) a) Using retrosynthetic analysis, suggest the suitable method to synthesise any one of the following. [3]

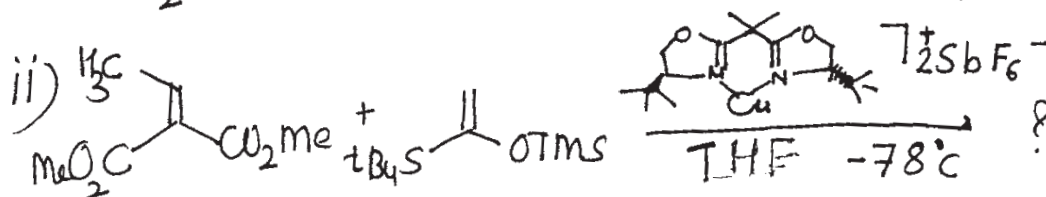
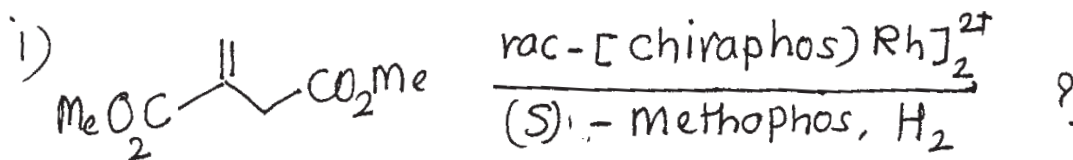


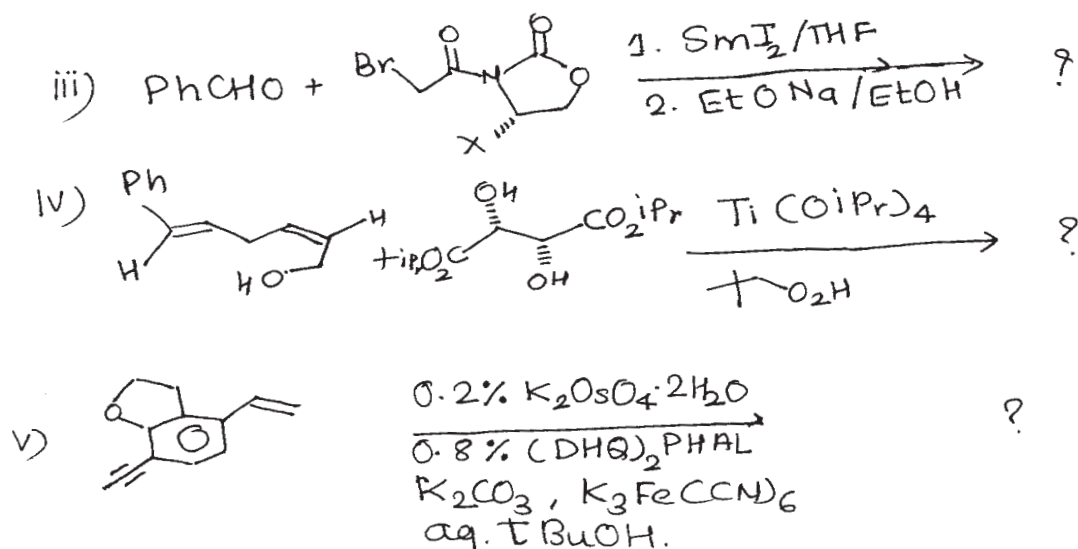
b) Arrange the following reagents in proper order to - accomplish the given conversion. Write the structures of the intermediates. [2]



### SECTION - II

Q4) Complete the following conversions and suggest the correct stereochemistry of the product/s with the help of mechanism. (All subquestions are compulsory) [10]

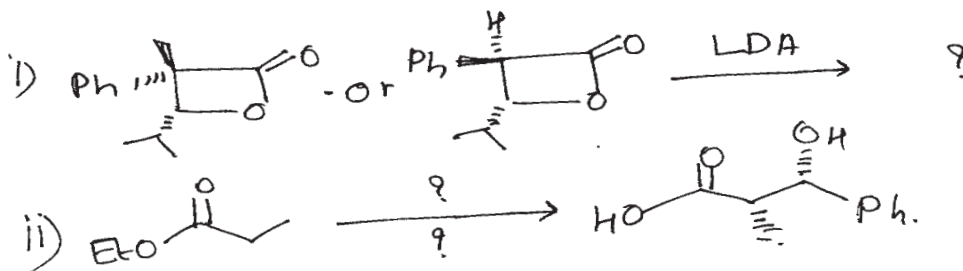




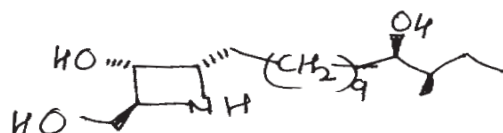
Q5) Answer any two of the following.

[10]

- a) Justify following observations with suitable reagents and stereochemical model. (If required).



- b) Suggest the synthesis of penaresdin-A



Penaresdin - A

- c) Define the following term.

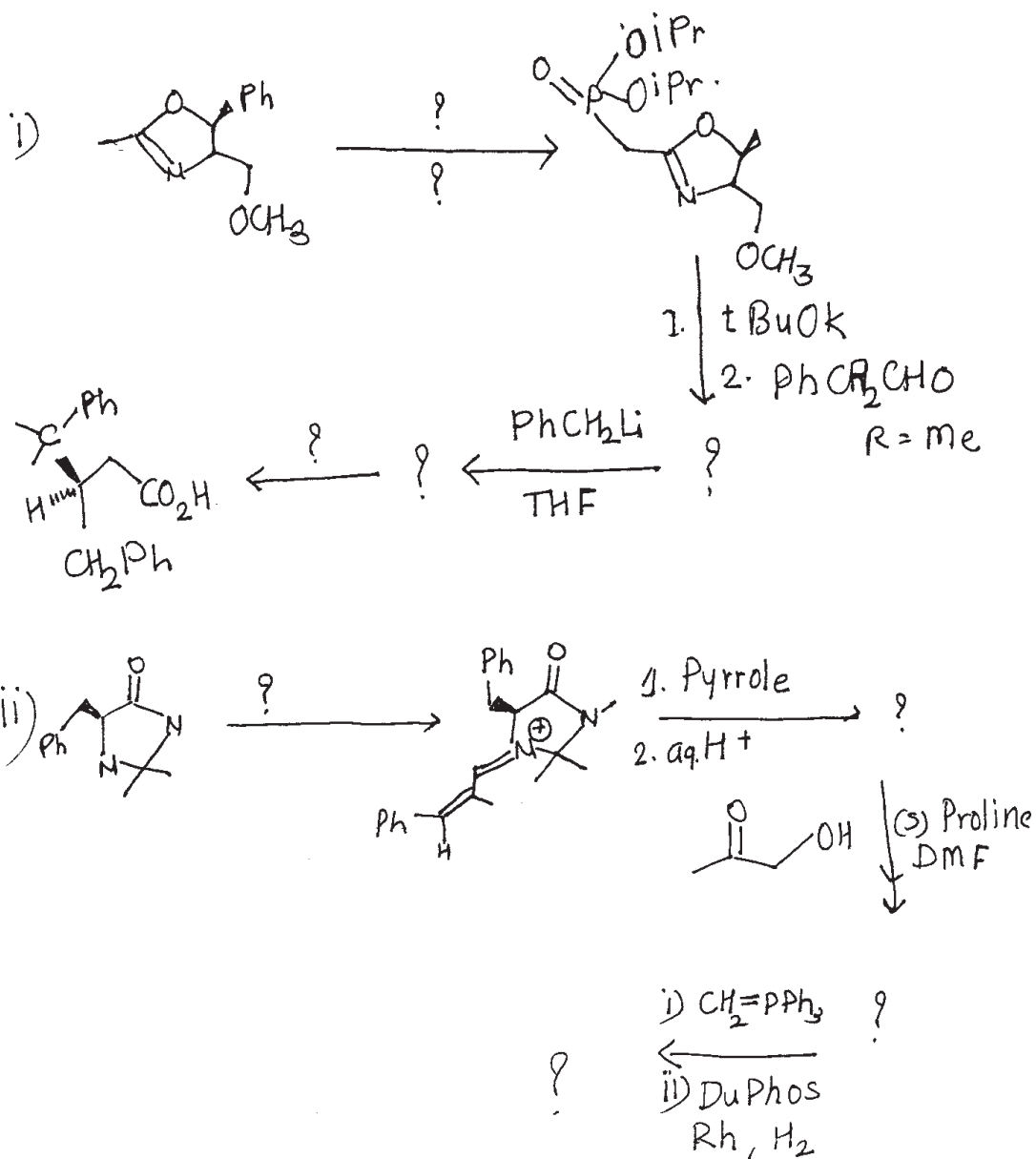
- i) CBS - reagent.
- ii) Chiral Rhodium catalyst.



d) Comment on the following statements and justify it with an appropriate examples.

- i) Chiral auxiliaries play important role in asymmetric synthesis.
- ii) "Enzymes give enantiomerically pure compound."

Q6) Complete the following multistep asymmetric synthesis using appropriate reagents or intermediates. (Any One) [5]



X X X

Total No. of Questions :6]

SEAT No. :

[Total No. of Pages :3

**P2900**

**[5023] - 414**

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CHA - 481: Analytical Toxicology and Food Analysis**

**(2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following:

**[10]**

- a) What is antidote?
- b) Give the principle of isolation and identification of amphetamine and methamphetamine type B procedure.
- c) Define the terms:
  - i) Coca derivatives
  - ii) Opium poppy
- d) Give the principle of isolation and identification of caffeine type C procedure.
- e) Explain 'Depressants'.

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

**[10]**

- a) Outline the procedure for determination of benzodiazepines.
- b) Explain the rules under narcotic and psychotropic substances related to cultivation of opium poppy and production of opium poppy straw.
- c) State the principle and give the procedure type B for determination of barbiturates.
- d) Give detail procedure for absorption and elution of cocaine.

***P.T.O.***

**Q3)** Attempt any one of the following: **[5]**

- a) What are the requirements for spectrophotometric assay?
- b) A sample containing barbiturate was analysed by gas chromatographic method.

It gave following observations:

- i) Concentration of known barbiturate = 4.5 ug/ml
- ii) Peak area of drug in sample = 7.5 min.
- iii) Peak area of internal standard = 5.8 min.
- iv) Peak area of known drug sample = 4.5 min.
- v) Peak area of internal standard in reference barbiturate solution = 8.7 min.

Calculate concentration of barbiturate in given sample.

### SECTION - II

**Q4)** Answer the following: **[10]**

- a) How casein is determined from milk?
- b) Write short note on proteins.
- c) What are food preservatives? Give it's classification.
- d) Explain the analytical procedure for determination of peroxide value of oil.
- e) Give an analytical method for determination of protein by Kjeldahl method.

**Q5)** Answer any two of the following: **[10]**

- a) How is amylase estimated?
- b) Give Nelson - Somyogi method for determination of carbohydrate.
- c) Explain the procedure for estimation of amino acids using colorimetric method.
- d) Explain the procedure for estimation of ascorbic acid.

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

**[5]**

- a) A 36.22 g food sample containing sulphite as preservative was subjected to Tanner method and titre value obtained with 0.01N NaOH was 8.0 ml. Calculate the amount of SO<sub>2</sub> in the sample.
- b) A sample of oil weighing 4.40 g was subjected to saponification with 50 ml of alcoholic KOH and it was titrated against 0.5 N HCl using phenolphthalein indicator, it required 12.0 ml of oil. [Molecular weight of KOH is 56.5] Calculate saponification value of oil.



Total No. of Questions :6]

SEAT No. :

[Total No. of Pages :3

**P2901**

**[5023] - 415**

**M.Sc.-II**

**ANALYTICAL CHEMISTRY**

**CHA - 490 : Analytical Spectroscopy**

**(2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

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

**SECTION - I**

**Q1)** Answer the following questions:

**[10]**

- a) State and explain the principle of x - ray photoelectron spectroscopy.
- b) State the applications of ultraviolet photoelectron spectroscopy.
- c) Define absorptive edge. Give it's significance in x - ray absorption method of analysis.
- d) What are the dispersive devices? Enlist the types of dispersive devices.
- e) What is scanning electron microscopy? What characteristic informations are observed in a SEM?

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

**[10]**

- a) With schematic diagram, explain the working of scanning transmission electron microscope.
- b) Explain the concept of ESCA chemical shift with suitable example.
- c) Discuss the principle of x - ray fluorescence spectroscopy. Explain the quantitative chemical analysis by x - ray fluorescence method.

***P.T.O.***

- d) The  $L_{III}$  critical absorptive edge (370 pm) of silver was used with absorptive edge method for quantitative analysis. The mass absorptive coefficients of silver at absorptive edge are  $1410 \text{ cm}^2 \text{ g}^{-1}$  at lower transmitted intensity and  $354 \text{ cm}^2 \text{ g}^{-1}$  at higher transmitted intensity. Determine the amount of silver in the solution from the following tabulated data:

Wavelength (Pm)	Detector response (Counts / 10 sec)
360	247
365	213
375	1464
380	1351

**Q3)** Attempt any one of the following: **[5]**

- Explain with schematic diagram, the spherical electrostatic field analyser.
- The measured kinetic energy of certain core shell electron is 180.5 eV and the work function of ESCA spectrometer is 8.79 eV, if the incident radiation of Mg,  $K_{\alpha}$  ( $\lambda = 0.988 \text{ nm}$ ). Calculate the binding energy of core shell electron.

[Given : Plancks constant =  $6.625 \times 10^{-34} \text{ Js}$ , Velocity of light =  $3 \times 10^8 \text{ ms}^{-1}$ ]

### SECTION - II

**Q4)** Answer the following questions: **[10]**

- Define fluorescence. What is the quenching of fluorescence?
- Explain, the inner - filter effect with suitable example.
- Explain, why  $^{13}\text{C}$  NMR is less sensitive than  $^1\text{H}$  NMR?
- State and explain the principle of chemiluminescence.
- State the significance of coupling constant in NMR.

**Q5)** Attempt any two of the following: **[10]**

- a) Describe the chemiluminescent method for the determination of Co, Cr and Fe with luminol.
- b) Define chemical shift. Discuss the factors affecting on chemical shift.
- c) State and explain the principle of  $^{13}\text{C}$  NMR. Discuss it's applications in quantitative analysis.
- d) The proton NMR of compound with empirical formula  $\text{C}_5\text{H}_8\text{O}_3$  shows singlet at  $2.0 \delta$ , singlet at  $3.41 \delta$  and singlet at  $3.67 \delta$ . Deduce the structure of the compound.

**Q6)** Attempt any one of the following: **[5]**

- a) Explain the terms: COSY and HETCOR with suitable examples.
- b) Predict the splitting pattern and ratio of the peaks area in each multiplet, as well as between the multiplets in the proton NMR spectrum of  $(\text{CH}_3)_2\text{CHCl}$ .



Total No. of Questions :6]

SEAT No. :

**P2902**

[Total No. of Pages :3

[5023] - 416

**M.Sc.-II**

**ANALYTICAL CHEMISTRY**

**CHA - 491 : Analytical Methods for Analysis of Fertilizers, Detergents,  
Water, Polymer, Paint and Pigment  
(2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

- 1) All questions of respective section are compulsory.*
- 2) Figures to right hand side indicate full marks.*
- 3) Neat labelled diagram must be drawn wherever necessary.*
- 4) Use of log tables / non - programmable calculator is allowed.*
- 5) Write the answers of two sections on separate answer books.*

**SECTION - I**

**Q1)** Answer the following questions:

**[10]**

- a) Give the general methods of analysis for soaps and detergents.
- b) Explain the term Syndet. Give it's examples.
- c) What is total hardness? Give it's estimation method.
- d) Enlist four organic pollutants found in waste water.
- e) What is chlorine demand?

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

**[10]**

- a) Discuss the estimation of potassium by direct intensity flame photometry method.
- b) How free glycerol from soap is determined?
- c) Discuss analytical method for the determination of cyanide from waste water.

***P.T.O.***



- d) Orthophosphate was determined by weighing as ammonium phosphomolybdate  $(\text{NH}_4)_2 \text{PO}_4 \cdot 12 \text{MoO}_3$ . Calculate the percentage of phosphorus and phosphorus pentoxide if, 1.832 g precipitate was obtained from 0.323 g of sample.

[Given : Atomic mass,  $\text{g mol}^{-1}$ : H = 1.00, N = 14.00, O = 15.99, P = 31.00, Mo = 95.94]

**Q3)** Attempt any one of the following: **[5]**

- a) Write a note on industrial waste water treatment.
- b) Give a brief account of biodegradability of detergents.

### SECTION - II

#### (Polymer Analysis)

**Q4)** Answer the following: **[10]**

- a) Explain the term
  - i) Haze
  - ii) Vapour permeability
- b) Define lacquers and extenders.
- c) What is the role of thinner in paints?
- d) Give brief account of electrical properties of polymer.
- e) What is polydispersivity index?

**Q5)** Answer any two of the following: **[10]**

- a) Describe the role of x-ray diffraction in structure determination of polymer.
- b) Explain 'isolation and determination of pigments'.
- c) Explain mechanical properties of polymers with respect to fatigue testing and impact testing.
- d) The intrinsic viscosity of myosin is  $217 \text{ cm}^3/\text{gm}$ . Calculate the approximate concentration of myosine in water, which could have a relative viscosity of 1.5.

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

**[5]**

- a) Explain the role of thermal methods used in structure elucidation of polymeric material with respect to TGA and DTA.
- b) 0.230 gm of yellow chrome pigment was disintegrated and soluble chromate was extracted with sulphuric acid. The solution was used for chromate estimation iodometrically which required 13.5 ml of 0.05 N  $\text{Na}_2\text{S}_2\text{O}_3$  solution. Calculate the percentage of chromium in a given sample. (At.wt. of Cr = 51.87)



Total No. of Questions :9]

SEAT No. :

**P2903**

[Total No. of Pages :4

[5023] - 417

M.Sc. - II

**ANALYTICAL CHEMISTRY**

**CHA - 492: Methods of Analysis and Applications**

**(2013 Pattern) (Semester - IV)**

*Time : 3 Hours]*

*[Max. Marks :50*

*Instructions to the candidates:*

- 1) *Students should attempt any two sections from section I, II and III.*
- 2) *All questions of respective sections are compulsory.*
- 3) *Figures to right hand side indicate full marks.*
- 4) *Neat labelled diagram must be drawn wherever necessary.*
- 5) *Use of log table /non - programmable calculator is allowed.*
- 6) *Write the answer of two sections on Separate answer books.*

**SECTION - I**

**(Pollution Monitoring and Control)**

**Q1)** Answer the following:

**[10]**

- a) What is the composition of particulate matter.
- b) Give control measures of NO<sub>2</sub>.
- c) List any two measures for the safety of workers, analyzing particulate matter.
- d) What is industrial effluent?
- e) State any two advantages of electrostatic precipitator.

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

**[10]**

- a) Explain the analytical method for the estimation of arsenic from waste water.
- b) Give the method used for recovery of copper.
- c) Write a note on cyclone separator.
- d) Explain SO<sub>2</sub> control measures and it's economics.

**P.T.O.**

**Q3)** Attempt any one of the following: [5]

- a) Discuss effects of atmospheric pollution with respect to particulate matter.
- b) Explain in brief photochemistry of air pollutions.

**SECTION - II**

**(Analysis of Body fluids)**

**Q4)** Attempt the following: [10]

- a) What is polyuria and anuria?
- b) What is GTT? What are the factors affecting GTT?
- c) Write the structure and deficiency diseases of tocopherol.
- d) What is ELISA?
- e) Write the principle of Van-der Bergh method.

**Q5)** Attempt any two of the following: [10]

- a) Write the principle of radioimmunoassay. Describe the application of radioimmunoassay in estrogen determination.
- b) Give an analytical method for the estimation of Na from blood serum.
- c) Explain collection, preservation and changes on keeping of blood.
- d) Two patients shows following readings during the analysis of urea clearance -

Patient No.	Blood urea (mg %)	Urinary Urea (mg%)	Rate of Urine flow (ml/min)
1	85	2200	2
2	70	2300	1

Calculate the urea clearance for each patient and comment on the results.

**Q6)** Attempt any one of the following:

**[5]**

- a) Give an analytical method for the estimation of serum xanthuric.
- b) Four times diluted urine sample of a 45 years patient required 9.5 ml of Benedicts Reagent during analysis of it's glucose content. Routine blood analysis of the same patient shows following readings.

Test	Method	O.D. of Sample	O.D. of Std.
Urea	DAM	0.110	0.115
Uric Acid	Caraway's	0.090	0.150
Phosphate	TCA	0.088	0.110
Creatinine	Picric acid	0.009	0.050

Calculate the concentration of each component present in per 100 ml of the sample.

### **SECTION - III**

#### **(Carbon-Nanostructures and Application of Nanotechnology)**

**Q7)** Attempt the following:

**[10]**

- a) What is coloumb blockade?
- b) What are sensing parameters in physical and chemical sensors?
- c) Explain the term Quantum Dots.
- d) Give Major routes of entry for engineered nanomaterials in the body.
- e) Define
  - i) Carbon Nanotubes
  - ii) Nanowires

**Q8)** Answer any two of the following:

**[10]**

- a) Write a short note on vibrational and mechanical properties of nanotubes.
- b) Explain electrochemical sensors and bio-membrane based sensors.
- c) Describe the applications of carbon nanotubes.
- d) Explain the role of fungi in nanoparticle synthesis.

**Q9)** Answer any one of the following:

**[5]**

- a) Explain the fabrication of carbon nanotubes.
- b) Write a short note on Nanoparticle toxicology.

