**P595**

**[3823]-101**

# M.Sc.

## PHYSICAL CHEMISTRY

### CH-110 : Physical Chemistry – I

*Time : 3 Hours]*          *[Max. Marks : 80*

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

### Physico-Chemical Constants

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

*P.T.O.*

1

## SECTION - I

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

    a) Explain Heisenberg's uncertainty principle. How is it used to determine the width of a spectral line?

    b) Deduce the relation $\dfrac{E_{n+1}-E_n}{E_n}=\dfrac{2n+1}{n^2}$ for a particle in a box and hence account for the energy continuum as $n\rightarrow\infty$.

    c) Write a note on steam distillation.

    d) What is Gibb's function? How is it related to Helmoltz function?

    e) Explain the second law of thermodynamics. Why is entropy called the arrow of time?

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

    a) Derive Clapeyron-Clausius equation and give its significance.

    b) Explain Exact and Inexact differentials giving examples of each.

    c) Write a note on Vant-Hoff isochore.

    d) Explain the third law of thermodynamics and explain its corollary.

    e) Define partial molar volume. Explain two methods to determine it.

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

    a) Find the osmotic pressure of 0.01 mol kg$^{-1}$ aqueous glucose solution at 25$^o$C and 1 atm pressure.

    b) An electron travels 2000 km in a ms. Calculate its deBroglie wavelength.

    c) Calculate the temperature of a star that emits light of wavelength 500 nm.

## SECTION - II

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

    a) Derive the expression for the rate constant of a second order reaction with equal concentrations of the reactants.

    b) Write a short note on Lineweaver and Eadie plots.

    c) Define a fast reaction. Explain the stopped flow technique to study the kinetics of such reactions.

    d) Explain the occurrence of explosion limits with suitable example.

    e) Describe the technique of flash photolysis used to study the rapid reactions.

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

   a)   Compare transition – state theory with the Kinetic theory of collisions.

   b)   Explain :
       i)   The physical significance of activation process.
       ii)   The reaction coordinate in potential energy contour diagram.
       iii)   The factors determining the effectiveness of collisions.

   c)   Derive the Boltzman distribution law for a degenerate system. Explain what is meant by degeneracy.

   d)   Derive an expression for the rotational partition function and obtain the relation for the standard entropy of a diatomic molecule.

   e)   Define partition function. Derive the expression for vibrational partition function.

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

   a)   Calculate the partition function for translational motion of $N_2$ molecules free to move along one dimension of a one litre cubic container at 25ºC [At. Wt. of N = 14].

   b)   The activation energy for the transformation of ammonium cyanate to urea has been measured to be 23.2 k cal. The value of 'A' is $4.27 \times 10^{12}$ lit mol$^{-1}$ S$^{-1}$. Calculate the rate constant at 27ºC for this reaction

$$NH_4CNO \rightarrow \left(NH_2\right)_2 CO.$$
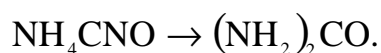
   c)   Thermal decomposition of a compound is of first order. If 50% of a sample of the compound is decomposed in 120 minutes how long will it take for 90% of the compound to decompose?

□□□

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# M.Sc. (Part - I)
# INORGANIC CHEMISTRY
## CH-130 : Inorganic Chemistry - I
### (New Course) (Sem. - I)

*Time : 3 Hours]*          *[Max. Marks : 80*

*Instructions to the candidates :*

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

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following:      **[15]**

a) Sketch and describe all the symmetry operations in $[AuCl_4]^-$ complex ion and classify it into appropriate point group.

b) Discuss the symmetry operations of the molecules having following point groups (any two).

    i) $D_5d$             ii) $C_2h$             iii) $D_3h$

c) Draw possible isomers of $[M(AA)_2b_2]$ complex. Explain which isomer is optically active. Justify your answer.

d) Develop Stereogram showing general point for the following point groups. Justify your answer.

    i) $D_5h$             ii) $C_3V$

e) Show the matrices for $C_2^Z$ and $\sigma_h^{XY}$ symmetry operations. Using matrix multiplication method show that $S_2 = i$.

**Q2)** Attempt <u>any three</u> of the following:      **[15]**

a) What are the conditions of a mathematical group? Explain them considering an example of non Abelian group.

b) Using similarity transformation and multiplication table given below, group the symmetry operations in appropriate classes.

| $C_2V$ | E | $C_2$ | $\sigma V_1$ | $\sigma V_2$ |
|---|---|---|---|---|
| E | E | $C_2$ | $\sigma V_1$ | $\sigma V_2$ |
| $C_2$ | $C_2$ | E | $\sigma V_2$ | $\sigma V_1$ |
| $\sigma V_1$ | $\sigma V_1$ | $\sigma V_2$ | E | $C_2$ |
| $\sigma V_2$ | $\sigma V_2$ | $\sigma V_1$ | $C_2$ | E |

c) Write out the characters of the representations of the following direct product and determine the set of irreducible representations which comprise them for the point group Td.

Direct - $T_1 \times T_2$

| Td | E | $8C_3$ | $3C_2$ | $6S_4$ | $6\sigma d$ | | |
|---|---|---|---|---|---|---|---|
| $A_1$ | 1 | 1 | 1 | 1 | 1 | | $X^2+Y^2+Z^2$ |
| $A_2$ | 1 | 1 | 1 | −1 | −1 | | |
| E | 2 | −1 | 2 | 0 | 0 | | $2Z^2-X^2-Y^2$, $X^2-Y^2$ |
| $T_1$ | 3 | 0 | −1 | 1 | −1 | $(R_X R_Y R_Z)$ | |
| $T_2$ | 3 | 0 | −1 | −1 | 1 | (X, Y, Z) | (XY, XZ, YZ) |

d) Sketch and explain all the symmetry operations for $[AuCl_4]^-$ complex ion and classify it in to appropriate point group.

e) Explain slide plane and screw axis with two examples of each.

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

a) Find out the normalized SALC using projection operator OF Eu irreducible representation on $\sigma_1$ of the $[Ni(CN)_4]^{2-}$ ion.
Given

| $D_4h$ | E | $2C_4$ | $C_2$ | $2C_2'$ | $2C_2''$ | i | $2S_4$ | $\sigma h$ | $2\sigma V$ | $2\sigma d$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Eu | 2 | 0 | −2 | 0 | 0 | −2 | 0 | 2 | 0 | 0 |

b) Show that Sn operation generates ''$n$'' orientations when $n$ is even and it generates ''$2n$'' operations when $n$ is odd.

c) For $[ZnCl_4]^{2-}$ complex ion, find the reducible representation for which sigma bond form the basis and find out which orbitals from $Zn^{2t}$ ion will be offered for sigma bonding.

[Character table for Td point group. Question no. 2c]

## SECTION - II

*Q4)* Answer <u>any three</u> of the following.                                    **[15]**

a) Give an account of nitrides of boron.

b) Give characteristic reactions of $PCl_5$

c) Define organometallic compounds. Give different applications of Organomagnesium compounds.

d) Give an account of electron precise compounds.

e) Define interhalogen compounds. Give their- classification. Explain preparation bonding and structure of $XY_5$ type of interhalogen compounds.

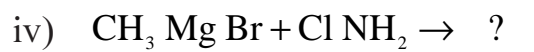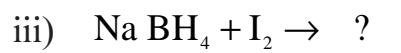*Q5)* Write notes on <u>any three</u> of the following:                            **[15]**
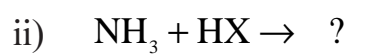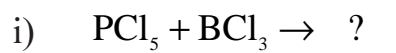
a) Saline hydrides.

b) Applications of inert gases.

c) Green house effect.

d) Crown ethers.

e) Fluoro carbons.

*Q6)* a) Draw <u>any five</u> structures.                                         **[5]**

   i) $S_4 N_4 F_4$

   ii) $H_2 S_2 O_6$

   iii) $B_3 N_3 H_6$

   iv) $[B_6 H_6]^{-2}$

   v) $X_e O_3$

   vi) $Si_3 O_9^{-6}$

b) Complete <u>any five</u> reactions. [5]

    i)    $PCl_5 + BCl_3 \rightarrow \underline{\quad ? \quad}$

    ii)   $NH_3 + HX \rightarrow \underline{\quad ? \quad}$

    iii)  $Na\,BH_4 + I_2 \rightarrow \underline{\quad ? \quad}$

    iv)  $CH_3\,Mg\,Br + Cl\,NH_2 \rightarrow \underline{\quad ? \quad}$

    v)   $S_4 + N_4 \xrightarrow[\text{MeOH} + 2H_2]{\text{Sn Cl}_2} \underline{\quad ? \quad}$

    vi)  $(C_6H_5)_3\,C - H + P \rightarrow \underline{\quad ? \quad}$

☐☐☐
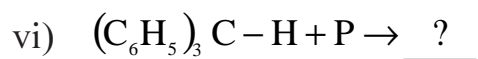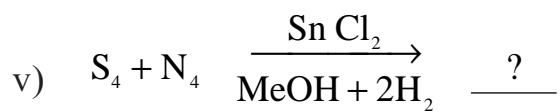
**[3823]-103**

# M.Sc. - I

# ORGANIC CHEMISTRY

## CH-150 : Organic Reaction Mechanism & Stereochemistry

### (2008 Pattern) (New Course)

*Time : 3 Hours]*                                                         *[Max. Marks : 80*

*Instructions to the candidates :*

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

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following:                          **[12]**

a) Why tropone is more stable than anticipated?

b) Trans-2-Chlorocyclohexanol gives epoxycyclohexane in high yield on reaction with a base, however the cis-isomer does not react this way. Explain.

c) Why biphenyl is o/p directing in electrophilic substitution reaction?

d) Meso-Stilbene dichloride does not undergo elimination reaction, when treated with pyridine at 200ºC. Explain.

e) Catalytic hydrogenation of cis-2, 3-diphenylbutene yields meso - 2, 3 - diphenyl butane while the trans isomer yields a dl isomer. Explain.

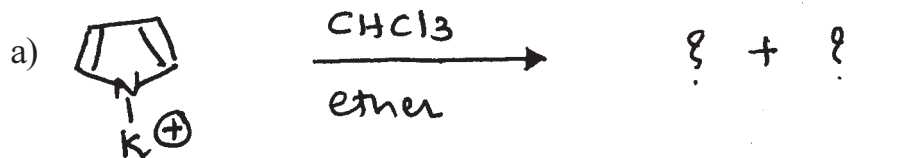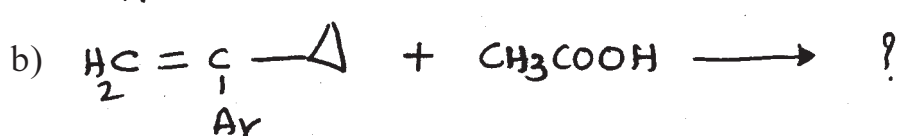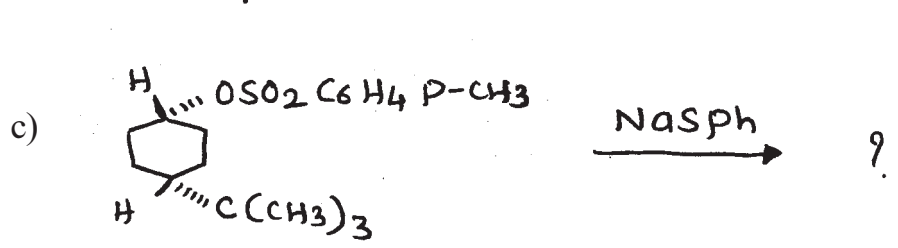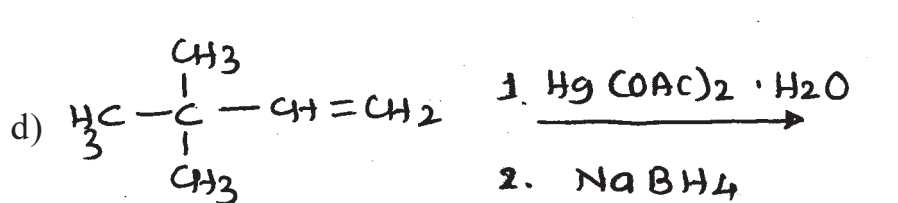*Q2)* a) Write short notes on <u>any two</u> of the following:             **[8]**

i) Annelation.

ii) Inclusion Compounds.

iii) Pyrolytic elimination

b) Explain the following conversions by giving complete reaction sequence (<u>any two</u>):                                                  **[8]**

i) Benzyne to Triptycene.

ii) 2-methyl-1-butene to 2-methyl butane-1-01.

iii) Benzene to cyclohexyl benzene.

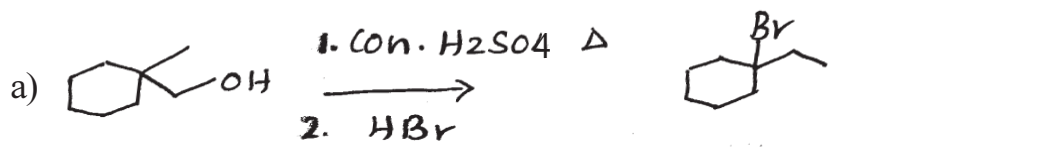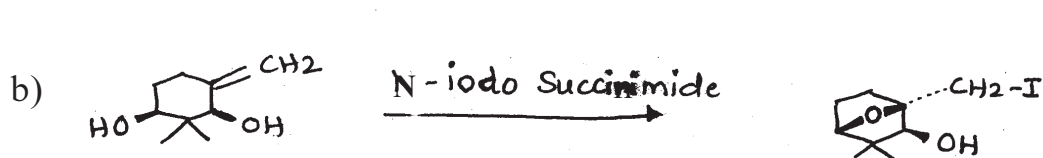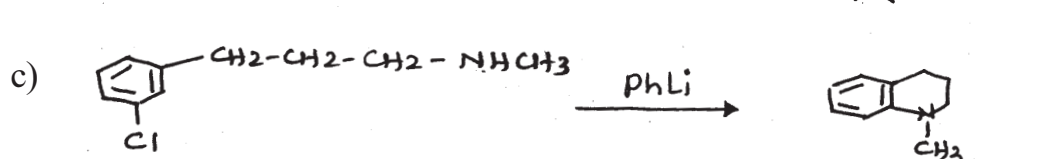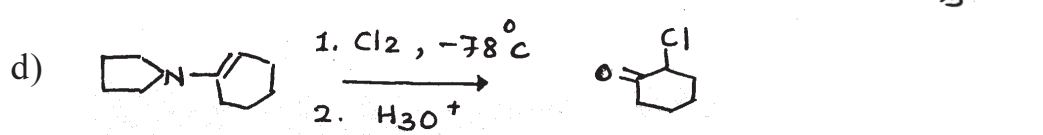*Q3)* Predict the product/s and justify your answer (<u>any four</u>) :            **[12]**

a)  $\xrightarrow[\text{ether}]{\text{CHCl}_3}$   ? + ?

b) $\underset{2}{\text{H}_2\text{C}} = \underset{\underset{\text{Ar}}{|}}{\text{C}} \!\!-\!\! \triangleleft$ + CH$_3$COOH $\longrightarrow$ ?

c)  $\xrightarrow{\text{NaSph}}$  ?

d) $\underset{\underset{\text{CH}_3}{|}}{\overset{\overset{\text{CH}_3}{|}}{\text{H}_3\text{C} - \text{C}}} - \text{CH} = \text{CH}_2$  $\xrightarrow[\text{2. NaBH}_4]{\text{1. Hg(OAc)}_2 \cdot \text{H}_2\text{O}}$  ?
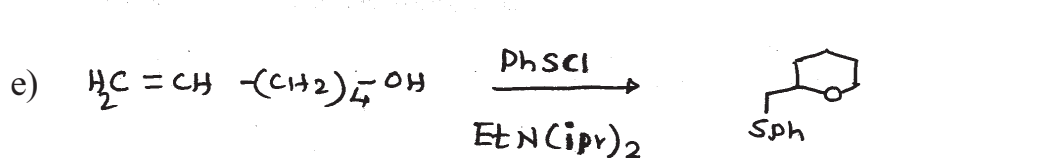
e)  +  $\longrightarrow$ ?

## SECTION - II

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

a)  $\xrightarrow[\text{2. HBr}]{\text{1. Con. H}_2\text{SO}_4 \ \Delta}$ 

b)  $\xrightarrow{\text{N-iodo Succinimide}}$ 

c)  $\xrightarrow{\text{PhLi}}$ 

d)  $\xrightarrow[\text{2. H}_3\text{O}^+]{\text{1. Cl}_2, -78^\circ\text{C}}$ 

e) $\underset{2}{\text{H}_2\text{C}} = \text{CH} - (\text{CH}_2)_4 - \text{OH}$ $\xrightarrow[\text{EtN(iPr)}_2]{\text{PhSCl}}$

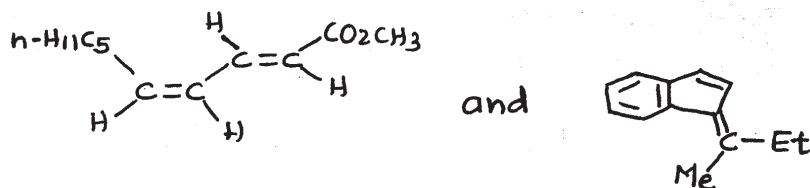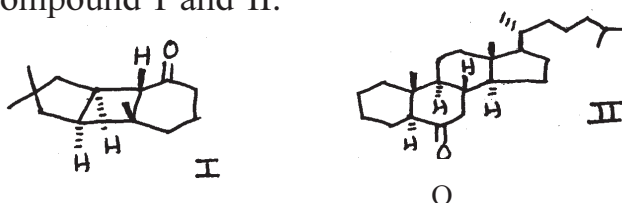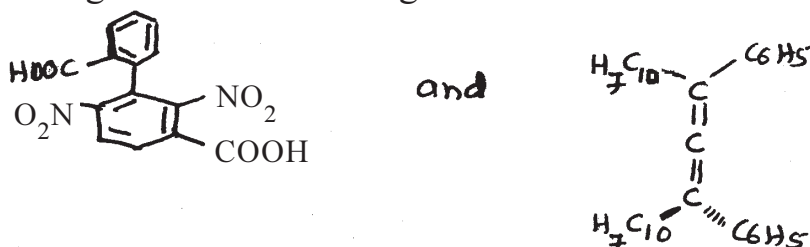*Q5)* Attempt <u>any eight</u> of the following: [16]

a) Assign E/Z configuration to the following.



and



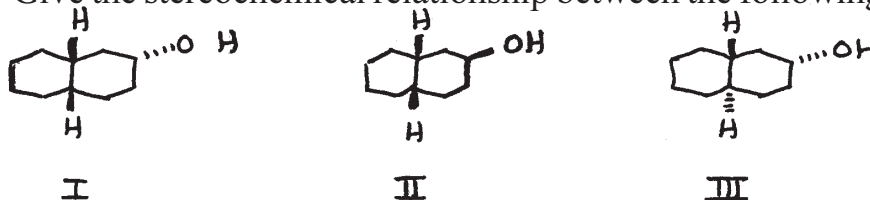b) Label the stereocentres and calculate the no. of stereoisomers in compound I and II.


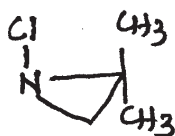
c) Assign 'R' and 'S' configuration.



and



d) Assign 'Si' and 'Re' faces in the following.



and

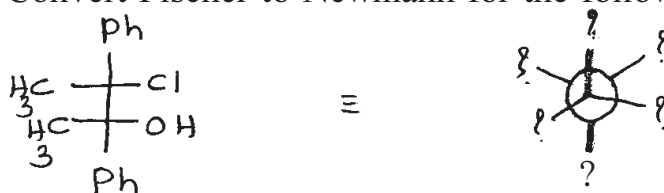$$Ph-\overset{O}{\underset{\|}{C}}-H$$

e) Give the stereochemical relationship between the following compounds.



f) Comment on the optical activity of the following compound.



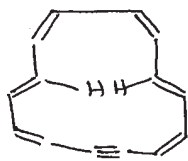g) Convert Fischer to Newmann for the following structure.



h) Explain in short push-pull or Captodative effert.

i) Define regioselectivity with one example.

**Q6)** Attempt <u>any four</u> of the following :                                      **[12]**

a)    Which of the following is more stable? Why?
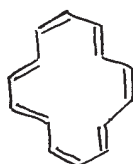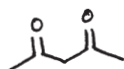


(A)                                      (B)
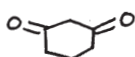
b)    Benzene in HF is a poor conductor and does not exchange deuterium. Explain.
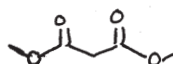
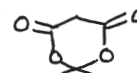c)    Explain the following PKa values.



Pka      13·3                 11·2                          15·9            7·3

d)    Write a note on ''Cine'' Substitution.

e)    Explain SNi mechanism.

❑❑❑

**P598**

# [3823]-104
# M.Sc.
# BIOCHEMISTRY
## BCH-170 : Biomolecules

*Time : 3 Hours]*             *[Max. Marks : 80*

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

## SECTION - I

**Q1)** Answer <u>any four</u> of the following:        **[10]**

     a)    What are epimers? Give any two examples.

     b)    With suitable example explain macromolecules giving its monomeric units.

     c)    Discuss acid base titration curve with suitable example.

     d)    Explain the term micelles and liposomes.

     e)    Explain cyclic structure of monosaccharides.

**Q2)** Attempt <u>any three</u> of the following:        **[15]**

     a)    Give coenzyme forms and biological significance of Niacin and Riboflavin.

     b)    Write short account on lipoproteins.

     c)    Discuss Chemical unity of diverse living organisms.

     d)    Discuss properties of water.

**Q3)** Answer <u>any three</u> of the following:        **[15]**

     a)    Discuss general properties of monosaccharides.

     b)    Explain aldoses and ketoses with suitable example.

     c)    Give structure and function of acyl glycerols.

     d)    Write a note on biological buffer systems.

*P.T.O.*

## SECTION - II

**Q4)** Answer <u>any five</u> of the following:                    **[15]**

   a)   Give structure of following tripeptide Asp - Val - tyr.

   b)   What is isoelectric pH? Explain Zwitterion form of amino acid.

   c)   Give reaction of amino acid with Dansyl Chloride.

   d)   What do you mean by super secondary structure?

   e)   How proteins are separated from small molecular weight substances?

   f)   Give classes of amino acid based on nutritional requirement.

**Q5)** Attempt <u>any three</u> of the following:                    **[15]**

   a)   Explain steps involved in sequencing of a polypeptide.

   b)   Discuss classification of proteins.

   c)   Give short account on properties of aminoacids.

   d)   Discuss forces stabilizing tertiary structure of proteins.

**Q6)** Write notes on <u>any two</u> of the following:                    **[10]**

   a)   Ramchandran plot.

   b)   Solid phase Synthesis.

   c)   End group analysis.

□□□

## [3823]-105
## M.Sc.
## BIOCHEMISTRY
## BCH-171 : Enzymology and Biophysical Techniques

*Time : 3 Hours]*        *[Max. Marks : 80*

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

### <u>SECTION - I</u>
### (Enzymology)

**Q1)** Answer <u>any five</u> of the following:        **[15]**

    a)   Define the terms, Km, Kcat. What is their significance?

    b)   Why it is necessary to purify an enzyme? How specific activity, yield and fold purification is determined during enzyme purification?

    c)   Derive Michaelis-Menten equation. Convert this equation into Lineweaver-Burk equation.

    d)   Ultracentrifugation and N-terminal determination are the criteria to judge the purity of an enzyme. Justify.

    e)   What is the effect of change in temperature on enzyme catalysed reaction?

    f)   Experimentally how it is proved that the enzyme catalyzed reaction goes via double displacement mechanisms.

    g)   Reversible change in covalent structure controls the enzyme activity. Explain.

**Q2)** Attempt <u>any three</u> of the following:        **[15]**

    a)   Distinguish between Monod, Wyman and Changnex model and Koshland, Nemethy and Filmer model to account the behaviour of allosteric enzymes.

    b)   Chemical modification amino acid chains determines the active center of enzyme. Explain why Ser. 195 of chymotrypsin is super reactive?

    c)   Give the therapeutic significance of enzyme inhibitors.

    d)   Give an account of enzyme specificity and catalytic power of an enzyme.

    e)   What is the effect of competitive, noncompetitive and uncompetitive inhibitors an lineweaver Burk plot?

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

*Q3)* Answer <u>any two</u> of the following:                                                    **[10]**

  a)   Give the clinical significance of serum acid and alkaline phosphatases.

  b)   What is a correlation between the rate of turnover and structure and function of an enzyme?

  c)   How pre-steady state kinetics is studied? What is its significance?

## SECTION - II

### (Biophysical Techniques)

*Q4)* Explain the following terms (<u>any five</u>) :                                            **[10]**

  a)   Optical density.

  b)   Partition coefficient.

  c)   Cation exchanger.

  d)   Blotting.

  e)   Dialysis

  f)   Nitro Cellulose filter.

*Q5)* Answer the following (<u>any three</u>):                                                   **[15]**

  a)   What is hydroxyapetite Chromatography? How it separate ssDNA from dsDNA?

  b)   Give principle, functioning and applications of lyophilization.

  c)   What is DNA agarose gel electrophoresis? Explain how it is useful for characterisation of DNA molecule.

  d)   Give the salient features and applications of DNA cellulose Chromatography.

  e)   Give details of southern transfer.

*Q6)* Attempt <u>any three</u> of the following:                                                **[15]**

  a)   Give principle, application and working of HpLc.

  b)   Discuss the theory of UV visible spectrometer. How it is useful for structural characterisation of biomolecules.

  c)   Explain in detail isoelectric focusing.

  d)   Write note on capillary electrophoresis.

  e)   What is dialysis? Give its type and applications.

□□□

2

**P600**                        **[3823]-106**
# M.Sc.
## BIOCHEMISTRY
### BCH-172 : Microbiology and Cell Biochemistry of Eukaryotes

*Time : 3 Hours]*                                        *[Max. Marks : 80*

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

### SECTION - I
### (Microbiology)

*Q1)* Answer of the following questions : (<u>any three</u>)          **[15]**

  a)  Discuss in detail differential staining with suitable example.

  b)  What do you understand from pour plate method? Give the Limitations of it.

  c)  Explain in detail the electron microscopy for studying microorganisms. Add a note on its limitations.

  d)  How the host microbe interaction takes place to cause an infection?

  e)  Explain the mode of action of phenol.

*Q2)* Explain in detail <u>any three</u>.                              **[15]**

  a)  Classification of plant and animal viruses.

  b)  Endotoxins.

  c)  Classification of bacteria & nomenclature.

  d)  Shape and arrangement of bacterial cells.

  e)  Nutritional types of bacteria.

*Q3)* Answer <u>any two</u> of the following:                          **[10]**

  a)  Methods of measurement of growth.

  b)  Mode of action of antimicrobial agents.

  c)  Industrial production of alcohol.

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

1

## SECTION - II

### (Cell Biochemistry / Cell Biology)

*Q4)* Attempt <u>any three</u> of the following: **[15]**

    a)    Describe various types of cell size, shape with suitable examples.

    b)    Explain ultrastructure of nucleus and its roles.

    c)    Give an account on differential centrifugation in cell studies.

    d)    Describe plasma membrane w.r.t. its composition, structure and physiological functions.

*Q5)* Attempt <u>any three</u> of the following: **[15]**

    a)    Give an account on conducting tissues in plants.

    b)    Explain the mitotic event in cell division.

    c)    Explain the significance of staining process in cytological studies. Cite suitable examples.

    d)    Describe the structure and role of chloroplast in plant cells.

*Q6)* Write notes on <u>any two</u> of the following: **[10]**

    a)    Lysosomes and peroxisomes.

    b)    Sponge as a model example for cell aggregation phenomena.

    c)    Stem cells derived from bone marrow and its medical applications.

□□□

**P601**

## [3823]-201
## M.Sc.
### PHYSICAL CHEMISTRY
### CH-210 : Physical Chemistry - II (New)

*Time : 3 Hours]*        *[Max. Marks : 80*

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

### Physico-Chemical Constants

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

*P.T.O.*

1

## SECTION - I

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

a) What is the frequency of IR radiation? Explain why electronic transitions have line widths dependent on collision and Doppler broadening rather than energy uncertainties.

b) Explain the role of microwave spectra in determining exact atomic weights and relative abundances of different isotopes.

c) Explain the cause of the breakdown of Born-Oppenheimer approximation. Sketch and explain the P and R branches of CO molecule.

d) Explain the rule of mutual exclusion and its converse. Sketch and explain the polarizability ellipsoids of the various modes of vibration of the $CO_2$ molecule. Which of these are Raman active.

e) Explain the Raman spectrum of rigid diatomic molecule.

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

a) State the Franck-Condon principle. Explain why electronic spectra are very complex?

b) Deduce $V_{max} = \dfrac{1-2x_e}{2x_e}$ for electronic transition.

c) Explain the Birge-Sponer extrapolation method used to determine the dissociation of $I_2$ molecule.

d) Write a note on Stark effect.

e) Explain the principle of NMR and give its applications.

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

a) The rotational spectra of CO has a spacing of 3.84235 cm$^{-1}$. Determine the bond length. [Atomic weight : C = 12, O = 16]

b) HCl is irradiated with 436 nm Hg line. Calculate the first stokes Raman line, if the fundamental vibrational frequency of HCl is $8.667 \times 10^{13}$ Hz.

c) The absorption spectra of $O_2$ shows a continuum at 56876 cm$^{-1}$. The upper electronic state dissociate into one ground state atom and one excited state atom. The excitation energy is 15875 cm$^{-1}$. Determine the dissociation energy of the ground state of $O_2$ in kJ mole$^{-1}$.

## SECTION - II

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

 a) Explain the construction and working of G.M. counter.

 b) What are the various modes of interaction of γ - rays with matter? Discuss any one of them in detail.

 c) Discuss the mechanism of radiolysis of water.

 d) Explain the different units for measuring radiation absorption.

 e) Explain isotope separation method for plutonium.

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

 a) Explain in detail critical size of thermal reactor.

 b) What is design parameter? Classify the reactors on the basis of fuel and moderator.

 c) What is the breeder reactor? Explain with an example the principle of breeding.

 d) What is diffusion? Discuss different types of diffusion processes and give one example of each.

 e) Describe the use of radioisotope in the measurement of the thickness of a moving sheet.

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

 a) The half-life period of radon is 3.8 days. After how many days will one twentieth of radon sample be left over?

 b) A 0.1 g gun metal alloy containing 90 % Cu was irradiated for one day in a neutron flux $10^9$n cm$^{-2}$s$^{-1}$. Calculate the activity after a cooling period of 6 hrs.

 [Given : At. weight of Cu = 63, $t_{1/2}$ for $^{64}Cu = 12.7 hrs$, σ = 4.5 barn, $r$ = 69.17%]

 c) Find out the linear absorption coefficient of methanol.

 [Given : $e^\mu$ = 0.211 barn/electron, density of methanol is 0.713 gm.cm$^{-3}$, Z of C = 6, H = 1, O = 8 and A of C = 12, H = 1, O = 16].

□□□

**P602**                                **[3823]-202**
## M.Sc. -I (Sem. - II)
## CHEMISTRY
## CH - 230 : Inorganic Chemistry - II

*Time : 3 Hours]*                                          *[Max. Marks : 80*

*Instructions to the candidates :*

   *1)   All questions are compulsory.*

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

   *3)   Neat diagrams must be drawn wherever necessary.*

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

   *5)   Use of logtables and calculator is allowed.*

   *6)   Given Atomic Numbers. Cr = 24, Mn = 25, Co = 27, Ni = 28.*

### SECTION - I

*Q1)* Attempt <u>any three</u> of the following:                    **[15]**

   a)   Prepare a table of micro states and obtain R.S. term symbols for $S^1d^1$ configuration.

   b)   State and explain Hund's rules in determining the ground state term. Using these rules arrange the following terms increasing order of energy.

      i)   $^4H$ $^4G$ $^2I$ $^2M$ $^2P$

      ii)   $^3P$, $^3F$, $^1S$, $^1G$, $^1D$

   c)   $d^3$ system in octahedral field gives the following transitions.

      i)   $^4A_{2g(F)} \rightarrow {}^4T_{2g(F)}$

      ii)   $^4A_{2g(F)} \rightarrow {}^4T_{1g(F)}$

      iii)   $^4A_{2g(F)} \rightarrow {}^4T_{1g(P)}$

      Correlate these transitions in terms of crystal field spliting parameter, $D_q$ and Racah parameter B.

   d)   Write short note on : ''Luminescence''.

   e)   i)   In the electronic spectra of $d^9$ complexes a shoulder is observed on main transition band. Explain.

      ii)   Electronic spectra of inner transition metal ions and their complexes are almost similar. Comment.

*P.T.O.*

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*Q2)* Answer <u>any three</u> of the following: **[15]**

a) $^4F$ R.S. term is allowed for $d^3$ configuration of $Cr^{3+}$ free ion. Find out how it looses, its degeneracy when $[Cr(OX)_3]^{3-}$ complex ion is formed.

b) Explain in which of the following complexes orbital contribution to the magnetic moment is quenched. Justify your answer.

   i) $[Mn(CN)_6]^{4-}$

   ii) $[Cr(H_2O)_6]^{3+}$

c) Calculate degeneracy for the following terms / configurations / states.

   i) $P^3d^2$,      ii) $(t_{2g})^3(eg)^3$,      iii) $^5H$,

   iv) $^4T_{2g}$,      v) $4.^2B_{2g}$.

d) Arrange the following transitions in octahedral complex according increasing intensity. Justify your answer.

   i) $A_{2g} \rightarrow A_{2u}$

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

   iii) $A_{2u} \rightarrow T_{2g}$.

e) How would you account for the magnetic moment listed against each of the following complexes?

   i) $[CoCl_2(OPPh_3)_2]$    $\mu = 4.91$ B.M.

   ii) $[Ni(PPh_3)_2Br_2]$    $\mu = 3.24$ B.M.

*Q3)* Answer the following: **[10]**

a) Construct correlation diagram for $d^2$ system in octahedral field.

   Given :

   i) R.S. Terms for free ion $d^2$ system are $^3F, ^1D, ^3P, ^1G$ and $^1S$ in the order of increasing energy.

   ii) In weak octahedral field the R.S. term split into the following group theoretical terms.

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

   $^1D = {}^1T_{2g} + {}^1E_g$.

   $^3P = {}^1T_{1g}$.

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

   $^1S = {}^1A_{1g}$.

OR

a) i) A complex $[Cr(H_2O)_6]Cl_3$ records three spin allowed transitions at 17400 cm⁻¹, 24600 cm⁻¹ and 37800 cm⁻¹. Calculate nephelauxetic ratio β and comment on nature of M–L bond B = 918 cm⁻¹.

ii) $Ni^{2+}$ octahedral complex shows 15% increase in its observed magnetic moment value. Calculate spin orbit coupling constant λ for $Ni^{2+}$ ion.
Given : Crystal spliting parameter = 8500 cm⁻¹.

## SECTION - II

*Q4)* Answer <u>any three</u> of the following: **[15]**

a) Principles of coordination chemistry are utilized in natural selection of metals in bio-system. Justify the statement with suitable example.

b) What is homeostatis? Explain with suitable example.

c) Comment on inner sphere and outer sphere electron transfer reactions.

d) What are Zinc – binding domains? Explain the role of Zinc in these domains.

e) Explain the uptake of Iron by cell.

*Q5)* Write note on (Any three): **[15]**

a) Classification of metalloproteins.

b) Metals in medicine.

c) Ferridoxin.

d) HSAB principle.

e) Calmodulin.

*Q6)* Draw the structures (Any five) : **[10]**

a) Oxyhemoglobin

b) 3Fe – 4.S

c) Pterin

d) Adenin

e) $[(Py)_2\, Pt\, (en)_2]^{+2}$

f) Uracil

## DIRECT PRODUCTS

1. Groups of the form $G \times i$ or $G \times \sigma_h$ :
   The $g, u$ or $', ''$ additions to the IR symbols in these groups satisfy
   $$g \times g = u \times u = g, \; g \times u = u, \; 'x' = ''x'' = ', \; 'x'' = ''.$$

2. Products of the form $A \times A$, $B \times B$, $A \times B$ :
   For all groups :
   Letter symbols : $A \times A = A$, $B \times B = A$, $A \times B = B$.
   Subscripts : $1 \times 1 = 1$, $2 \times 2 = 1$, $1 \times 2 = 2$
   except for the B representations of $D_2$ and $D_{2h}$ where
   $B \times B = B$ and $1 \times 2 = 3$, $2 \times 3 = 1$, $3 \times 1 = 2$.

3. Products of the form : $A \times E$, $B \times E$ :
   ( $a$ ) For all groups : $A \times E_k = E_k$ irrespective of the suffix on A.
   ( $b$ ) For all groups except $D_{6d}$, $D_{4d}$, $S_8$ :
   $\quad$ $B \times E_1 = E_2$, $B \times E_2 = E_1$
   $\quad$ irrespective of the suffix on B. ( If the group has only one E representative
   $\quad$ put $E_1 = E_2 = E$. )
   ( $c$ ) For $D_{6d}$ :
   $\quad$ $B \times E_1 = E_5$, $B \times E_2 = E_4$, $B \times E_3 = E_3$, $B \times E_4 = E_2$, $B \times E_5 = E_1$
   $\quad$ irrespective of the suffix on B.
   ( $d$ ) For $D_{4d}$, $S_8$ :
   $\quad$ $B \times E_1 = E_3$, $B \times E_2 = E_2$, $B \times E_3 = E_1$
   $\quad$ irrespective of the suffix on B.

4. Products of the form $E \times E$ :
   ( For groups which have A, B or E symbols without suffixes put $A_1 = A_2 = A$,
   etc. in the equations below )
   ( $a$ ) For $O_h$, $O$, $T_d$, $D_{6h}$, $D_6$, $C_{6v}$, $C_{6h}$, $C_6$, $S_6$, $D_{3d}$, $D_{3h}$, $D_3$, $C_{3v}$, $C_{3h}$, $C_3$ :
   $\quad$ $E_1 \times E_1 = E_2 \times E_2 = A_1 + A_2 + E_2$; $E_1 \times E_2 = B_1 + B_2 + E_1$.
   ( $b$ ) For $D_{4h}$, $D_4$, $C_{4v}$, $C_{4h}$, $C_4$, $S_4$, $D_{2d}$ :
   $\quad$ $E \times E = A_1 + A_2 + B_1 + B_2$.
   ( $c$ ) For $D_{6d}$ :
   $\quad$ $E_1 \times E_1 = E_5 \times E_5 = A_1 + A_2 + E_2$,
   $\quad$ $E_2 \times E_2 = E_4 \times E_4 = A_1 + A_2 + E_4$,
   $\quad$ $E_3 \times E_3 = A_1 + A_2 + B_1 + B_2$.
   $\quad$ $E_1 \times E_2 = E_4 \times E_5 = E_1 + E_3$, $E_1 \times E_3 = E_3 \times E_5 = E_2 + E_4$,
   $\quad$ $E_1 \times E_4 = E_2 \times E_5 = E_3 + E_5$, $E_2 \times E_3 = E_3 \times E_4 = E_1 + E_5$,
   $\quad$ $E_1 \times E_5 = B_1 + B_2 + E_4$, $E_2 \times E_4 = B_1 + B_2 + E_2$.

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

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

(e) For $D_{4d}$, $S_E$.

$$E_1 \times E_1 = E_3 \times E_3 = A_1 + A_2 + E_2,$$
$$E_2 \times E_2 = A_1 + A_2 + B_1 + B_2$$
$$E_1 \times E_2 = E_2 \times E_3 = E_1 + E_3, \quad E_1 \times E_3 = B_1 + B_2 + E_2.$$

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

$$A_1 \times T_1 = T_1, \quad A_1 \times T_2 = T_2, \quad A_2 \times T_1 = T_2, \quad A_2 \times T_2 = T_1,$$
$$E \times T_1 = E \times T_2 = T_1 + T_2.$$
$$T_1 \times T_1 = T_2 \times T_2 = A_1 + E + T_1 + T_2,$$
$$T_1 \times T_2 = A_2 + E + T_1 + T_2.$$

6. The complete results for O are :

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

# CORRELATION TABLE FOR GROUP $O_h$

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

## Character Table for (O) rotational group

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

**P605**

**[3823]-205**

**M.Sc.**

**BIOCHEMISTRY**

**BCH-271 : Biophysical Techniques**

*Time : 3 Hours]*　　　　　　　　　　　　　　　　*[Max. Marks : 80*

*Instructions to the candidates :*

    *1)*　*Answers to the two sections must be written in two separate answer books.*

    *2)*　*All questions are compulsory.*

    *3)*　*Figures to the right indicate full marks.*

**SECTION - I**

*Q1)*　Answer <u>any five</u> of the following:　　　　　　　　　　**[15]**

    a)　What are CM - cellulose and DEAE Cellulose? Give their uses.

    b)　Why is β- mercaptoethanol and SDS used in SDS - PAGE.

    c)　Give the significance of polycarbonate and nitrocellulose filters.

    d)　Write a note on Principle and applications of dialysis.

    e)　Differentiate between stacking gel and separating gel.Give its significance .

    f)　Write short note on hydrophobic chromatography.

    g)　Define Isoelectric pH. Give the Principle of Isoelectric focussing.

*Q2)*　Attempt <u>any three</u> of the following:　　　　　　　　　　**[15]**

    a)　Differentiate between southern and Northern blotting techniques. Give their applications.

    b)　Explain the steps involved in determination of molecular weight of proteins by SDS - PAGE.

    c)　Discuss the Principle, Procedure and application of Gas liquid chromatography.

    d)　Describe the Principle and Procedure involved in Separation of mixture of an acidic, basic and neutral aminoacids by ion - exchange Chromatography.

    e)　How are DNA fragments separated in agarose gel electrophoresis?

*P.T.O.*

**Q3)** Answer <u>any five</u> of the following:                                    **[10]**

a)   How are suitable ligands attached to matrix in affinity chromatography?

b)   What is HPLC and HPTLC? Give its uses.

c)   Why glycerol and Bromophenol blue are mixed with samples that are loaded in Gel electrophoresis?

d)   What are the two main techniques employed for the development of paper chromatograms?

e)   Differentiate between isocratic elution and gradient elution.

f)   Give the principle of UV-Visible spectrophotometry.

g)   List out the significance of Gel permeation chromatography.

## SECTION - II

**Q4)** Answer <u>any three</u> of the following:                                    **[15]**

a)   Define sedimentation. Explain in detail the construction and working of analytical ultracentrifuge.

b)   How will measure partial specific volume by using pycnometer?

c)   What is the effect of addition of ethidium bromide on viscosity of DNA?

d)   What is meant by Quenching? Explain different factors that are involved in quenching.

e)   What is meant by sensitization in autoradiography?

**Q5)** Explain <u>any three</u> of the following:                                    **[15]**

a)   Diffusion measurement and arrangement of subunits of hemoglobin.

b)   Measurement of viscosity by Zimm Crother's viscometer.

c)   Difference between band and boundary sedimentation.

d)   Liquid scintillation counting.

e)   Molecular autoradiography.

**Q6)** Write short notes on <u>any two</u> of the following:                                    **[10]**

a)   Meselson stahl experiment by using sedimentation.

b)   Types of radiations used in Biochemistry.

c)   Effect of friction on sedimentation.

□□□

**P606** **[3823]-206**

# M.Sc.

## BIOCHEMISTRY

### BCH-273 : Membrane Biochemistry and Nucleic Acids

*Time : 3 Hours]* *[Max. Marks : 80*

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

### SECTION - I

### (Membrane Biochemistry)

**Q1)** Answer <u>any three</u> of the following: **[15]**

a) Singer and Nicolson's model of biomembrane.

b) Phospholipids as a membrane constituent.

c) Freez fracture technique in membrane studies.

d) Chloride exchanger.

**Q2)** Answer <u>any three</u> of the following: **[15]**

a) Active transport of glucose.

b) Patch clamp studies.

c) Functioning of sodium p-potassium ATPase pump.

d) Bacterial phosphotransferase.

**Q3)** Write short notes on (<u>Any two</u>): **[10]**

a) Iron transport by receptor mediated endocytosis.

b) Valinomycin as a transport antibiotic.

c) Structure of acetyl choline receptor channel.

*P.T.O.*

# SECTION - II
## (Nucleic Acids)

**Q4)** Answer <u>any three</u> of the following: **[15]**

   a) What are inborn errors of metabolism ? How they are caused? Discuss few examples in detail.

   b) What are plasmids? How they are used in gene cloning experiments?

   c) Explain in detail the complement test.

   d) Describe in detail the Lysogenic Life cycle of bacteriophage.

**Q5)** Answer <u>any three</u> of the following: **[15]**

   a) Describe in detail tetrad analysis in fungi and give its significance.

   b) What is bacterial conjugation? Describe it in detail.

   c) What is attenuation of operon? Explain it with suitable example.

   d) Explain the Mendel's principle of gene segregation.

**Q6)** Write short notes on <u>any two</u> of the following: **[10]**

   a) Selection and isolation of bacterial auxotrophs.

   b) Conditional mutants.

   c) Salient features of Watson and Crick model of DNA.

☐☐☐

**P607**               **[3823]-301**

# M.Sc.

## PHYSICAL CHEMISTRY

### CH-310 : Quantum Chemistry and Solid State Chemistry (New)

*Time : 3 Hours]*                     *[Max. Marks : 80*

***Instructions to the candidates :***

     *1)*     *Answers to the TWO sections should be written in SEPARATE answer books.*

     *2)*     *ALL questions are COMPULSORY.*

     *3)*     *Figures to the RIGHT SIDE indicate FULL marks.*

     *4)*     *Use of logarithmic table calculator is ALLOWED.*

     *5)*     *Neat diagrams must be drawn WHEREVER necessary.*

#### Physico-Chemical Constants

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

*P.T.O.*

1

## SECTION - I

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

a) The unnormalized wave function for a particle in a one-dimensional box is given as $\Psi_n = A.\sin \dfrac{n\pi}{a}.x$

Where '$a$' is the length of the box. Determine the value of the normalization constant A.

b) Deduce the quantum mechanical operator for linear momentum.

c) Explain raising and lowering operators.

d) Discuss the application of the variation method for helium atom.

e) Derive the expression for the first order correction to the energy of the non-degenerate perturbation method.

f) Formulate the Hamiltonian operators for $Be^{+2}$ and $H_2^-$ ions. State the terms involved in each of these.

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

a) Obtain the secular determinant for cyclobutadiene and hence sketch the MO's.

b) Explain how Hess and Schaad improved Huckel's calculations for M.O. energies.

c) Discuss why cyclo-octatetraene dianion is stable but the molecule is not stable.

d) Explain the mnemonic model used to evaluate MO energies and their spacings in annuclens.

e) Discuss Huckel's 4m + 2 rule citing benzene and cyclo-octatetraene as examples.

f) Discuss the effect of promoting two pielectrons in the ground state butadiene molecule to the first excited level on the bond lengths, on the basis of HMO energies.

**SECTION - II**

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

    a)   Comment on the effect of temperature on carrier density and conductivity of n-type extrinsic conductor.

    b)   Derive the expression for Fermi energy of an intrinsic semiconductor.

    c)   Derive the expression for the Frenkel defects in a crystal at a given temperature.

    d)   Discuss the mechanism of diffusion in crystalline solids.

    e)   Fast growing faces are eliminated whereas slow growing faces persist in a crystal. Explain.

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

    a)   Explain the experiment used to determine the nature of carriers in a silver chloride crystal.

    b)   Write a note on optical properties of semiconductors.

    c)   Explain the formation of colour centres in ionic crystals.

    d)   Explain the kinetic rate laws of nucleation for the decomposition of a single solid.

    e)   Write and explain the mechanism for the reactions occuring at the

        i)   Interphase $AgI/Ag_2HgI_4$ for the reaction between $AgI$ and $HgI_2$.

        ii)  Interphases $Cu/CuCl$ and $CuCl/AgCl$ for the reaction between $Cu(s)$ and $AgCl(s)$.

*Q5)* Solve **any two** of the following. [10]

    a)   Determine the value of forbidden energy band at $27^o$C in a crystal containing $10^{16}$ and $10^{12}$ holes and electrons per cubic meter respectively.

    b)   Calculate the drift mobility of a charge carrier for a semiconductor having donor concentration of $10^{22}$ m$^{-3}$.
        [Given : Conductivity = 100 mho m$^{-1}$]

    c)   The density of Schottky defects in sodium chloride crystal is $5 \times 10^{11}$ per m$^3$ at 25 $^o$C. If the observed interionic (Na$^+$– Cl$^-$) distance is 2.82 A$^o$, determine the average energy required to create one schottky defect.

□□□

**P608**

**[3823]-302**

# M.Sc.

## PHYSICAL CHEMISTRY

### CH-311 : Nuclear and Radiation Chemistry (New)

*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates :*

   *1)*    *Answers to the TWO sections should be written in SEPARATE answer books.*

   *2)*    *ALL questions are COMPULSORY.*

   *3)*    *Figures to the RIGHT SIDE indicate FULL marks.*

   *4)*    *Use of logarithmic table, calculator is ALLOWED.*

   *5)*    *Neat diagrams must be drawn WHEREVER necessary.*

### Physico-Chemical Constants

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| | | | $= 1.602 \times 10^{-19} \text{ C}$ |
| 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 | $= 8.314 \times 10^{7} \text{ ergK}^{-1} \text{ mol}^{-1}$ |
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| 13. | Mass of an electron | $m_e$ | $= 9.11 \times 10^{-31} \text{ kg}$ |

*P.T.O.*

1

# SECTION - I

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

a) Discuss the principle of Breeder reactor.

b) Write a note on Fermi's four factor formula and reproduction factor K.

c) Explain the neutron energy distribution curve. What is the origin of delayed neutrons?

d) Describe with suitable example the process of spontaneous fission.

e) What are the various forms of nuclear potential?

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

a) What are the merits of a shell model?

b) Discuss the principle of PIXE technique.

c) Describe how depth profile can be studied using RBS technique.

d) Give an account of photonuclear reactions.

e) Derive Breit Wigner formula.

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

a) If the threshold for the reaction $A(p, n)B$ is 2.5 MeV. What is the mass difference between A and B.
   Give : Mass of $p$ = 1.007 825 $u$
   Mass of $n$ = 1.008 665 $u$.

b) Calculate the number of uranium atoms that must fission per second if power generated equals 15 MW.
   Given : Energy released per Uranium fission is 200 MeV.

c) In the fission of $^{239}_{94}Pu$, the fragments have the mass numbers 100 and 138 whose stable isobars are $^{100}_{42}Mo$ and $^{138}_{56}Ba$. What are the primary fragments?

# SECTION - II

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

    a)    What are after effects of Chernobyl accident?

    b)    What are man made sources of radiations? What are the ways and means to control them?

    c)    Explain how external radiation hazards can be controlled.

    d)    Discuss the working of quartz fibre electrometer.

    e)    Give an account of Szilard-Chalmers reactions.

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

    a)    Describe the characteristics of semiconductor detectors and explain why are the semiconductor devices are superior to scintillators.

    b)    Write a note on photomultiplier tube.

    c)    Distinguish between somatic and genetic effects of radiation.

    d)    Explain the terms, retention, annealing and G-value.

    e)    Write a note on ceric sulphate dosimeter.

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

    a)    Find the dose absorbed by methanol in 2h when exposed to $\gamma$ - radiation in terms of rads.

    b)    Find the biologically effective dose in sieverts for a radiation dose of 0.1 rad due to $\alpha$ - particles and 0.02 rad due to fast neutrons.

    c)    Find the dose due to $^{60}Co$ at a distance of four meters.
        Given : $E_\gamma = 1.33$ and 1.17 MeV.

□□□

**P609**                                     **[3823]-303**

# M.Sc.

## PHYSICAL CHEMISTRY

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

*Time : 3 Hours]*                                        *[Max. Marks : 80*

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

#### Physico-Chemical Constants

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

*P.T.O.*

1

## SECTION - I

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

a) Define Bremsstrahlung and short-wavelength cut off ($\lambda_0$). Explain the dependence of intensity and $\lambda_0$ on atomic number and accelerating potential respectively.

b) What are SEM and STEM? Discuss their applications.

c) Explain chemical analysis by X-ray absorption.

d) Write the equation for the activity produced by a specific nuclide when irradiated with neutrons and explain the terms involved in it.

e) Explain the terms, isotopic abundance, matrix and particle flux used in NAA.

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

a) Describe the prompt-radiation activation analysis technique.

b) Explain the time-of-flight analyzer with a neat labelled diagram.

c) Name the detectors used in mass spectrometry. Describe the Faraday Cup detector.

d) Why are satellite peaks observed in ESCA?

e) With a neat labelled diagram explain the cylindrical mirror analyzer used in ESCA.

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

a) What will be the activity for a 90 mg sample of an alloy containing 0.2% manganese after one hour irradiation in a flux of $2\times10^{12}$ n cm$^{-2}$s$^{-1}$?

[Given : $t_{1/2}$ of $^{56}Mn=2.58h, \sigma=13.3b, \gamma=100\%$ ]

b) A magnet has a field strength of 0.24T. The radius of curvature of the ion path is 12.7 cm. Determine the accelerating voltage required to direct a singly charged water molecule through an exit slit of the magnetic sector of this mass spectrometer.

c) Aluminium is to be used as windows for a cell for X-ray absorption measurements with the Ag K$\alpha$ line. The mass absorption coefficient for aluminium at this wavelength is 2.74 cm$^2$/g. Its density is 2.70 g/cm$^3$. What maximum thickness of an aluminium foil could be used to fabricate the window if no more than 3.5% of the radiation is to be absorbed by them?

# SECTION - II

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

   a) How the technique of Chemiluminescence used for the determination of gaseous air pollutants?

   b) What are 'S' route and 'T' route mechanisms as used in Electrochemiluminescence?

   c) Enlist the advantages of using plasma over flame and electrothermal methods.

   d) With a neat labelled diagram describe the working of a typical ICP – emission spectrometer.

   e) Describe briefly, the applications of thermogravimetry.

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

   a) Discuss briefly the technique of differential scanning calorimetry.

   b) Explain the principle of controlled potential coulometry with the help of a typical example.

   c) Give the advantages of secondary coulometric analysis.

   d) State the principle of voltametry technique. How is the reaction mechanism studied by using hydrodynamic voltametry?

   e) Write a note on pulse voltammetry.

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

   a) The initial current is 90mA and decreases exponentially with $K = 0.0058 \text{ sec}^{-1}$. The titration time is 714 sec. How many milligrams of uranium (VI) are reduced to uranium (IV)? (At. wt. of U = 238.)

   b) A 25.0 mL portion of a solution containing ethylenediamine was thermometrically titrated with 1.046 M hydrochloric acid.

$$H_2NCH_2CH_2NH_2 + HCl \quad \rightarrow \quad NH_2CH_2CH_2NH_3^+ + Cl^-$$

The first end point of titration was 1.048 mL. Determine the concentration of ethylenediamine in the solution.

   c) If the initial concentration of silver is $5 \times 10^{-2}$M, how long should the deposition take assuming.

       $\delta = 2 \times 10^{-3}$ cm

       $D = 7 \times 10^{-5}$ cm$^2$S$^{-1}$

       V = 200 mL and

       A = 150 cm$^2$.

□□□

**P610**                 **[3823] - 304**

## M.Sc.

## PHYSICAL CHEMISTRY

### CH-314 : Polymer Chemistry (New)

*Time : 3 Hours]*                                      *[Max. Marks : 80*

*Instructions to the candidates:*

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

### Physico - Chemical Constants

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| | | | $= 8065.5$ cm$^{-1}$ |
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| 13. | Mass of an electron | $m_e$ | $= 9.11 \times 10^{-31}$ kg |

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following : **[15]**

    a)    Distinguish between chain and step polymerization.

    b)    Describe the secondary bond forces of the polymer.

    c)    Derive the co-polymer equation.

    d)    Write a note on thermoplastic and thermosetting polymers.

    e)    Distinguish between addition and condensation polymerization.

**Q2)** Attempt <u>any three</u> of the following : **[15]**

    a)    Describe Flory-Krigbaum theory of dilute polymer solution.

    b)    Explain, why Nylon-6 is highly crystalline?

    c)    Distinguish between homopolymer and co-polymer. What are the advantages of co-polymer?

    d)    Discuss the effect of degree of crystallinity on hardness, modulus and permeability.

    e)    Explain,- It is almost impossible to obtain an 100% crystalline polymer.

**Q3)** Solve <u>any two</u> of the following : **[10]**

    a)    A polymer with $M = 100000$ obeys Mark-Houwink equation. $K = 1.2 \times 10^{-4}$ and $\alpha = 0.72$, Huggin's constant $= 0.33$. Calculate relative viscosity at $C = 0.6$ g/dl.

    b)    One mole of vinyl acetate is co-polymerised with three moles of vinyl chloride, the monomer reactivity ratios are 0.23 and 1.68 respectively. Calculate instantaneously composition of polymer.
       [At. wts. : $C = 12$, $H = 1$, $O = 16$, $Cl = 35.5$].

    c)    The extent of reaction for linear step reaction polymerization is 0.98. Calculate the number average degree of polymerization and the weight fraction of the chain having $\overline{X}_n$ repeating units.

## SECTION - II

**Q4)** Attempt <u>any four</u> of the following : **[20]**

    a)    Describe the experimental method by viscosity measurement to determine the molecular weight of the polymer.

    b)    Discuss the use of TGA technique in the analysis of polymer.

    c)    Describe the principle of membrane osmometry.

    d)    Discuss the effect of irradiation on degradation and cross linking of the polymer.

e) Describe the preparation of polymer sample for IR spectrum. Why do the IR spectra of crystalline and amorphous polymer differ.

f) Write a note on X-ray diffraction in analysis of polymers.

*Q5)* Attempt <u>any four</u> of the following : **[20]**

a) Discuss conduction mechanism in conducting polymer.

b) What is Rheology? Discuss the viscous flow phenomenon and its mechanism in polymers.

c) Derive the stress strain equation for simple stretching of an elastomer.

d) Deduce expressions for enthalpy, entropy and free energy of mixing of a polymer solution.

e) Describe injection moulding with neat diagram.

f) What are the techniques used for the production of reinforced plastics. Explain any one technique with neat diagram.

✦✦✦✦

**P611**           **[3823] - 305**

# M.Sc.

## PHYSICAL CHEMISTRY

### CH-315 : Special Topics in Physical Chemistry

**(New Course)**

*Time : 3 Hours]*           *[Max. Marks : 80*

*Instructions to the candidates:*

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

     *2)*    *All questions are compulsory.*

     *3)*    *Figures to the right side indicate full marks.*

     *4)*    *Use of logarithmic tables / calculator is allowed.*

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

## Physico - Chemical Constants

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| | | | $= 4.184 \text{ J}$ |
| 10. | 1 amu | | $= 1.673 \times 10^{-27} \text{ kg}$ |
| 11. | Bohr magneton | $\beta_e$ | $= -9.274 \times 10^{-24} \text{ J T}^{-1}$ |
| 12. | Nuclear magneton | $\beta_n$ | $= 5.051 \times 10^{-27} \text{ J T}^{-1}$ |
| 13. | Mass of an electron | $m_e$ | $= 9.11 \times 10^{-31} \text{ kg}$ |

## SECTION - I

*Q1)* Answer <u>any four</u> of the following : **[20]**

    a)     What are the basic criteria for sensors?

    b)     Give classification of sensors according to their principle of conversion.

    c)     Explain the properties of conducting electrodes for operation of sensors.

    d)     Define adsorption isotherm. Draw different types of adsorption isotherms and explain the isotherm of type IV.

    e)     Define the terms, activity, selectivity, stability, inhibitor and catalyst.

    f)     Explain catalytic cycle for acetal hydrolysis in aqueous acid solution.

*Q2)* Answer <u>any four</u> of the following : **[20]**

    a)     Draw and discuss the mechanism of the phenolacetone condensation reaction to give bisphenol A.

    b)     Derive the expression for Michaelis-Menten kinetics.

    c)     Write the mass balance on thiosulphate and oxalate in 0.01 M $H_2S_2O_3$ and 0.02 M $H_2C_2O_4$ solutions respectively.

    d)     Write proton condition for $H_2CO_3$ and $CH_3COOH$.

    e)     Calculate pH and concentration of all species for 0.1 N $CH_3COONa$. Given : $Ka = 1.8 \times 10^{-5}$.

    f)     Calculate the fractions of carbonic acid existing as $H_2CO_3$, $HCO_3^-$ and $CO_3^{2-}$ in the solution.

           Given : pH = 7.98, $Ka_1 = 4.47 \times 10^{-7}$, $Ka_2 = 5.62 \times 10^{-11}$.

## SECTION - II

*Q3)* Attempt <u>any four</u> of the following : **[20]**

    a)     State and explain the characteristics of a passively smart material.

    b)     What do you mean by replicating nature? How is it applied to prepare smart materials?

    c)     Write a note on electron microscope.

    d)     Calculate the wavelength of an electron emitted in cathode ray tube operating at 10,000 V.

    e)     Give an account of Sushi sensor.

    f)     Write a note on Pachinko Machine.

*Q4)* Attempt <u>any four</u> of the following :                                    **[20]**
   a)  Derive phase rule.
   b)  Write a note on constant boiling liquids.
   c)  Describe briefly carbon nano tubes.
   d)  What is smart car? Explain the basic principles involved in it.
   e)  Explain the principle of steam distillation.
   f)  Write a note on Fullerin.

✦✦✦✦

## M.Sc. - II

### INORGANIC CHEMISTRY

**CH-331 : Structural Methods in Inorganic Chemistry**

**(New Course) (Sem. - III)**

*Time : 3 Hours]*                 *[Max. Marks : 80*

*Instructions to the candidates:*

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

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

a) Explain the cyclic voltamogram of $K_3[Fe(CN)_6]$ in 1M $KNO_3$ scanned between 0.8 V to –0.15V.

b) Discuss the ESR spectrum of cyclopentadienyl anion.

c) $^{31}P$ NMR spectrum of $H_3PO_3$ and $H_3PO_4$ are recorded. How many lines will be observed in each spectrum? Predict the structures of the compounds on the basis of the NMR.

d) What is meant by isomer shift in Mössbauer spectroscopy? Explain its importance in structure determination.

e) Explain with the help of DTA curves the decomposition of $CaC_2O_4.H_2O$ in
   i) air
   ii) $CO_2$ atmospheres.

*Q2)* Attempt <u>any four</u> :                 **[20]**

a) A rubber sample weighing 0.5g showed a weight loss of 2% between $70^o – 100^oC$, on further heating till $400^o$ a residue weighing 0.31g and which was stable upto $600^oC$ was obtained. Comment on the above data and determine the amount of filler in the rubber.

b) Explain the principle of NQR.

c) With the help of a schematic diagram explain the instrumentation and principle of DSC.

d) Sketch and explain the [100], [111] and [200] planes with respect to CCP and HCP structures.

e) Calculate the ESR frequency of an unpaired electron in a magnetic field of 3000G. (Given : g = 2; h = 6.627 x $10^{-34}$ JS).

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

a) Which of the following will show ESR spectrum? $C_6H_6^-$; $H_2$; $Na^+$, $CH_3$, $CO_2$. Explain the transitions observed in any one of them.

b) Define the following terms and give their significance
  i) $E_{pa}$.
  ii) $I_{pc}$.
  iii) $E_{1/2}$.

c) $^1H$ nmr spectrum of $GeFH_3$ consists of 2 lines separated by 42 Hz. What are the relative positions and intensities of all lines in the $19_F$ spectrum of
  i) $GeDHF_2$.
  ii) $GeD_2^{F+1}$.
  iii) $GeD_3F$.

d) What is the structural information that can be drawn from NQR?

e) Sketch the energy level diagram and the transitions for quadrupole nucleus with $I = 5/2$ and $\eta \neq 0$.

*Q4)* Write notes on <u>any four</u> : **[20]**

a) Zero field splitting.

b) SEM.

c) Factors affecting TG and DTA curves.

d) Spin-spin coupling in NMR.

e) Miller indices & Bravais Lattices.

✦ ✦ ✦ ✦

**P615**                                  **[3823] - 309**

## M.Sc. - II

## INORGANIC CHEMISTRY

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

### (New Course) (Sem. - III)

*Time : 3 Hours]*												*[Max. Marks : 80*

*Instructions to the candidates:*
1) *All questions are compulsory.*
2) *All questions carry equal marks.*

*Q1)* Answer the following (any four) :										**[20]**
   a)	The ionic radius of $Mn^{+2}$ ion lies between that of $Ca^{+2}$ and $Mg^{+2}$ ions. On the basis of this, compare the chemistry of the three ions in biological systems.
   b)	Discuss the biochemistry of nickel.
   c)	Explain with suitable examples, how reactivity of perfectionate ion changes with complexing agents.
   d)	Describe the model compounds of iron-sulphur proteins.
   e)	Explain the bifunctional binding modes of cis-platin with DNA.

*Q2)* Attempt <u>any four</u> of the following :									**[20]**
   a)	Explain how bone-density measurements are used in diagnostic radiopharmaceutical.
   b)	Explain the reactions of Vit. $B_{12}$.
   c)	Discuss oxygen transport properties of copper containing proteins.
   d)	Describe the role of zinc in gene regulatory proteins.
   e)	Discuss why increased levels of superoxide dismutase enzyme are observed during anthracyclenone treatment for cancer chemotherapy.

*Q3)* Write short notes on (any four) :										**[20]**
   a)	Managese clusters.
   b)	Dehydrogenase.
   c)	MRI contrast reagents.
   d)	Model compounds.
   e)	Cytochromes.

*Q4)* a) Answer in short (any five) : **[10]**

    i) What are the possible modes of binding of anti-cancer drug with DNA?

    ii) Why transition metal complexes are good spectroscopic probes?

    iii) Mention any four techniques that are used for characterisation of radio pharmaceutical isomers.

    iv) Give any four enzymes of managenese.

    v) What do you mean by "Radiolabelling"?

    vi) Explain what do you mean by iron buffering?

b) Draw the structures (any five) : **[5]**

    i) Carboplatin.

    ii) $\left[ T_C O \left( SCH_2 CH_2 S \right)_2 \right]^-$

    iii) $\left[ Cu \left( phen \right)_2 \right]^+$

    iv) Eithidium bromide.

    v) Deoxyhaemerythrin.

c) Match the following : **[5]**

| A | B |
|---|---|
| Vit $B_{12}$ | DNA cleavage |
| Cytochrome | Hydrolysis |
| Superoxide dismutase | reduction of ribose to deoxyribose. |
| $\left[ Ru \left( Bipy \right)_3 \right]^{2+}$ | e⁻ transfer |
| Carboxypeptidase | $O_2 \underset{-1e^-}{\overset{+1e^-}{\rightleftharpoons}} O_2^-$ |

✦✦✦✦

**P616**                          **[3823] - 310**

**M.Sc. - II**

**ORGANIC CHEMISTRY**

**CH-350 : Organic Reaction Mechanism**

**(New Course) (2008 Pattern)**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

  *1)   All questions are compulsory.*

  *2)   Figures to the right indicate full marks.*

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

## SECTION - I

*Q1)* Write short notes on (any three) :                          **[12]**

   a)   Zinc carbenoid.

   b)   Isotope labeling in determination of reaction mechanism.

   c)   Hunsdiecker reaction.

   d)   Transannular rearrangement.

*Q2)* Attempt <u>any three</u> of the following :                          **[12]**

   a)   Predict the sign of $\rho$ for the following reactions. Justify.



   $$Ar - COCl + Ar - OH \longrightarrow Product$$
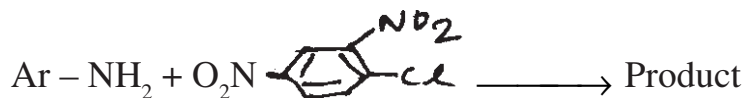
   b)   Predict the sign of Hammett sigma ($\sigma$) constant for each of the following substituents giving reasons

   $$m - OCH_3, \ p - NO_2, \ m - \overset{\oplus}{N}Me_3, \ p - OH$$
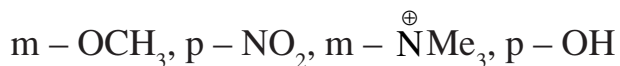
   c)   Explain the significance of substituent constant $\sigma$.

   d)   Explain Stork enamine synthesis.

*Q3)* Predict the product/s with mechanism of <u>any four</u> of the following :     **[16]**

b) 

c) 

d) 

e) 
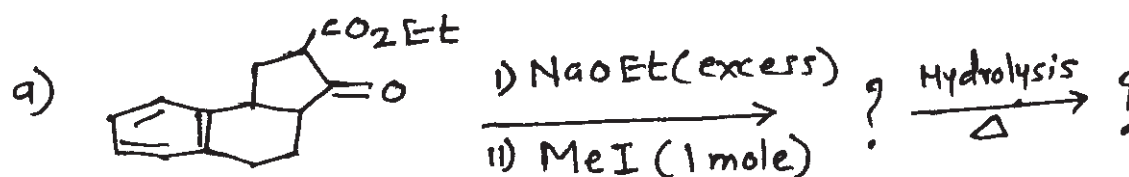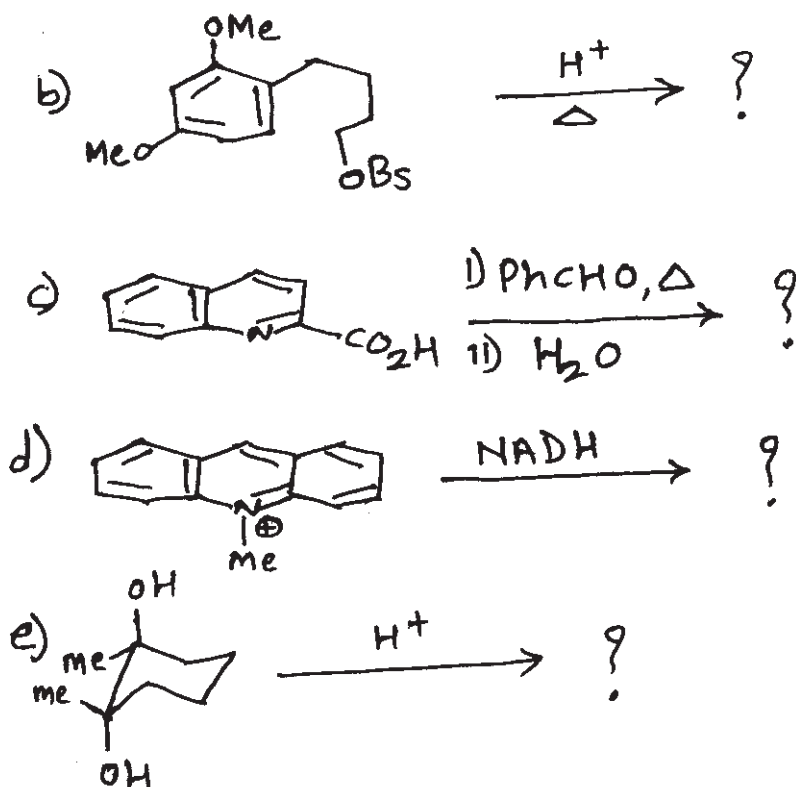
## SECTION - II

**Q4)** Explain <u>any three</u> of the following : **[12]**

a) 2, 6 – Dimethyl benzonitrile may be hydrolysed with alkali to 2, 6 – dimethyl benzamide but this amide is extremly difficult to hydrolyse with alkali to carboxylate salt.

b) When pyrrole is reacted with chloroform in aqueous NaOH gives 2-formyl pyrrole and 3-chloropyridine?

c) Which member of the following pair is more extensively enolised. Justify.
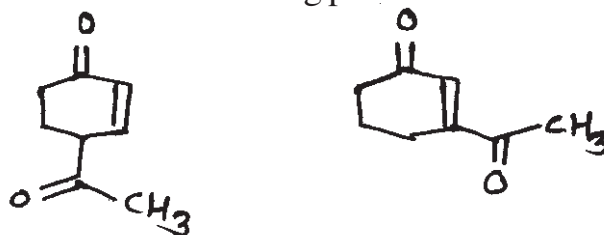


d) Explain the pKa of $CH_2(CN)_2$, $CH_3 - NO_2$, $CH_2(NO_2)_2$ is 11.2, 10.2 and 3.6 respectively.

*Q5)* Suggest the mechanism for the following (any three) :                [12]

a)


b)


c)
                → Citric acid ( Natural synthesis)

d)
    hv, MeOH / THF →
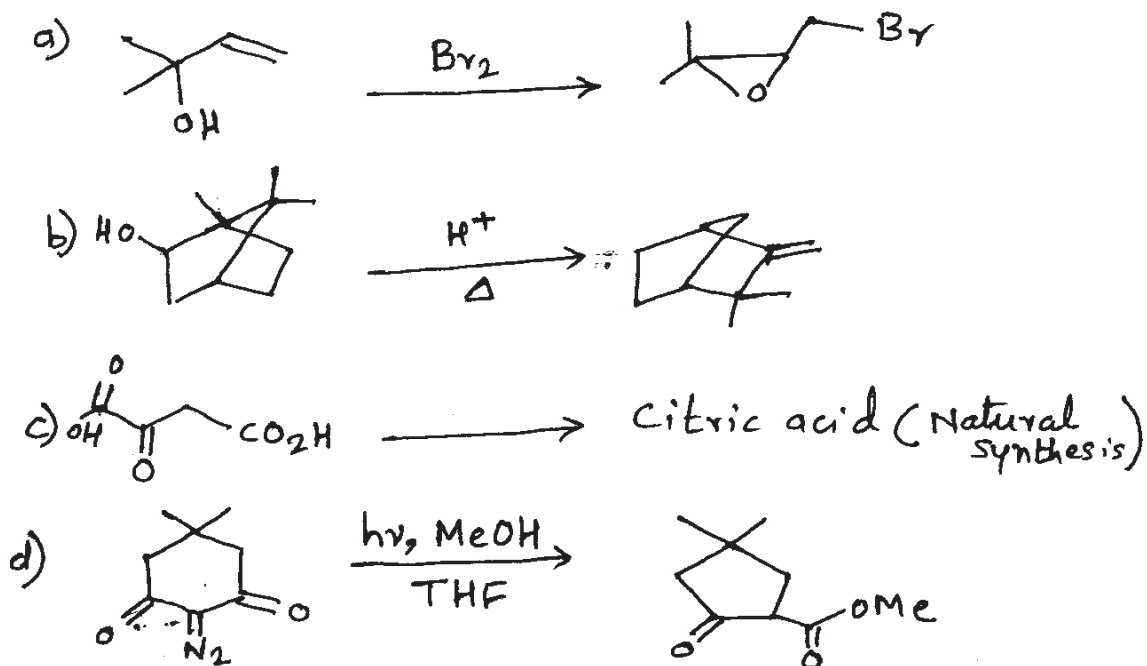
*Q6)* Attempt <u>any four</u> of the following :                [16]

a)  Demonstrate the utility of crossover experiment in the investigation of reaction mechanism for the following reaction –
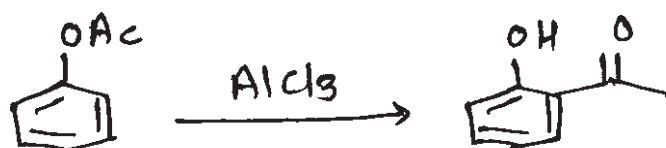


b)  Explain with suitable example – C – H insertion reactions of carbene.

c)  Which one will get decarboxylated easily in quinoline.
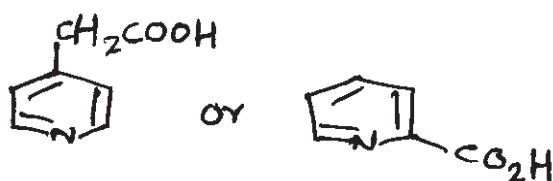


d)  Hydrolysis of $O_2N$ —⟨ ⟩— $S – CH_2 – CH_2 – Cl$ is considerably slower than that of $Et – S – CH_2 – CH_2 – Cl$.

e)  Explain the synthesis of tyrosine and phenyl alanine starting from Shikimic acid.

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**P617**      **[3823] - 311**

## M.Sc. - II

## ORGANIC CHEMISTRY

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

*Time : 3 Hours]*          *[Max. Marks : 80*

*Instructions to the candidates:*
1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Answers to the two sections should be written in separate answer books.*
4) *Spectroscopic data tables are not provided.*

### SECTION - I

**Q1)** Explain <u>any four</u> of the following :          **[12]**

a) Explain the Jab for the compounds shown below.
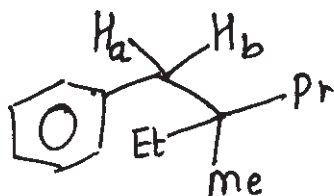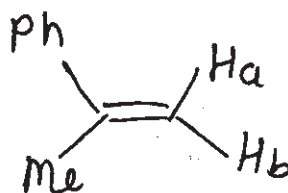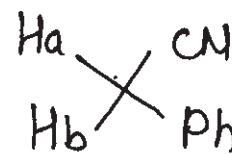


$$J_{ab} = 14\,Hz \qquad\qquad 2\,Hz \qquad\qquad 20\,Hz$$

b) Aromatic protons of 6-methyl quinoline in 0.1M solution of $Eu(fod)_3$ in $CCl_4$ exhibit $^1H$-NMR signals at 15, 13, 9.5, 9, 8.5, 8 ppm. Assign the signals to the protons and justify your assignment.

c) $(CD_3)_2SO$ shows five lines in $^{13}C$-NMR at 40.1 ppm. Explain.

d) Mass spectrum of 1-phenyl propanol has intense ions at 77 & 107.

e) DEPT and off resonance decoupling techniques aid in interpretating $^{13}C$-NMR.

**Q2)** Answer <u>any four</u> of the following :          **[16]**

a) Three regio-isomers of molecular formula $C_8H_{10}$ show the following NMR patterns. Identify these regioisomers by analysing CMR and PMR data.

| Regio isomer | PMR | CMR |
|---|---|---|
| A | 2 signals with intensity ratio 2 : 3 | 3 - signals |
| B | 3 signals with intensity ratio 3 : 1 : 1 | 4 - signals |
| C | 4 signals with intensity ratio 6 : 2 : 1 : 1 | 5 - signals |

b) Distinguish the following pairs by using given spectral method.

i)  and  by $^{13}C$-NMR

ii)  and  by $^{1}H$-NMR
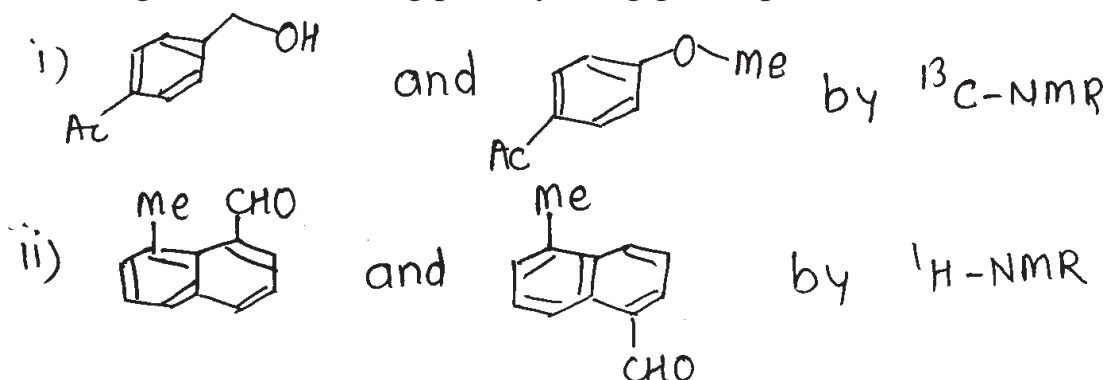
c) Assign mass peaks given below to the correct structure from the structures shown below. Justify your choice.

M/z = 15(50), 41(50), 59(8), 69(100), 85(22), 100(18).
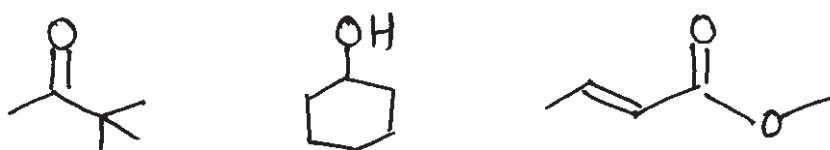


d) Three isomeric compounds with molecular formula $C_4H_4N_2$ have the following $^{13}C$-NMR pattern. Assign structure to each of these isomers and justify your assignment.

i) 122, 157, 159.
ii) 127, 153.
iii) 144.

Q3) Discuss <u>any three</u> of the following : [12]
a) Strategies to improve $M^+$ intensity in MS.
b) Applications of solvent shifts in $^{1}H$–NMR.
c) Principles and applications of FT-NMR.
d) DEPT and APT in CMR.

## SECTION - II

Q4) Answer <u>any three</u> of the following : [12]
a) A compound with M.W. 113 gives ions in its EI-MS at M/z = 84, 70, 56, 41, 20, 44 and 98 (in decreasing abundance). Give a structure that is consistent with data.

b) A compound shows prominent IR bands at 1690 & 1598 cm$^{-1}$. The M.S. shows the following important ions = 134(10%), 105(100%), 77(42%), 51(18%). Deduce the structure of the compound.

c) Give the genesis of the following ions in MS.

i)  M/z = 96, 95, 81, 53, 43

ii)  M/z = 181, 139, 109, 93, 65
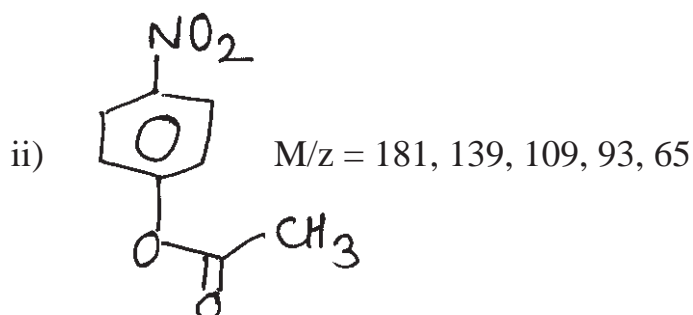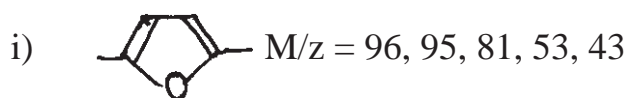
d) Acrolein on reaction with HBr/glycol gives compound A; which shows insignificant IR above 1200 cm$^{-1}$. Assign correct structure to A by using following spectral data.

$^{13}$C–NMR of acrolein   :   139, 148, 195
        Compound A  :   103, 61, 29, 15
M/z(%) of compound A  :   181(100), 179(90), 163(10), 152(60), 136.9(45), 122.9(12), 108.9(73), 107(65), 101(12), 80.9(8), 73(60).

Q5) a) Shikimic acid shows the following spectral data; draw the correct stereo-structure of shikimic acid and explain all the structural details and stereo chemistry with the help of spectral data. **[10]**



Shikimic acid
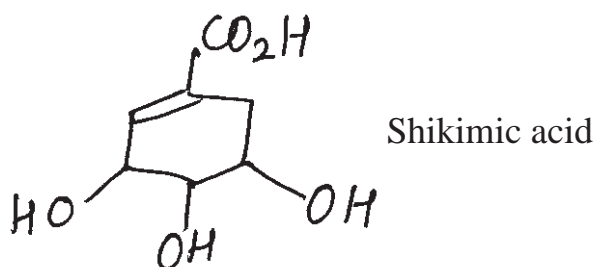
$^{13}$C – NMR   :   172.9, 140, 132.5, 75, 69, 68, 33.1
$^{1}$H – NMR   :   2.23 (ddd, J = 18, 6.5, 1.9 Hz, 1 H)
                 2.74 (ddd, J = 18, 5.3, 1.8 Hz, 1 H)
                 3.78 (dd, J = 9, 4.4 Hz, 1 H)
                 4.04 (ddd, J = 9, 6.5, 5.3 Hz, 1 H)
                 4.46 (dd, J = 4.4, 4.2 Hz, 1 H)
                 6.83 (ddd, J = 4.2, 1.8, 1.9 Hz, 1 H)
HETCOR   :   140 → 6.83; 73 → 3.78; 69 → 4.04; 33 → 2.23 & 2.74

COSY        :   2.23 → 2.74, 4.04 & 6.83

               2.74 → 2.23, 4.04 & 6.83

               3.78 → 4.04 & 4.46

               4.04 → 3.78, 2.74 & 2.23

               4.46 → 3.78 & 6.83

               6.83 → 4.46, 2.74 & 2.23

b)   A chemical reaction of compound $\underline{X}$ produces two isomers of the product. Isomer $\underline{A}$ has $^1$H-NMR at 3.08 (dt, J = 4, 9.9 Hz, 1 H); 4.32 (d, J = 9 Hz, 1 H). While $\underline{B}$ isomer has $^1$H-NMR at 4.27 (d, J = 4 Hz, 1 H). The other two protons over lap isomer $\underline{B}$ is converted into isomer $\underline{A}$ on treatment with base. Discuss the stereo chemistry of these diastereomers. $\underline{A}$ and $\underline{B}$.                                                                                         **[6]**



$\underline{X}$
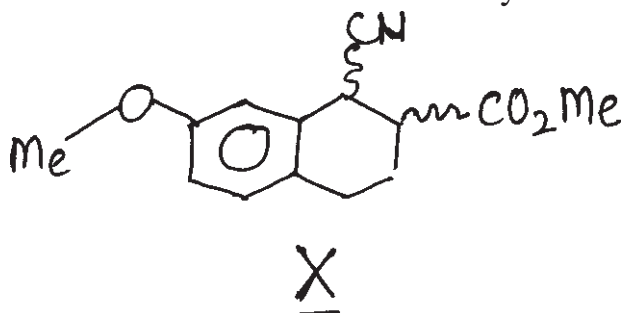
*Q6)* An unknown compound exhibits the following spectral data. Analyse spectra and attempt to put these data together and assign a reasonable structure. Justify your assignment.                                                                                         **[12]**

IR Spectrum
(liquid film)
1740

V (cm$^{-1}$)
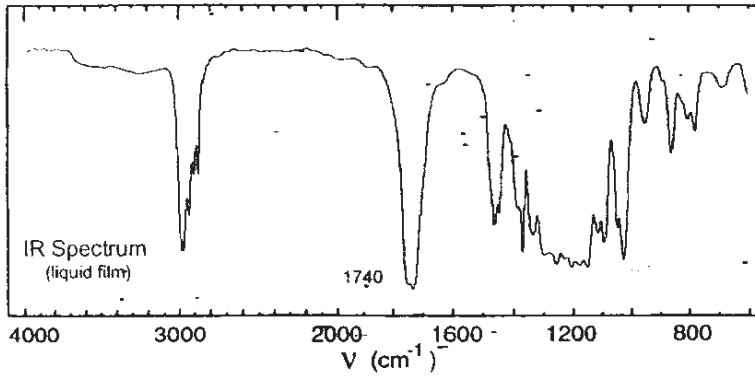
Use the basic spectral data plus the COSY and C-H correlation spectra on the facing page to deduce the structure of this compound.



Mass Spectrum

73
143
160

M$^{+\cdot}$
188

$C_9H_{16}O_4$

% of base peak

m/e



UV spectrum

44.1 mg / 10 mls
path length : 0.1 cm
solvent : ethanol

absorbance

$\lambda$ (nm)

$^{13}C$ NMR Spectrum
(100 MHz, CDCl$_3$ solution)

DEPT  CH$_2$↓ CH$_3$↑ CH↑

proton decoupled

solvent

$\delta$ (ppm)

$^1H$ NMR Spectrum
(300MHz, CDCl$_3$ solution)

TMS

$\delta$ (ppm)

## ¹H - ¹H COSY Spectrum
(300 MHz, CDCl₃ solution)

## C-H Correlation Spectrum
(¹H 300 MHz; ¹³C 75 MHz; CDCl₃ solution)
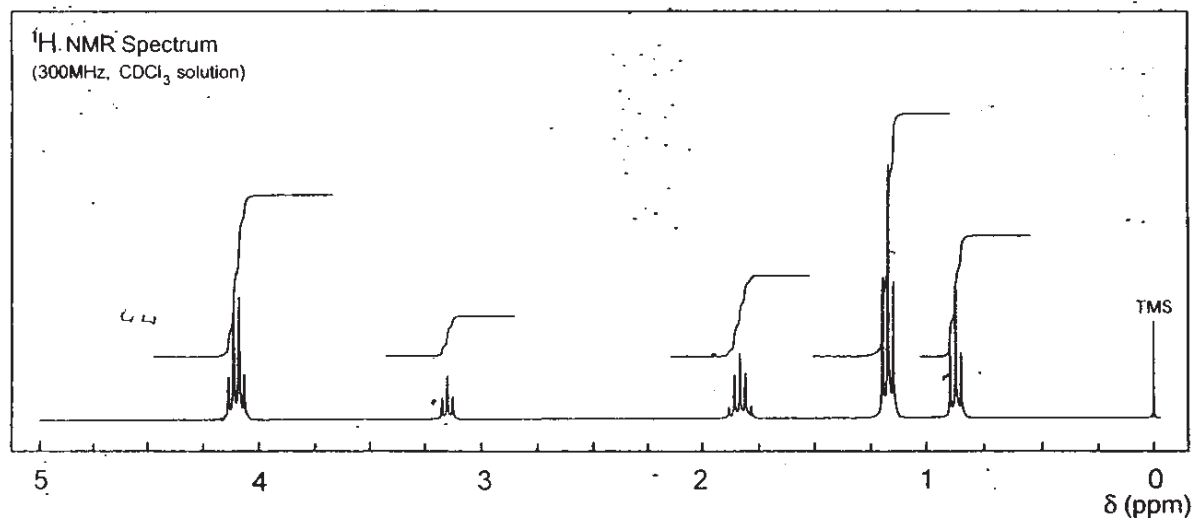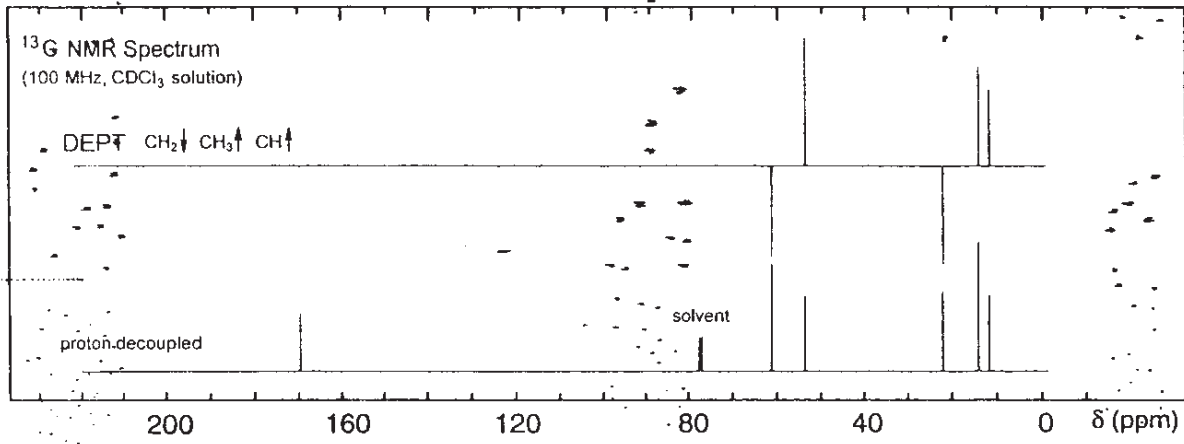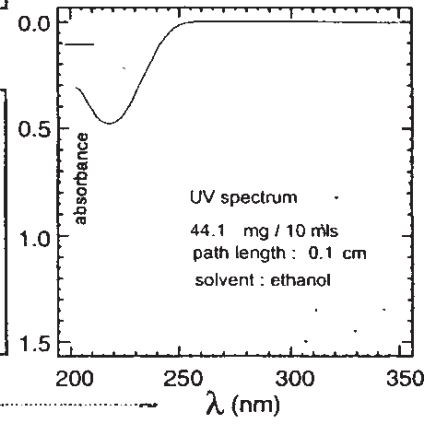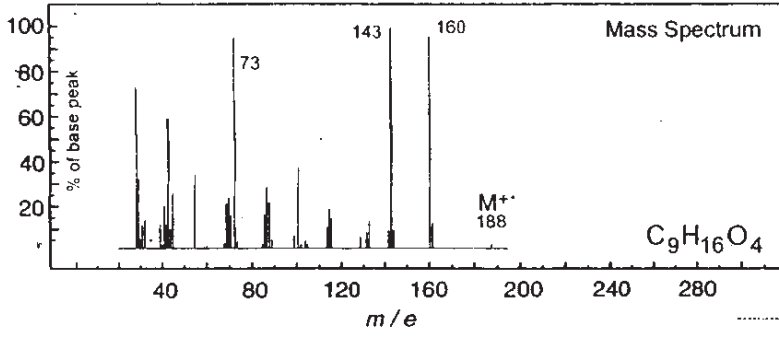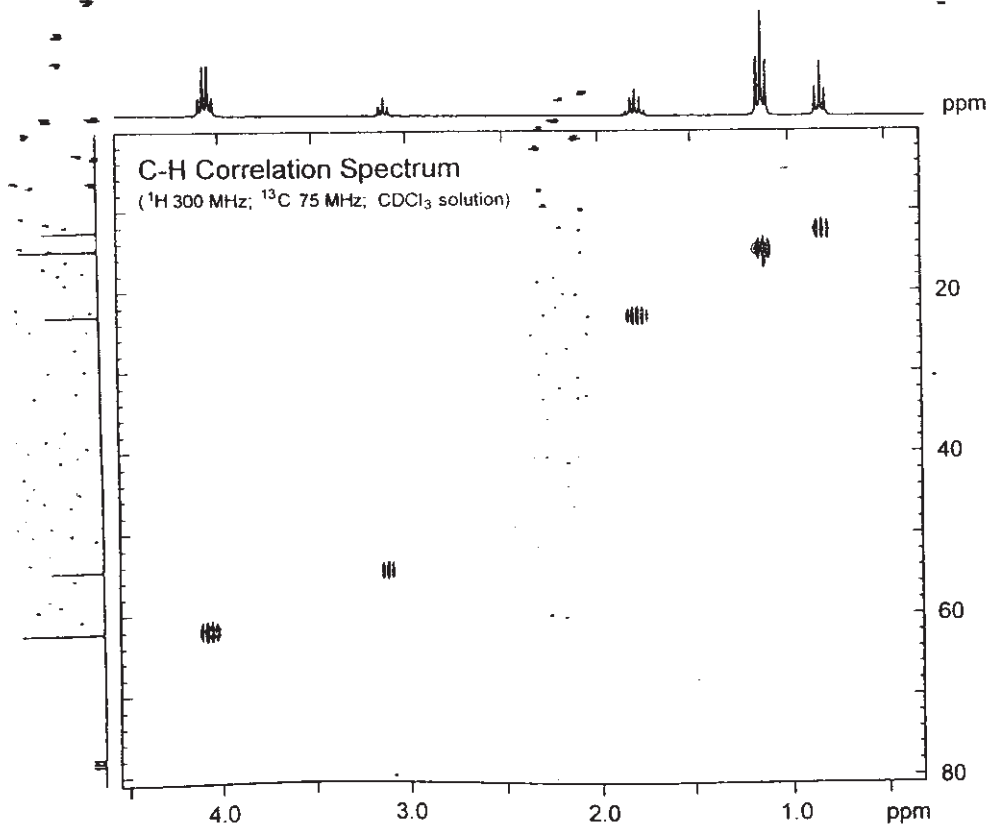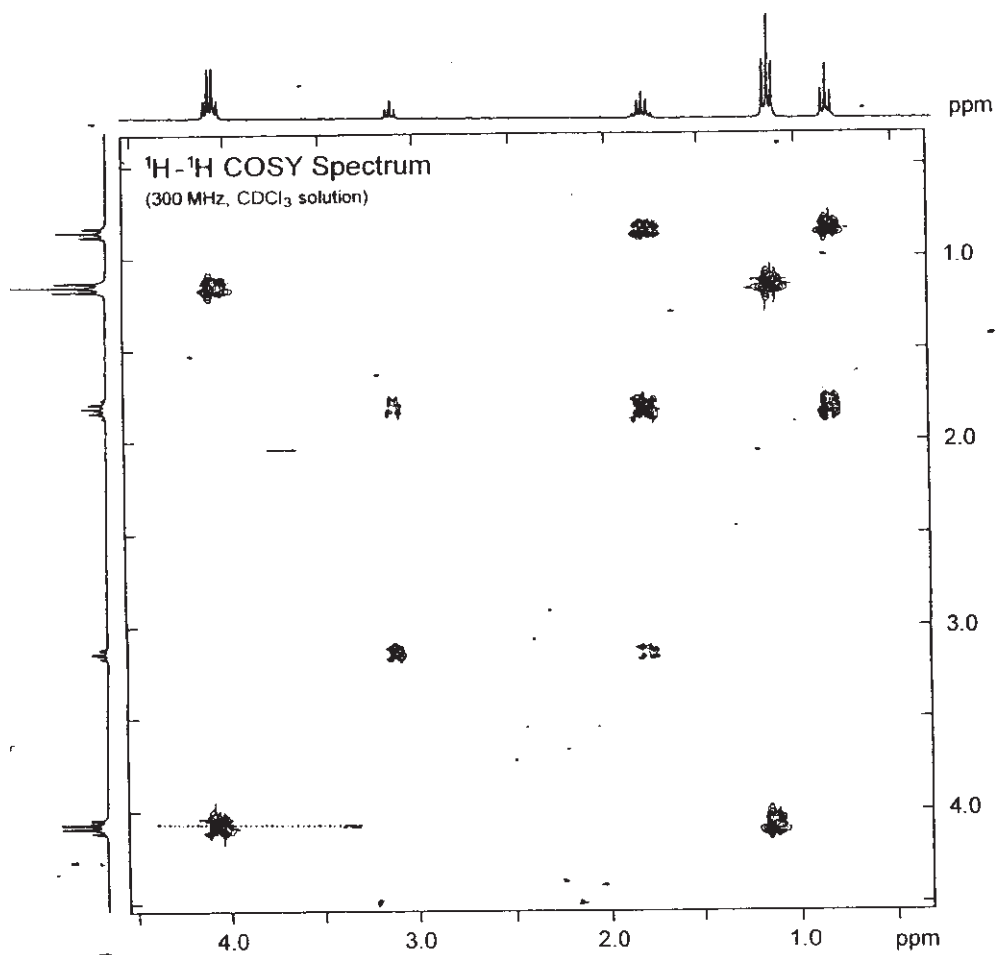
**[3823] - 312**

**M.Sc.**

## ORGANIC CHEMISTRY

### CH-352 : Organic Stereochemistry

**(2008 Pattern) (New)**

*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates:*

*1)*   *All questions are compulsory.*

*2)*   *Figures to the right indicate full marks.*

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

### SECTION - I

*Q1)* Answer <u>any four</u> of the following :        **[16]**

a)   The energy difference between diaxial and diequatorial conformations of menthone is less than that in 4-isopropyl-methylcyclohexane.

b)   Trans-g-methyl decalin is more stable than its cis isomer by 3.35 KJ/mol. Explain.

c)   2, 3 - $\beta$-Epoxylanost-8-ene (A) undergoes diequatorial ring opening with HBr, where as the $\alpha$-epoxide gives normal diaxial ring opening with HBr.
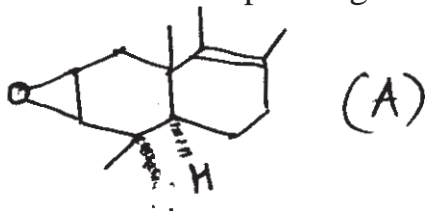


d)   Draw conformational structures of the compound I and II. Give their nomenclature and discuss the stability.
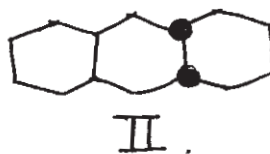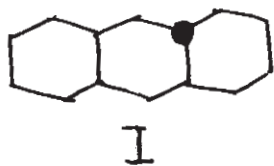


e)   In the IR spectra of following aminoketones the carbonyl absorption around 1700 cm$^{-1}$ disappears on protonation. Explain.
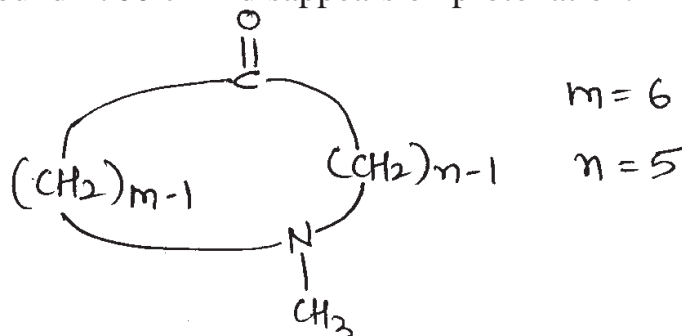


$m = 6$

$n = 5$

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

a)



$$\text{(cyclohexenyl methyl ketone)} \xrightarrow[\text{H}^+]{\text{PhMgBr}} \text{?} \xrightarrow{\text{NaOEt}} \text{?}$$

b)



$$\xrightarrow{\text{HNO}_2} \text{?}$$

c)



$$\xrightarrow{\text{KMnO}_4} \text{?}$$

d)



$$\xrightarrow{\text{Base}} \text{?}$$

e)



$$\xrightarrow[\triangle]{\text{PhNEt}_2}$$
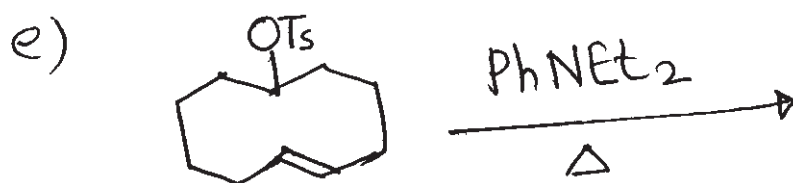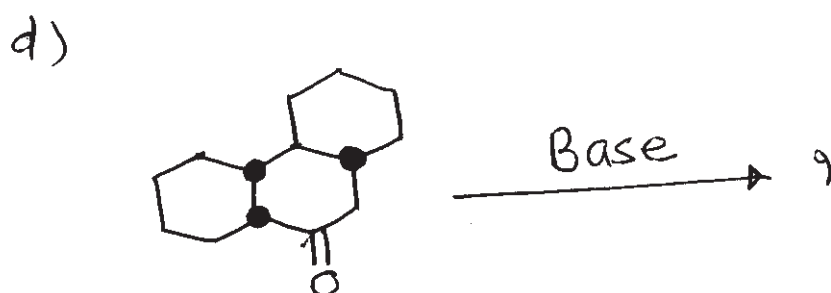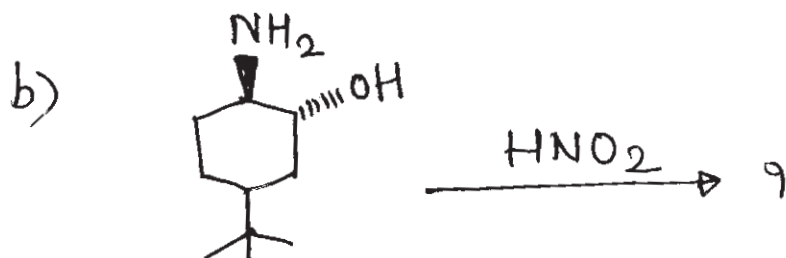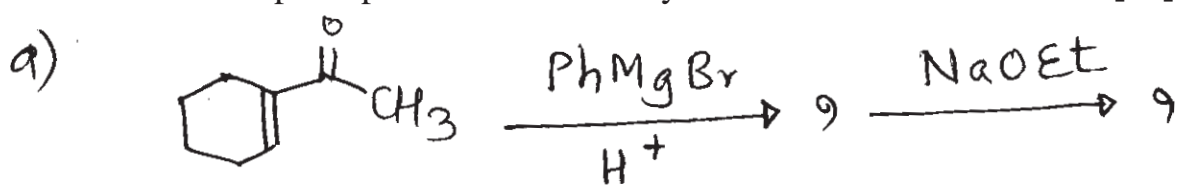
**Q3)** Write notes on <u>any three</u> of the following : **[12]**

a)   Determination of configuration of hydrindanes.

b)   Chromic acid oxidation in cholesterol.

c)   Stereochemistry of NGP reactions.

d)   Use of chiral solvating reagent.

## SECTION - II

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

    a)    Give the evidence to establish relative configuration of $C_5$ and $C_6$ in codeine.

    b)    Prove that cinchonidine and Cinconine have different configuration at $C_8$.

    c)    How NMR spectroscopy is used to find stereochemistry of lactone fusion in enhydrin?

    d)    How relative configuration in quinine at $C_8$ and $C_9$ is deduced by comparison with ephidrine.

*Q5)* Attempt the followings (any four) :                                     **[12]**

    a)    Identity pro-R and pro-S hydrogen atoms in the compound I and II.
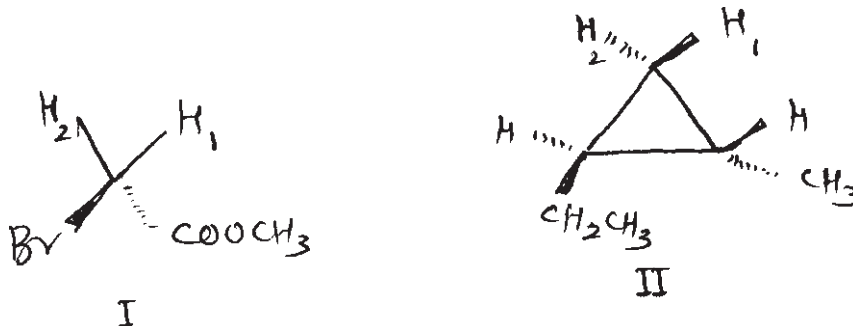


    b)    Identify the underline groups / atoms as homotopic or enantio topic or dia stereo topic.
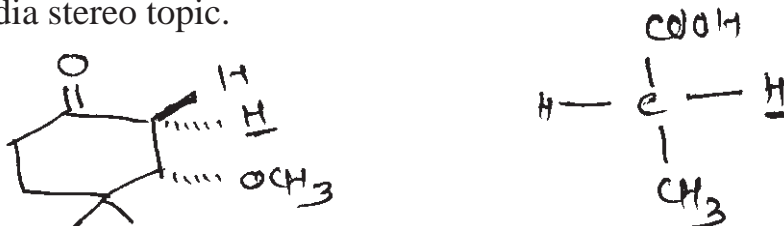


    c)    Using Cram's rule rationalise the following reactions, write major and minor products.
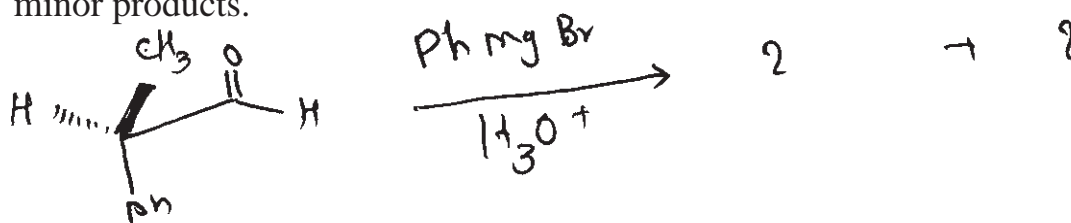


    d)    Explain the terms :

        i)    Chiral auxillary.

        ii)   Topocity.

    e)    Explain the diaistereomeric excess and calculate de in following reaction.
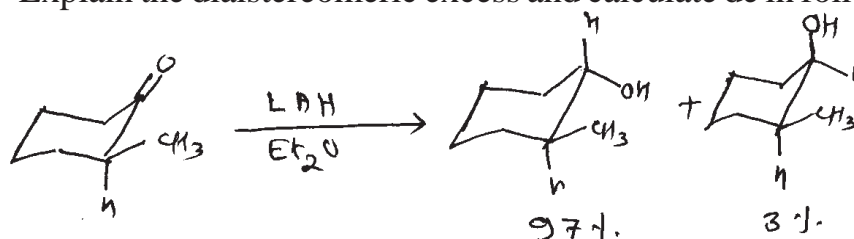
*Q6)* a) Predict the product/s in the following reactions. Explain the stereochemistry and mechanism in detail (any four) : **[8]**

i)



1) $Ph COOOH / CH_2 Cl_2, 25°C$
2) $LiOH / MeOH / H_2O$ → ?

ii)



$\xrightarrow[Bose]{HO Br}$ ?

iii)



1) $TsCl / Pyridine$ (1 equivalent)
$\xrightarrow{25°C}$ ?
ii) $t\text{-}BuOK / t BuOH$ Δ

iv)



$\xrightarrow[(S)\text{-}BINAP] Ru(OAc)_2]{H_2}$ ?

v)



$\xrightarrow[(Anhydrous)]{ZnCl_2}$ ?
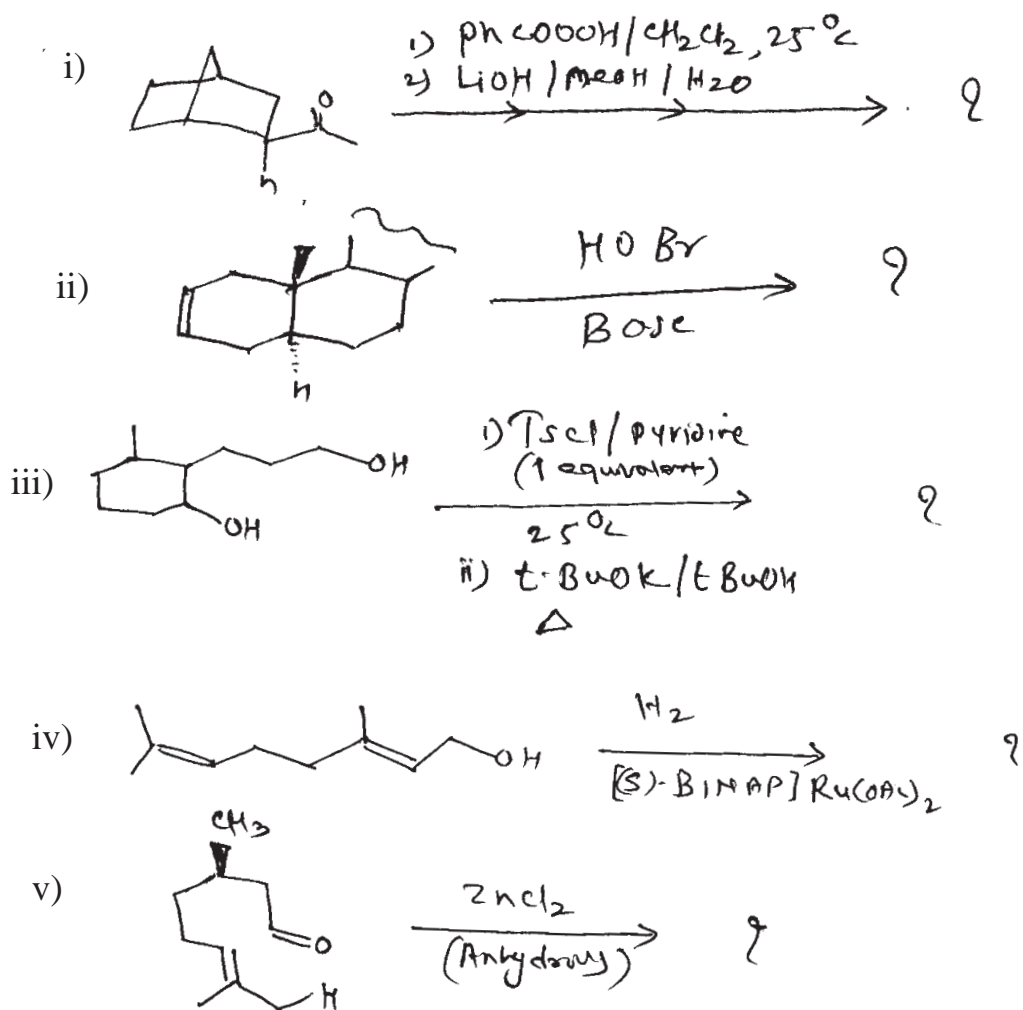
b) Suggest the reagent and stereochemistry of the following reactions. (any two) : **[8]**

i)



i) ?
2) ?
3) ?

ii)



+ ? → 

$S(-)\text{-}iPsenol$

iii)



+ 

1) Auxillary ?
2) ?
3) ?
→
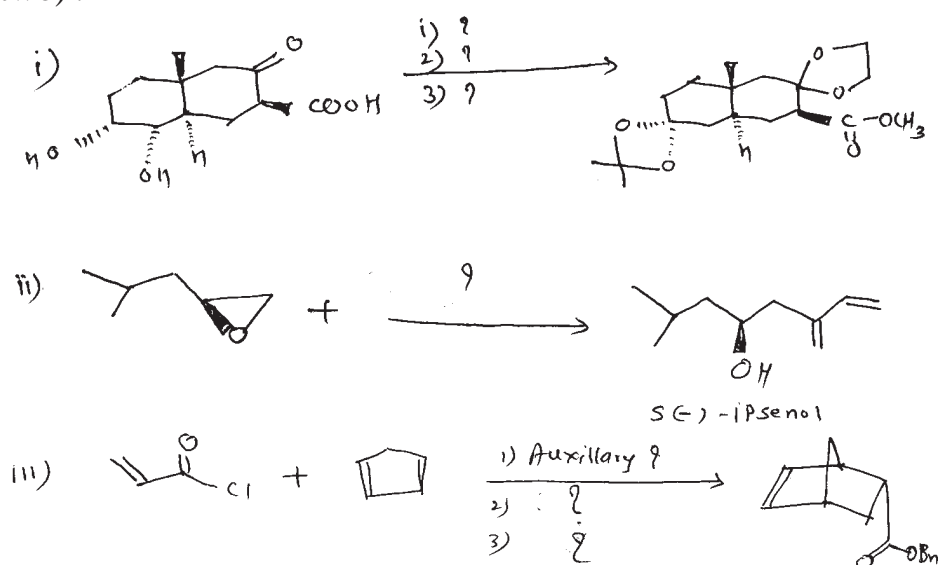
**P619**       **[3823] - 313**

## M.Sc. - II

## ORGANIC CHEMISTRY

**CH-353 : Free Radicals, Photochemistry and Pericyclic Reactions**
**(2008 Pattern) (New)**

*Time : 3 Hours]*       *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*    *All questions are compulsory.*

    *2)*    *Figures to the right indicate full marks.*

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

**SECTION - I**

*Q1)* Suggest suitable mechanism for <u>any four</u> of the following :       **[12]**
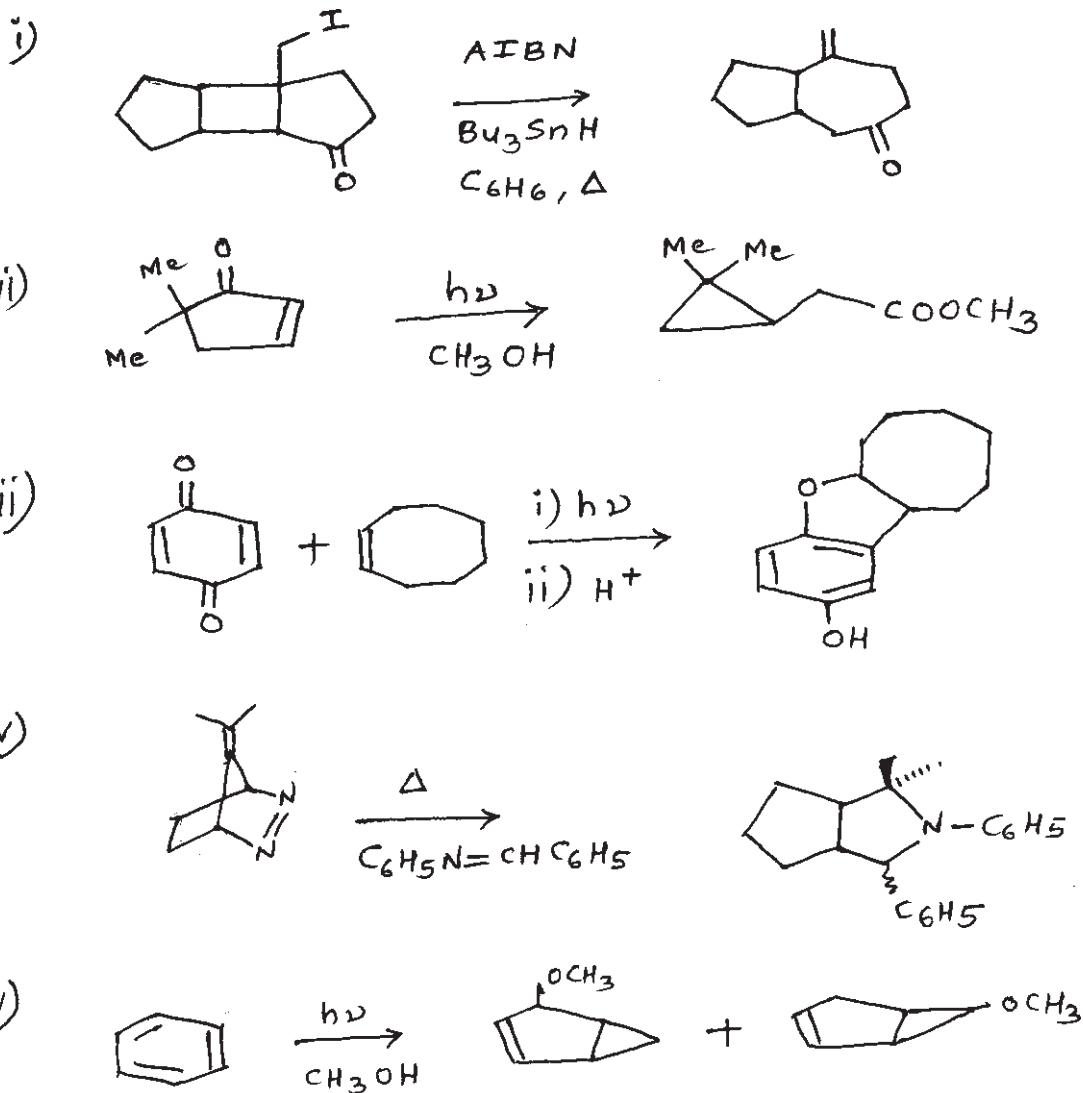
*Q2)* a) Explain Di- $\pi$ methane rearrangement with suitable examples. **[4]**

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

i)



$\xrightarrow[E+OH]{h\nu}$ ?

ii) $(CH_3)_3CHgCl$ +



$\xrightarrow{NaBH_4}$ ?

iii) TMS



$\xrightarrow[Bu_3SnH]{AIBN}$ ?

iv)



$\xrightarrow{h\nu}$ ?

v) $Ar-\overset{NO}{\underset{|}{N}}-COMe$ $\xrightarrow[\Delta]{\beta-Naphthol}$ ?

vi) $MeO$



$CHO$ +



$\xrightarrow{h\nu}$ ?
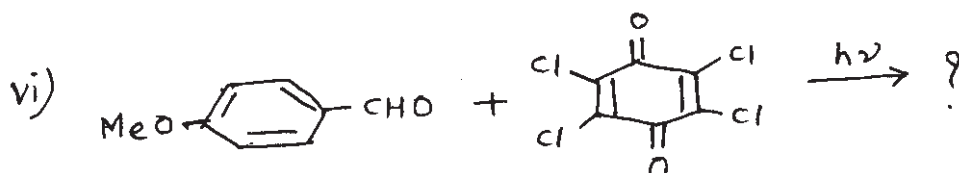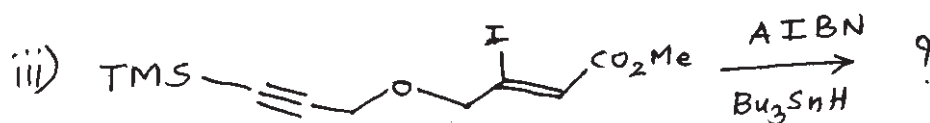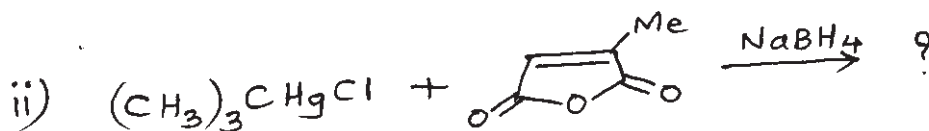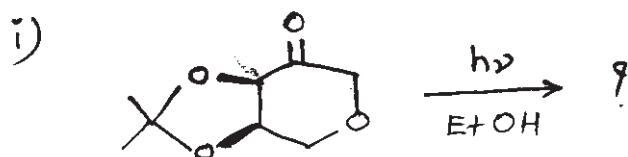
*Q3)* a) Explain <u>any two</u> of the following : **[6]**

i) 4-Dimethylaminobenzophenone undergoes very slow photoreduction in isopropanol but it becomes faster when converted to its hydrochloride.

ii) Proof for the existence of (I) as an intermediate in the light induced chlorination of benzene to give hexachlorocyclohexanes.



(I)
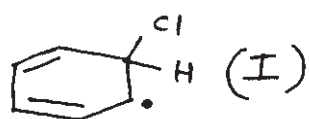
iii) Me. Et CH $-\overset{\overset{\displaystyle O}{\|}}{C}-$ O $-$ O $-\overset{\overset{\displaystyle O}{\|}}{C}-$ CHMeEt decomposes on heating to give an ester in which $\alpha$-carbon atoms, both in the alkyl and acyl groups retain their configuration.

b) Write short notes on <u>any two</u> of the following : **[8]**

   i) Photosensitisation.

   ii) Telomerisation.

   iii) Free radical arylation of aromatic rings.

## SECTION - II

**Q4)** a) Construct the correlation diagram for $\pi^2 s + \pi^2 s$ cycloaddition reaction. Predict whether the reaction is thermally allowed or photochemically allowed. **[6]**

b) Predict the product/s in <u>any four</u> of the following reactions. Explain their stereochemistry and mechanism. **[8]**
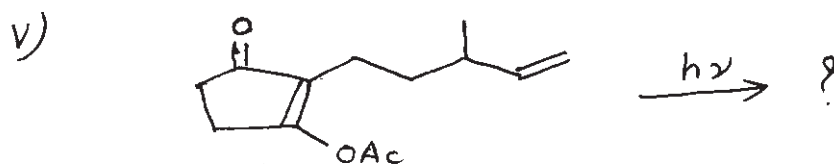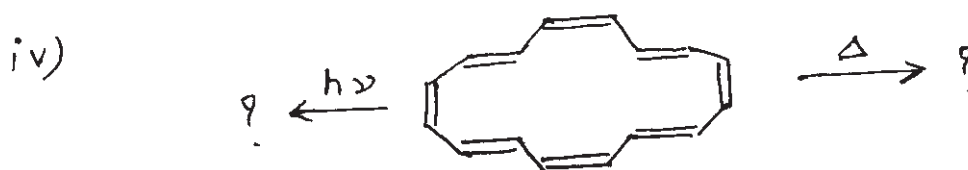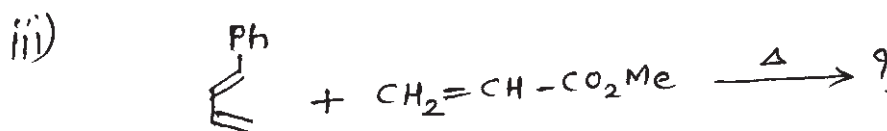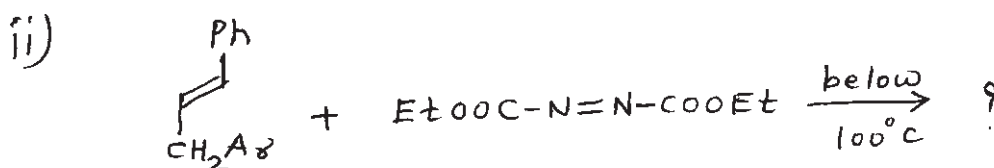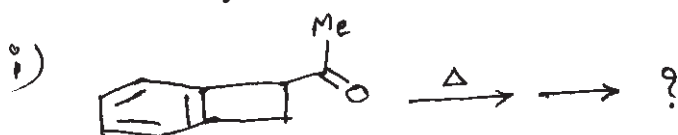
*Q5)* a) Using the Aromatic Transition state concept predict whether the conrotatory and disrotatory opening of 1, 3 - cyclohexadiene to 1, 3, 5 - hexatriene will be allowed thermally or photochemically. **[4]**

b) Explain the mechanism for <u>any four</u> of the following reactions. **[8]**

i)

ii)

iii)

iv)

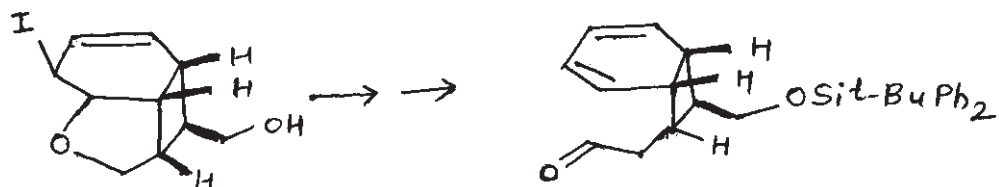Major        Minor

v)
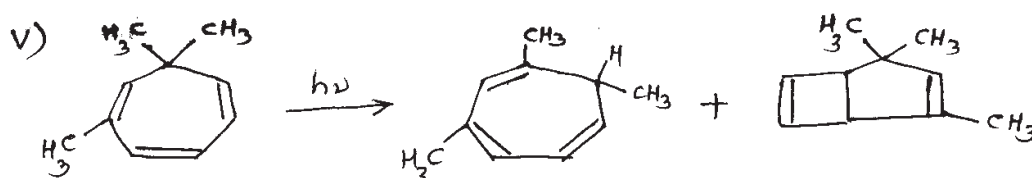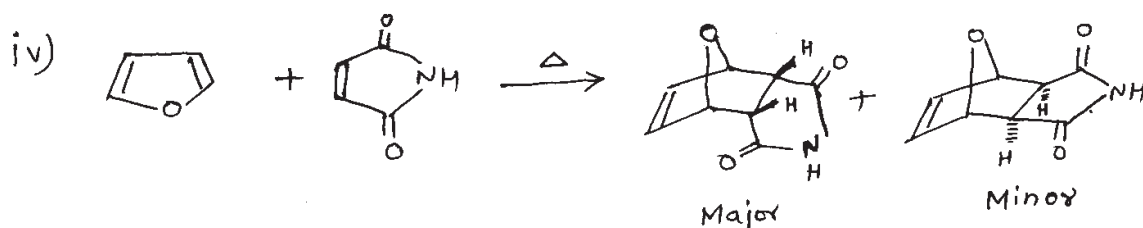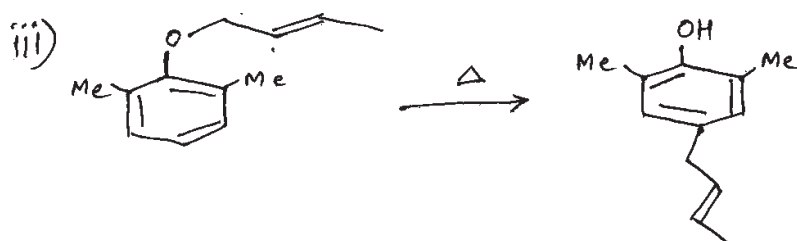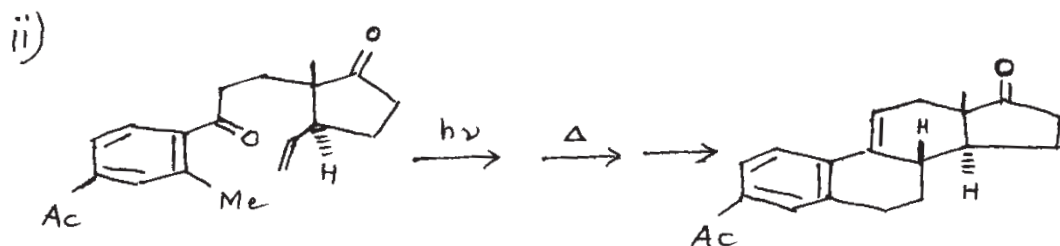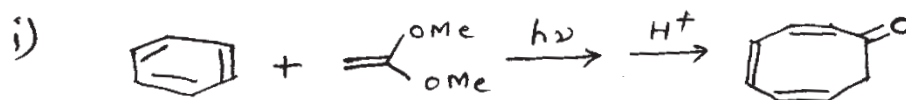
*Q6)* a) Complete <u>any two</u> of the following synthetic sequences indicating all intermediates and reagents required. **[8]**
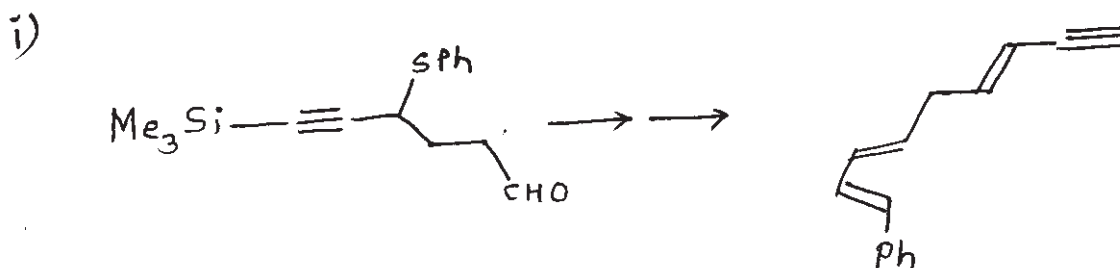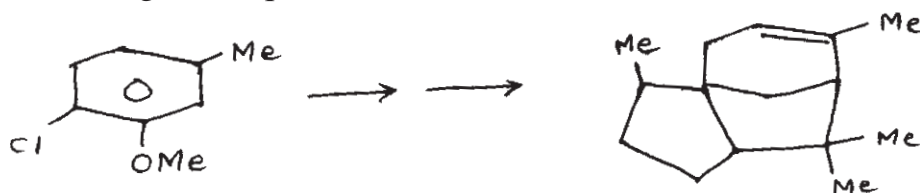
i)

ii)
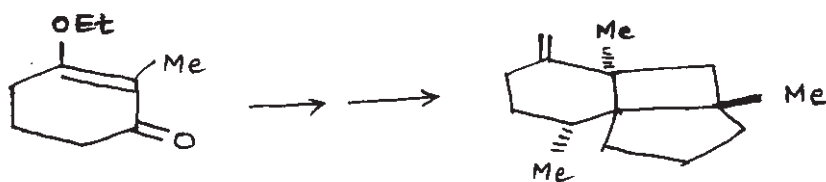


iii)



b) Complete the following synthetic sequence indicating all intermediates and reagents required. **[6]**



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**P621**

**[3823] - 315**

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CH - 391: Environmental and Analysis of Industrial Materials**

**(New Course)**

*Time : 3 Hours]*                                              *[Max. Marks : 80*

*Instructions to the candidates:*

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

2) *All questions are compulsory and carry equal marks.*

3) *Neat diagrams must be drawn wherever necessary.*

4) *Use of logarithmic tables, non - programmable calculator is allowed.*

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following:

a) What are mixed fertilizers? Describe the method of estimation of nitrogen from urea sample.

b) Describe the process of estimation of sodium from glass sample.

c) Define the terms:

   i)   Pigment.                    ii)   Binder.

   iii) Vehicle                     iv)   Varnish.

   v)   Flash point.

d) Outline the procedure for estimation of Zinc from deodorants and antiperspirants.

e) 0.310 gm of organic compound analysed for nitrogen content by Kjeldahl's method. The evolved ammonia was absorbed in 50 ml of 0.11N HCl. The remaining acid when back titrated with 0.11N NaOH gave the burette reading of 21.2 ml. Calculate the % of nitrogen in the given organic compound.

   [Given:- Atomic wts. of H = 1, N = 14, 0 = 15.99, S = 32.06]

                                                              *P.T.O.*

*Q2)* Attempt <u>any four</u> of the following:

   a)   Explain method of identification and analysis of pigments.

   b)   Discuss the general scheme of analysis of soap.

   c)   What are cosmetics? How is boric acid estimated from cosmetics?

   d)   0.450 gm of iron sample was disintegrated with concentrated HCl. The residue of $SiO_2$ was filtered . After ignition, the residue weighed 0.115gm. The filtrate was diluted to 100ml and was found to contain 0.012 gm of Fe by colorimetric estimation. Calculate percentage of silica and $fe_2O_3$ in the sample.
   [Given At.wts. 0 = 15.99, Fe = 55. 85]

   e)   0.160 gm of bauxite ore was disintegrated by suitable method. After removal of impurities the filtrate containing $Al^{3+}$ ions was diluted to 100 ml. An aliquot of 10 ml required 15 ml of 0.0095 MEDTA solution for complete reaction. Calculate % of $Al_2O_3$.
   [Given:- At. wts. Al = 26.98, O = 15.99]

## SECTION - II

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

   a)   What is an alloy? Give two examples of copper based alloys. How is copper estimated from alloy sample volumetrically?

   b)   Define:- ore. How is Titanium estimated from Ilmenite ore?

   c)   What are the causes of air pollution? Discuss the use of filters and setting chamber.

   d)   When 8.00 gm sample of glass was analysed for barium, it give 0.650 gm of $BaSO_4$. Calculate percentage of Barium oxide.
   [Given At. wts. Ba = 137, O = 16, S = 32]

   e)   60 ml waste water sample was refluxed with 25 ml of 0.1 N $k_2Cr_2o_7$ solution and 25 ml con. $H_2SO_4$. The solution required 13 ml ferrous ammonium sulphate solution. 25 ml of 0.1 N $k_2Cr_2o_7$ solution required 24.5 ml of ferrous ammonium sulphate solution. Calculate COD of waste water sample.

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

    a)    Discuss the working and use of trickling filter in waste water treatment.

    b)    Explain the analytical method for the estimation of lead from waste water sample.

    c)    Comment upon air pollution caused by suspended particulate matter. What are the sources and hazards of $CO_x$.

    d)    Explain.

        i)    Sludge disposal.

        ii)    Safety methods in industries.

    e)    What is BOD? What is its significance? How is it estimated?

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**P622**

[3823] - 316

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CH - 392: Advanced Analytical Techniques**

**(New Course)**

*Time : 3 Hours]*                                                    *[Max. Marks : 80*

*Instructions to the candidates:*

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

  2)   *All questions are compulsory and carry equal marks.*

  3)   *Neat diagrams must be drawn wherever necessary.*

  4)   *Use of logarithmic tables, non - programmable calculator is allowed.*

  5)   *Use of graph paper is allowed.*

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following:                          **[20]**

  a)   State and explain Ohm's law and Kirchhoff's law. Explain with a suitable example. How these laws are useful in circuit analysis.

  b)   What are semiconductors? Give the important properties of semiconductors. Explain the working of intrinsic and extrinsic semiconductors in brief.

  c)   Draw a schematic diagram for operational amplifiers. Explain the function of various components.

  d)   Explain the term process control and draw the block diagram of control loop that is used in automated process control.

  e)   A thin metallic plate of 20 cm length and 10 cm breadth is to be electroplated with nickel. If the plate is immersed in nickel salt solution and the current is adjusted to 8.0 ampere and has been passed for one hour. What will be the thickness of deposited nickel on the surface of the plate?
Given:-   Density of nickel - 8.9 g / ml
          At. wt. of nickel - 58.71 g/mole.
          F 96487 coulomb / mole.

*P.T.O.*

*Q2)* Attempt <u>any four</u> of the following: **[20]**

    a)    What is process control analyzer? Give the categorized list of the techniques where they are used.

    b)    Draw a schematic diagram of an Automated laboratory analyzer and give the function of each component.

    c)    What are Robots? Give the classification of robots on the basis of programming.

    d)    What is meant by transformer? Explain the working of the set up and set down transformer.

    e)    State the rules for binary arithmetic operations. Perform the following operations using binary number system.

        i)    $87 \times 13$.                 ii)    $123 + 321$.

## SECTION - II

*Q3)* Attempt <u>any four</u> of the following: **[20]**

    a)    Write a note on types of interferences encountered in AAS.

    b)    Give the principle of Radioimmuno assay. And describe the radioimmunoassay of insulin by receptor technique.

    c)    Give the comparison between atomic absorption spectroscopy and emission spectroscopy.

    d)    State the principle of supercritical fluid chromatography and explain it's applications.

    e)    A Serum sample is analysed for potassium by flame emission spectrometry using standard addition method. Two 0.4 ml aliquots of the sample are added to 4.0 ml portions of water. In one portion 10.0 $\mu L$ of 0.050 MKCI solution was added. The net emission signals in arbitrary units were 32.1 and 52.9. What is the concentration of potassium in the serum?

*Q4)* Attempt <u>any four</u> of the following: [20]

a) Explain the term micronutrients. Enlist various micronutrients. Discuss a suitable method for the determination of Boron.

b) Discuss in brief working of total consumption burner and premix burner used in AAS.

c) Give in detail a method for protein blotting.

d) Explain the principle and experimental procedure of rocket electrophoresis method as an immunological technique.

e) A 45.0 mg sample of mineral is dissolved in HCl, diluted to 100 ml and analysed for calcium by FES. The emission signal is 30 units on the emission scale. The standard solution gave following results.

| Ca (ppm) | Emission signals |
|----------|------------------|
| 5.0 | 13 |
| 7.5 | 19 |
| 10.0 | 25 |
| 12.5 | 32 |
| 15.0 | 37 |

Calculate the percentage of Ca in the mineral sample.

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**P623**

**[3823] - 317**

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CH - 380: Pharmaceutical Analysis.**

**(New Course)**

*Time : 3 Hours]* *[Max. Marks : 80*

*Instructions to the candidates:*

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

*2) All questions are compulsory and carry equal marks.*

*3) Use of lagarithmic table - non programmable calculator is allowed.*

### SECTION - I

*Q1)* Attempt <u>any four</u> of the following : **[20]**

a) Give a brief account of impurities associated with pharmaceutical products during manufacturing process.

b) Explain the term solution and suspension mention the precautions to be taken at the time of use and storage.

c) Explain the role of binders and lubricants in the preparation of medicinal products.

d) 0.16 g coconut oil sample was dissolved in 10 ml carbon tetra chloride to which 10 ml Wij solution was added and bottle was kept aside in dark for 30 minutes. Then 20 ml potassium iodide (10%) solution was added and iodine was back titrated with 0.1 N sodium thiosulfate solution using starch solution as an indicator. The titration reading was 5.2 ml. The blank titration reading was 9.9 ml. Determine the iodine value for the given oil.

e) Write short note on - Inadequate storage.

*Q2)* Answer <u>any four</u> of the following : **[20]**

a) Explain the term - dissolution test and disintegration test. Describe in detail the disintegration test for film coated tablets.

b) What are limit tests? Why are they necessary? Give the procedure for carrying out the limit test for arsenic in a given sample.

c) Explain the term - Emulsions. How emulsions are prepared? Write the advantages of emulsions.

*P.T.O.*

d) What is FDA? Explain in detail how FDA controls the pharmaceutical and cosmetic industries all over the country.

e) 0.18 g phenobarbitone ($C_{12}H_{12}O_3N_2$) was dissolved in 40 ml DMF and solution was titrated with 0.1 N lithium methoxide using quinaldinered indicator. The burette reading recorded was 7.5 ml. Determine the percentage of phenobarbitone in the given sample.

## SECTION - II

*Q3)* Attempt <u>any four</u> of the following : **[20]**

a) Give a brief account of biological assay of insulin.

b) What is Karl - Fischer reagent? How is it prepared and standardized?

c) Explain the term sterilization. Describe in detail the steam sterilization. Give advantages and disadvantages of this method.

d) An ascorbic acid ($C_6H_8O_6$) sample, 0.63g was dissolved in 30 ml distilled water and diluted to 100 ml. 25 ml of the diluted solution was titrated with 0.1 N iodine solution using starch solution as an indicator. The titration reading was 17.5 ml. Determine the percentage of ascorbic acid in the given sample.

e) 0.13 g of ferrous gluconate ($C_{12}H_{22}O_{14}Fe$) sample was dissolved in a mixture of 75 ml water and 25 ml dilute sulfuric acid. The solution was titrated with 0.01 N ammonium ceric sulfate solution using o - phenanthroline - ferrous ion solution as an indicator. The burette reading was 28.1 ml. Determine the percentage of ferrous gluconate in the sample.

*Q4)* Answer <u>any four</u> of the following : **[20]**

a) Explain the term ash value. Give the method for determination of sulfated ash value for given vegetable drug sample.

b) How amylase activity is determined?

c) What is pyrogen? Explain preliminary (sham test) for pyrogen.

d) 0.15 g salicyclic acid ($C_7H_6O_3$) was dissolved in 10 ml ethanol. To this, 50 ml (0.5 M) sodium hydroxide was added and solution was boiled for 20 minutes. On cooling, excess alkali was titrated with 0.5 M hydrochloric acid solution using phenolred indicator. The titration reading was 30.1ml. The blank titration reading was 50 ml. Determine the percentage of salicyclic acid in the sample.

e) Write short note on - Novel drug delivery system.

## ✱✱✱✱✱

**P624**

**[3823] - 319**
**M.Sc.**
**BIOCHEMISTRY**
**BCH - 370: Molecular Biology**
**(Old and New Course)**

*Time : 3 Hours]* *[Max. Marks : 80*

*Instructions to the candidates:*

  1) *All questions are compulsory.*

  2) *Figures to the right hand side indicate full marks.*

  3) *Draw necessary diagrams wherever necessary.*

*Q1)* Answer <u>any four</u> of the following: **[20]**

  a) Recombination of DNA is usually beneficial for the survival of <u>E.coli</u>, explain.

  b) Design an experiment to prove that there are nicks in DNA.

  c) How pyrimidine dimer is formed? How it affects the activity of <u>E.coli</u>.

  d) Explain the action of rifamycin, chloramphenicol, heparin and puromycin on protein biosynthesis.

  e) What do you understand by the term gene? Discuss the role of each segment that constitute gene.

*Q2)* Answer <u>any four</u> of the following: **[20]**

  a) Give a flow sheet that will explain a typical gene expression.

  b) Describe in detail the molecular structure of RNA polymerase of <u>E. coli</u>.

  c) Describe various events that are taking place before DNA replication in <u>E. coli</u>.

  d) How Okazaki fragments are formed during DNA replication.

  e) Distinguish between adeno - and retro viruses.

*P.T.O.*

*Q3)* Answer <u>any two</u> of the following:                                          **[20]**

   a)   Describe in detail the structure and function of clover leaf model of tRNA.

   b)   Describe in detail the various types of DNA repair mechanisms.

   c)   What is promoter? Describe various types of promoters present in genes that are transcribed by RNA polymerase II.

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

   a)   Genome of retrovirus.

   b)   Nucleosome.

   c)   Protein targeting to lysosomes.

   d)   SOS.

   e)   Mechanism of splicing.

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**P575**                    **[3823] - 42**

# M.Sc. II

## ORGANIC CHEMISTRY

### CH-350 : Organic Reaction Mechanism

### (2005 Pattern) (Old Course)

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

*1)   All questions are compulsory.*

*2)   Figures to the right indicate full marks.*

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

### SECTION - I

*Q1)* Write short note on <u>any three</u> :                    **[12]**

   a)   Aldol condensation.

   b)   Use of isotopes in organic reaction mechanism.

   c)   Role NAD$^+$ and NADH in biotransformations.

   d)   Stability of carbanions.

*Q2)* Answer <u>any three</u> :                    **[12]**

   a)   What are assumptions in deriving the Taft equation? Justify.

   b)   Show that Hammett equation is linear free energy relationship.

   c)   Give the physical significance of $\rho$ and $\delta$ constants.

   d)   Explain the failure of Hammett relation and what are the efforts made to improve the correlation?

*Q3)* Predict the product/s with mechanism (any four) :                    **[16]**

e) 
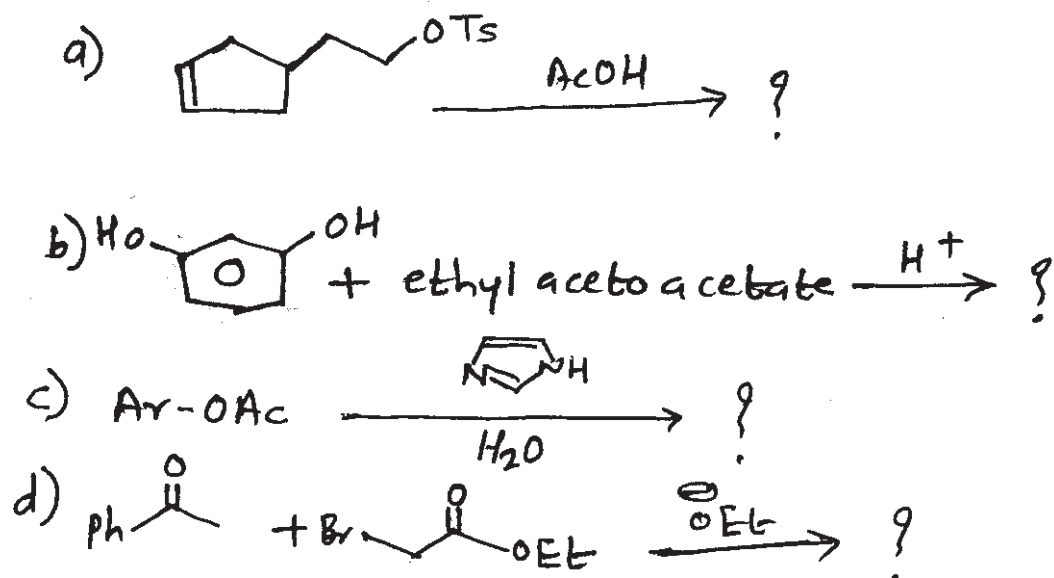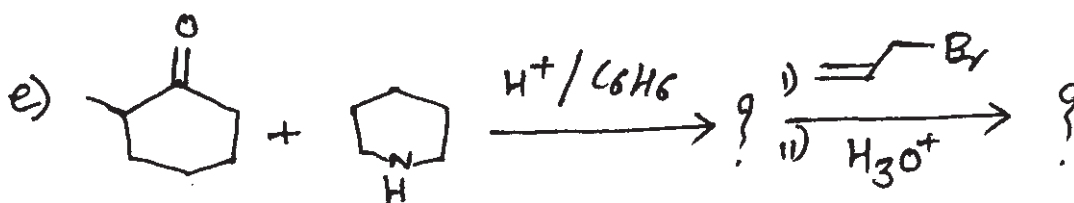
## SECTION - II

**Q4)** Explain <u>any three</u> of the following : **[12]**

a) The decarboxylation $\beta, \gamma$- unsaturated carboxylic acid occures readily at high temperature.

b) $H_3CCOCH_2Ph$ on bromination in acidic and basic medium gives only one product.

c) Use of crossover experiment in determination of reaction mechanism.

d) Non classical carbocation.

**Q5)** Suggest the mechanism for the following conversion (any four) : **[16]**
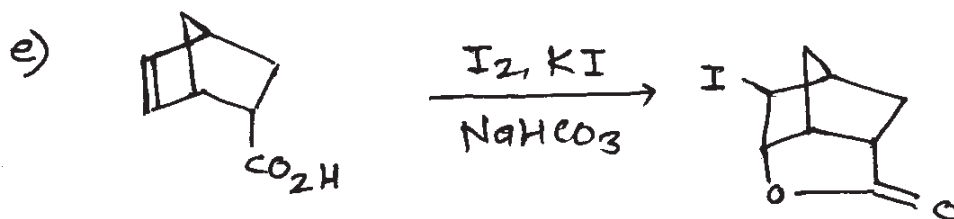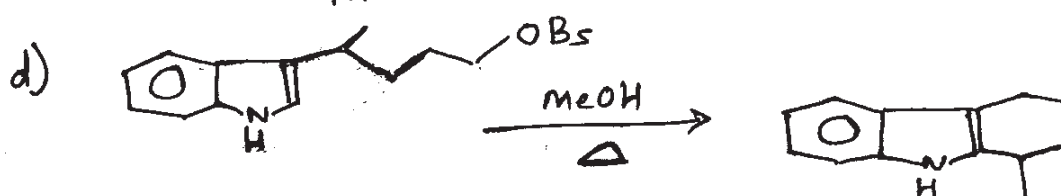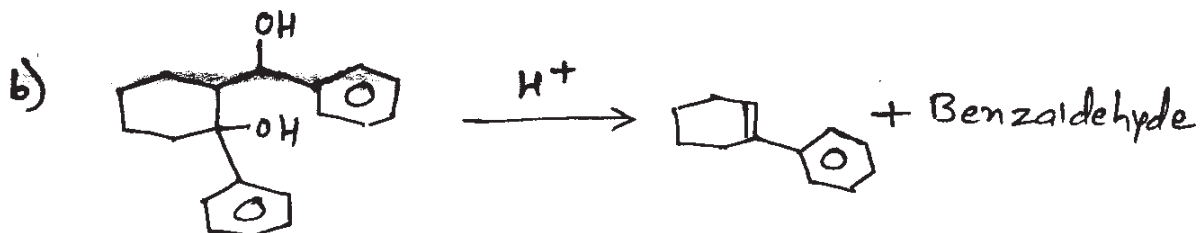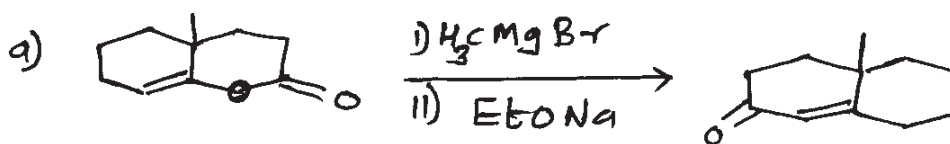
*Q6)* Answer <u>any three</u> of the following : **[12]**
   a)   Explain acetyl acetone is stronger acid than acetoacetic ester.
   b)   Explain, use of enol equivalence in biochemical transformations.
   c)   Decarboxylation of benzoic acid is not possible merely by heating.
   d)   Rate of lactonisation for 10 membered ring is slower than that six
        membered ring.

✦ ✦ ✦ ✦

**P576**       **[3823] - 43**

# M.Sc. - II

## ORGANIC CHEMISTRY

### CH-351 : Spectroscopic Methods in Structure Determination

**(2005 Pattern)**

*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*    *All questions are compulsory.*

    *2)*    *Figures to the right indicate full marks.*

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

## SECTION - I

*Q1)*   a)   Distinguish between the following pairs by using the indicated spectral method. (any four)     **[8]**
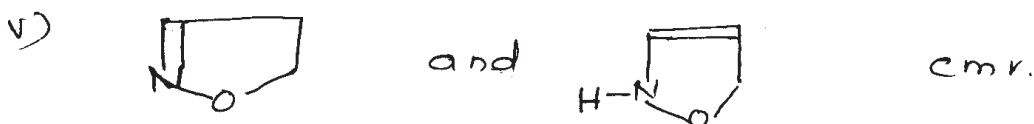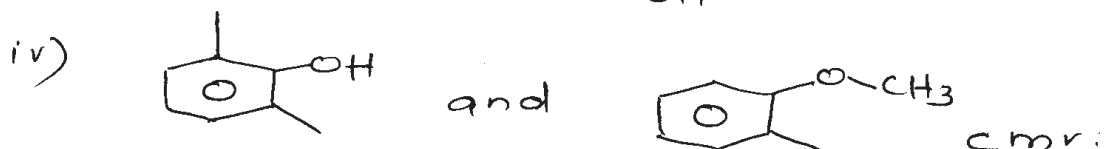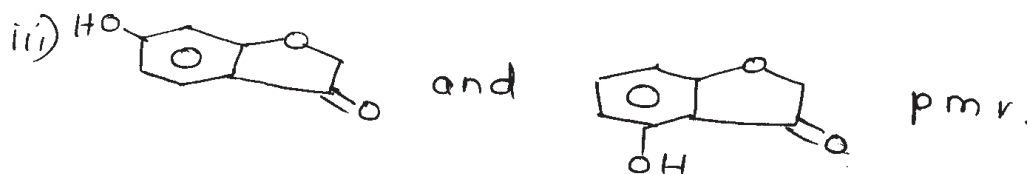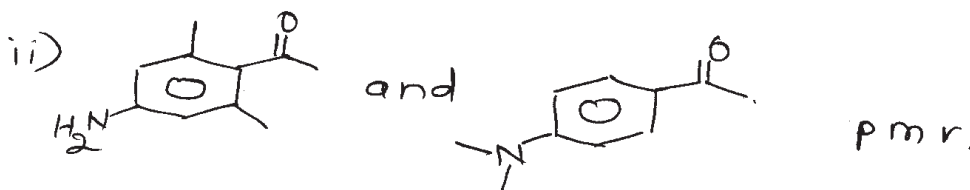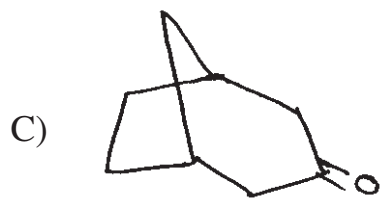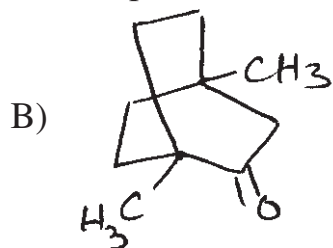
b) Explain <u>any four</u> of the following : **[8]**

   i) Calculate the chemical shift in ppm($\delta$) for a proton that has resonance 128 Hz downfield from TMS on a spectrometer which operates at 60 MHz.

   ii) Nitrobenzene shows $\dfrac{m}{e} = 77$ as the base peak in mass.

   iii) How many $^{13}C$ peaks should be seen in the broad-band decoupled spectrum of the following?

     A) Napthalene.

     B) 

     C) 

     D) P-nitrotoluene.

   iv) DEPT can be used to differentiate between $-CH_3$ and $-\overset{|}{\underset{|}{C}}H$ groups.

   v) The three isomeric difluoroethylenes produce pmr spectra which are complex.

*Q2)* Answer <u>any three</u> of the following : **[12]**

  a) Deduce the structure using spectral data.
    M.F. :$C_8H_7N$
    I.R. : 2220, 1620, 1510 cm$^{-1}$.
    PMR : 2.4 (15 mm, s), 7.2 (10 mm, d, J = 8 Hz), 7.5 (10 mm, d, J = 8 Hz)

  b) Deduce the structure using CMR.
    M.F. : $C_9H_{11}NO$.
    CMR : 39.7 (q, st.), 110.8 (d, st.), 124.9 (s, w), 131.6 (d, st.), 154.1 (s, w), 189.7 (d, mod.).

  c) Predict the structure
    IR : 1715 cm$^{-1}$.
    Mass : 128 (M$^+$, 3%), 85 (10%), 72 (40%), 43 (100%)

  d) Predict the structure.
    M.F. : $C_7H_{14}O_2$
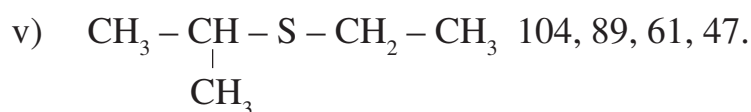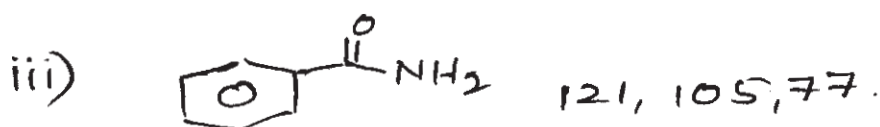    Mass : 130, 115, 98, 73, 43
    CMR : 208 (s), 75 (s), 54 (t), 50 (q), 33(q), 25 (q, st.)

*Q3)* Write short notes on <u>any three</u> of the following : [12]
    a) Karplus relationship.
    b) Inlet system in mass spectrometer.
    c) Use of D-labelling in $^{13}C$-NMR spectroscopy.
    d) Spin decoupling technique.

## SECTION - II

*Q4)* a) Explain the genesis of any four of the following ions. [8]

    i) $\begin{matrix} CH_3 \\ \diagdown \\ H_3C \diagup \end{matrix} N - (CH_2)_4 - COOCH_3$   159, 128, 74, 59, 58.

    ii) $H_3C(CH_2)_5 - CH(OC_2H_5)_2$   103, 75, 47.

    iii)  121, 105, 77.

    iv)  87, 72, 43, 30.

    v) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - S - CH_2 - CH_3$   104, 89, 61, 47.

    b) An aromatic compound $C_9H_{10}O$ reacts with $NH_2OH$ giving two stereo isomers. The compound shows the following spectral data. [4]
    IR : 1690, 1600, 1465, 1370 & 750 cm$^{-1}$.

    Mass : $\dfrac{m}{e}$ 134 (M$^+$), 119 (20%), 91(100%), 65 (45%), 43 (80%)

    Deduce the structure.

*Q5)* a) Assign the given $^1H$ NMR signals to various protons in the given compound <u>A</u> and comment on the double resonance experiments given below.      $^1H$ NMR : $\delta$ [8]



    **A**
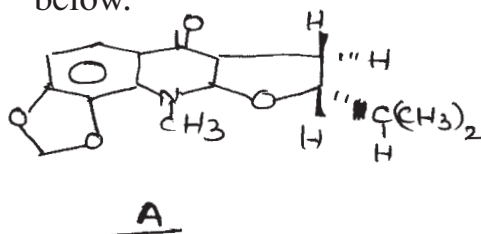
    0.97 (d, J = 7 Hz, 3H)
    1.03 (d, J = 7 Hz, 3H)
    2.01 (eight lines J = 7 Hz, 1H)
    2.25 (d, d, J = 15.3 & 8.7 Hz, 1H)
    2.95 (d, d, J = 15.3 & 9.9 Hz, 1H)
    3.80 (s, 3H)
    4.76 (eight lines ddd, J = 9.9, 8.7 & 7.0 Hz, 1H)

    6.02 (s, 2H), 7.93 (d, J = 8.5 Hz 1H), 8.0 (d, J = 8.5 Hz, 1H)
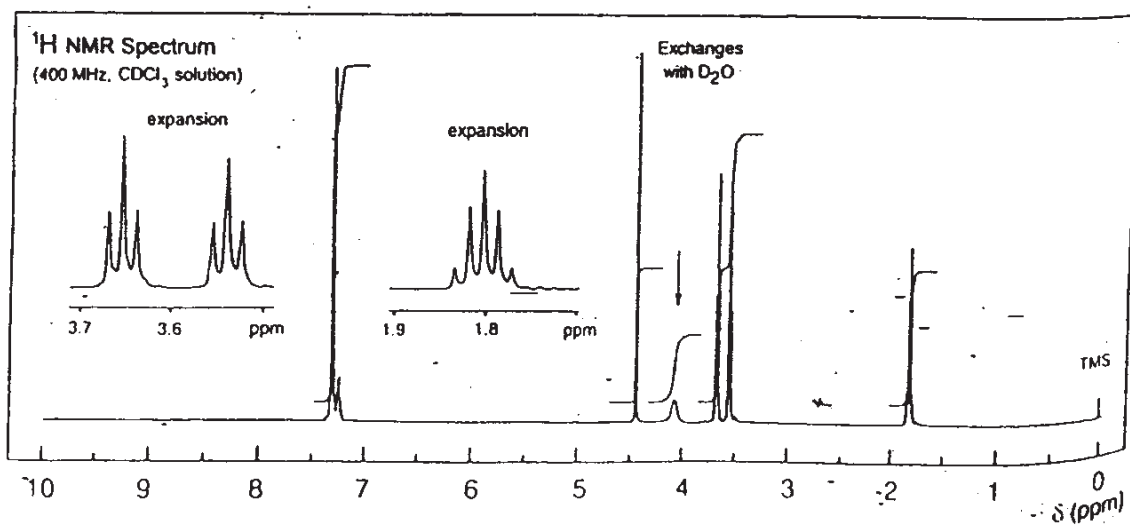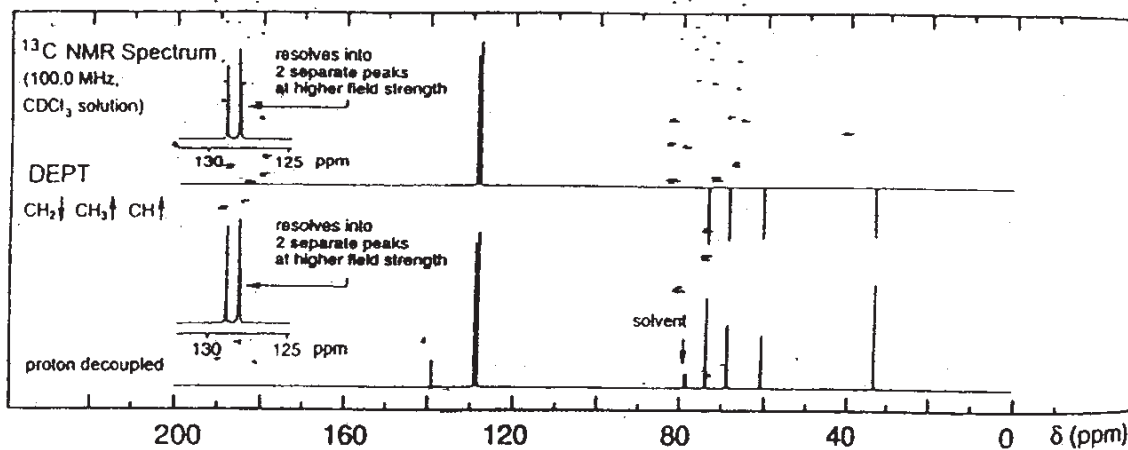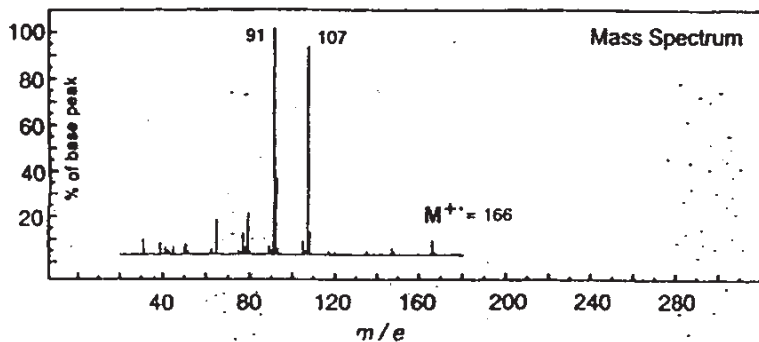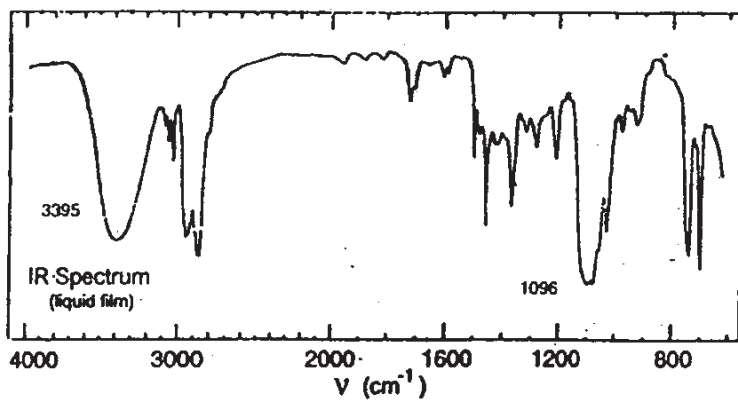
Spin decoupling Experiment :

| Irradiation at | | Change at | |
|---|---|---|---|
| i) | 2.01 $\delta$ | i) | 1.03 (d) → S. |
| | | ii) | 4.76 (ddd) → dd (J = 9.9 & 8.7 Hz). |
| ii) | 2.25 $\delta$ | i) | 2.95 (dd) → d (J = 9.9 Hz) |
| | | ii) | 4.76 ddd → dd (J = 9.9 & 7.0 Hz) |

b) Assign the signals to the different carbons of compound B. Explain your answer. **[8]**



| 35.05 (t) | 114.15 (s) |
|---|---|
| 61.01 (t) | 117.15 (d) |
| 69.96 (d) | 117.70 (d) |
| 73.52 (d) | 126.04 (d) |
| 76.64 (d) | 148.61 (s) |
| 76.96 (d) | 152.17 (s) |
| 103.06 (d) | 172.92 (s) |

**Q6)** A compound exhibits the following spectral properties shown on the attached sheet. Suggest the structure for the compound and explain the spectral data. **[12]**

IR Spectrum
(liquid film)

3395

1096

4000   3000   2000·   1600   1200   800

ν (cm⁻¹)

Mass Spectrum

91   107

M⁺· = 166

% of base peak

100
80
60
40
20

40   80   120   160   200   240   280

m/e

¹³C NMR Spectrum
(100.0 MHz,
CDCl₃ solution)

resolves into
2 separate peaks
at higher field strength

130   125 ppm

DEPT

CH₂↓ CH₃↑ CH↑

resolves into
2 separate peaks
at higher field strength

130   125 ppm

solvent

proton decoupled

200   160   120   80   40   0   δ (ppm)

¹H NMR Spectrum
(400 MHz, CDCl₃ solution)

Exchanges
with D₂O

expansion

3.7   3.6   ppm

expansion

1.9   1.8   ppm

TMS

10   9   8   7   6   5   4   3   2   1   0   δ (ppm)

7

✦ ✦ ✦ ✦

# M.Sc.

## ORGANIC CHEMISTRY

### CH-352 : Organic Stereochemistry

### (2005 Pattern) (Old Course)

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

*Q1)* Answer <u>any four</u> of the following :                          **[16]**

a) The relative rates of saponification 1 are $K_{trans} / K_{cis} = 20$, while for 2 are $K_{trans} / K_{cis} = 2.5$.



$$X = 1 = -COOEt$$
$$X = 2 = -OCO-\langle O \rangle-NO_2$$

b) Von Auwers-Skita rule can not be applied to cyclohexanols.

c) Draw conformational structures of the compound I and II. Give their nomenclature and discuss the stability.



I                                    II
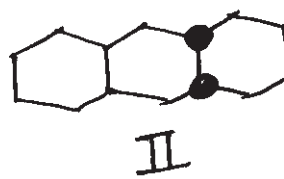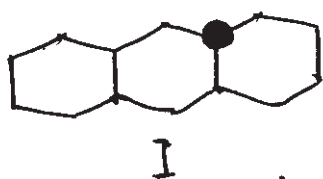
d) Comment on the strain in the chair-chair conformation of bicyclo [3, 3, 1] nonane. Name all related structure entirely free of strain.

e) $2\alpha$-Chloro-Cholestane-$3\beta$-ol is cyclised to the 2, $3\beta$-epoxycholestane several thousand times slowly than $3\alpha$-chloro-cholestane-$2\beta$-ol. Explain.

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

a)



b)



c)



d)
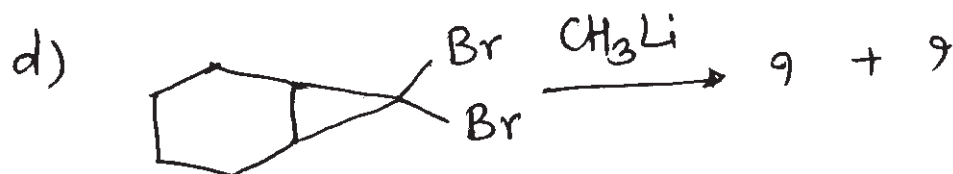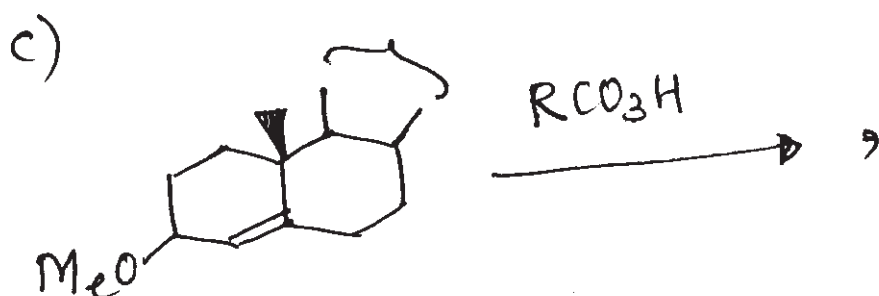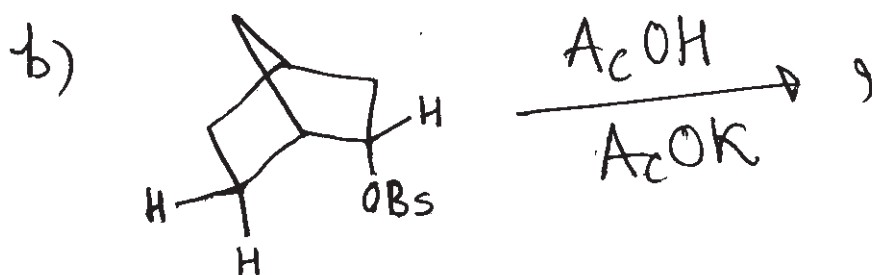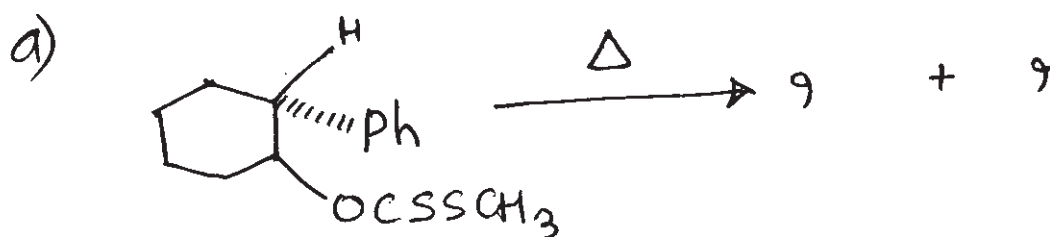


e) Cis-anti-cis hexahydrodiphenic acid
   i) $\xrightarrow{CH_2N_2}$ ?
   ii) NaOMe.
   iii) $H_3O^+$.

*Q3)* Attempt <u>any three</u> of the following : **[12]**
   a) Transannular reactions with examples.
   b) Isobornyl chloride rearrangement.
   c) Bredt's rule.
   d) 2 - Alkyl ketone effect.

## SECTION - II

**Q4)** Answer <u>any three</u> of the following :                                                    **[12]**

a)   Give the reaction of diazo methane with enhydrin. How this reaction help to deduce the lactone ring fusion with enhydrin.

b)   How will you prove that Cinchonine and Cinchonidine have different configuration at $C_8$ and $C_9$.

c)   Find the relative configuration at $C_5$ & $C_6$ in dihydrocodeine.

d)   Explain the following terms :
   i)   Plain curve.                          ii)   Circular dichroism.

**Q5)** Answer <u>any three</u> of the following :                                                    **[12]**
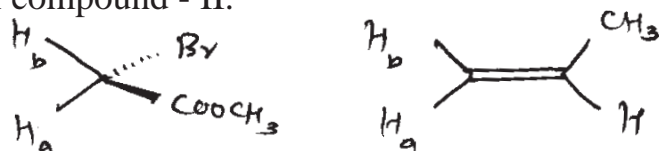
a)   The ketones A & B display opposite sign of cotton effect. Explain which compound have large magnitude? Why?
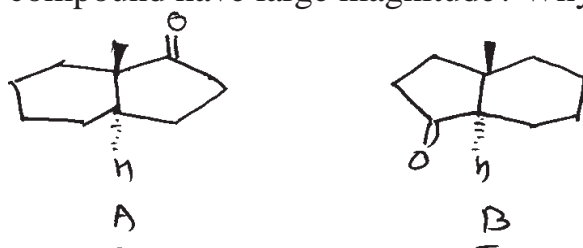


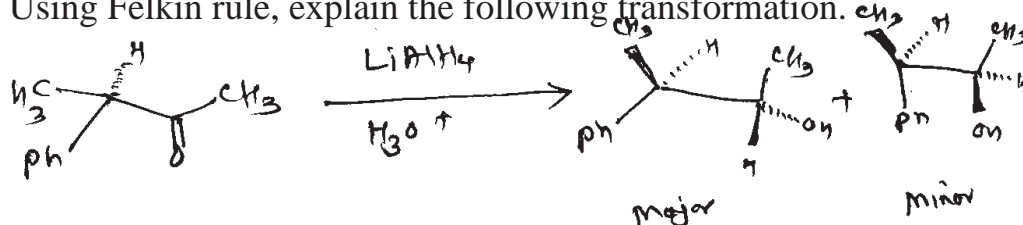b)   Using octant rule, predict the sign of cotton effect of the following compounds (any two) :
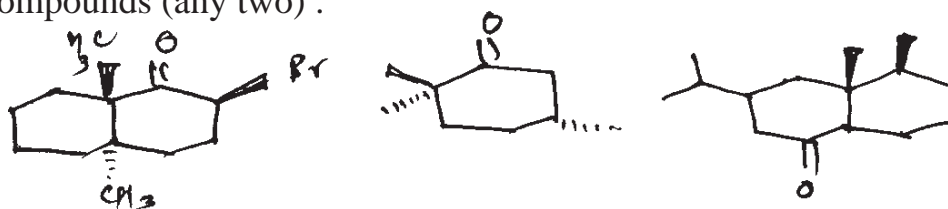


c)   Identify pro-R/pro-S hydrogen atoms in compound - I and pro-E/pro-Z in compound - II.
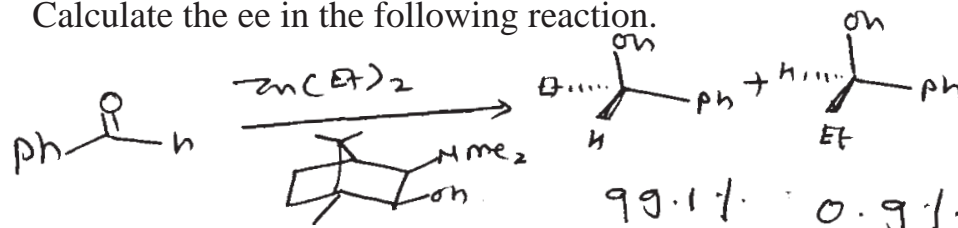


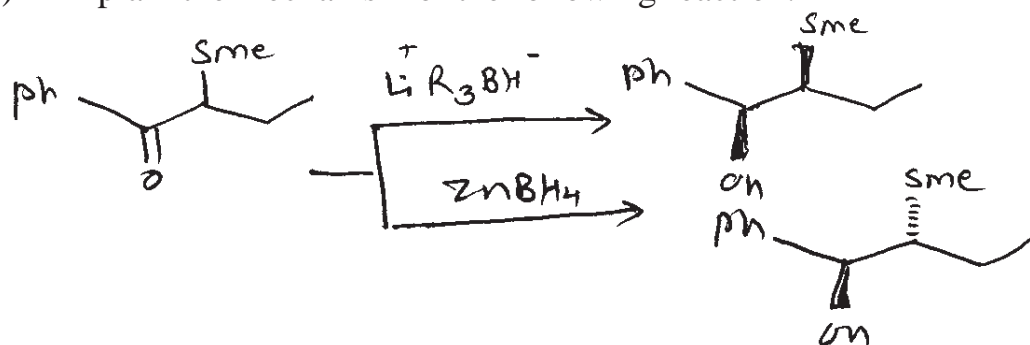d)   Using Felkin rule, explain the following transformation.



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

   i)   Calculate the ee in the following reaction.

ii) Explain the mechanism of the following reaction.



iii) Explain the difference of yields and products obtain in following elimination reaction.



$$A + B + C$$
$$51\% \quad 18\% \quad 31\%$$

b) Attempt <u>any five</u> of the following : **[10]**

i)



$$\xrightarrow[\text{Ti}(O\text{-}i\text{-}Pr)_4]{t\text{-}BuOOH} \quad ?$$
$$L(+) \text{ DET}$$

ii)



$$\xrightarrow{\text{PhCHO}} \quad \text{Write T.S. and product}$$

iii)



i) 
ii) LDA
iii) $PhCH_2I$

$$\longrightarrow \quad ?$$

iv)



$$\xrightarrow{PhLi} \quad ?$$

v)



a) $ZnCl_2$
b) Reduction

$$\longrightarrow \quad ?$$

vi)



$$+ \quad BrMg\text{-} \quad \xrightarrow{H_3O^+} \quad ?$$

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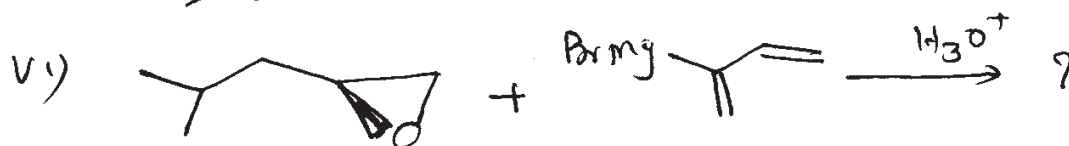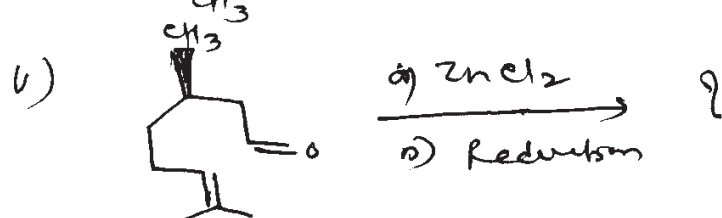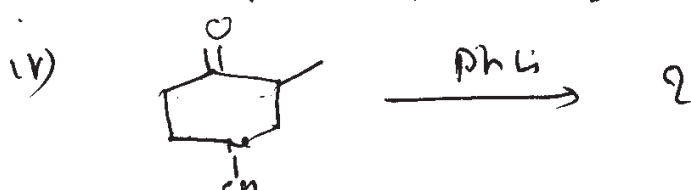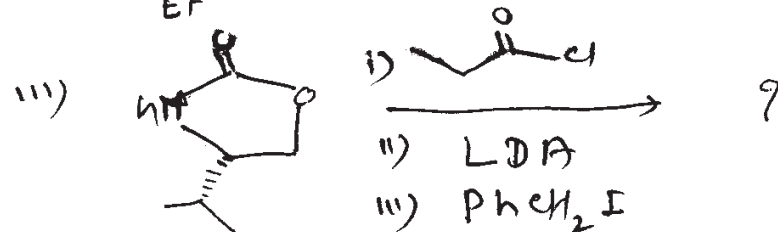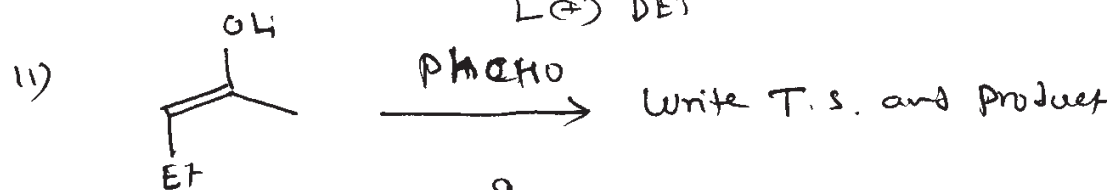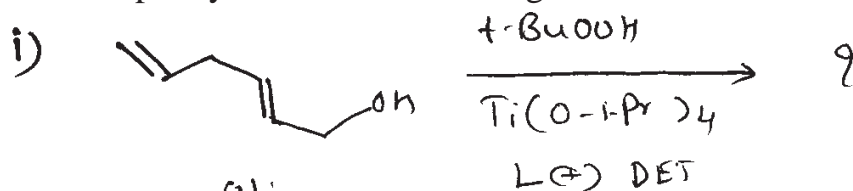
**P578**                    **[3823] - 45**

**M.Sc.**

## ORGANIC CHEMISTRY

**CH-353 : Heterocyclic Chemistry, Photochemistry and Free Radicals**
**(2005 Pattern) (Old Course)**

*Time : 3 Hours]*                    *[Max. Marks : 80*

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

### SECTION - I

*Q1)* a)   Explain <u>any three</u> of the following :                    **[6]**
   i)   Aniline readily forms anilinium ion in mineral acid, while pyrrole does not form 1-Hpyrrolium ion.
   ii)  Imidazole has a higher boiling point than N-methyl imidazole.
   iii) 2-Nitro-5-Bromothiophene undergoes nucleophilic displacement much more readily than 1 Bromo 4-nitrobenzene.
   iv)  Pyridine - N - oxide are susceptible to both electrophilic and nucleophilic substitution.

   b)   Write short notes <u>any two</u> :                    **[6]**
   i)   Knorr pyrrole synthesis.
   ii)  Pomeranz Fritsch isoquinoline synthesis.
   iii) Synthesis of pyrazoles from 1, 3 dicarbonyl compounds.

*Q2)* a)   Suggest suitable mechanism for <u>any four</u> :                    **[8]**

(iv) $NO_2$— [indole/quinoline structure] — $ClCH_2SO_2Ph$ over $KOH, DMSO$ → [product with $CH_2SO_2Ph$] $NO_2$—[structure]

(v) [furan]—$Ac$  (i) $HNO_3/Ac_2O$ at $-10^\circ$  (ii) Pyridine → $O_2N$—[furan]—$Ac$  + [furan]—$NO_2$
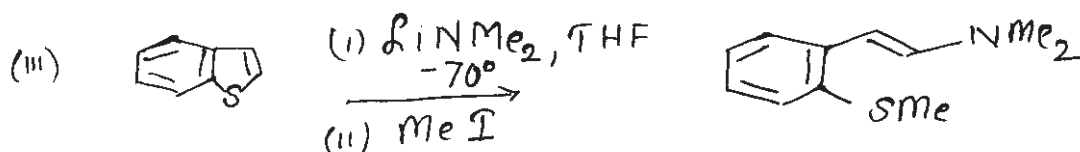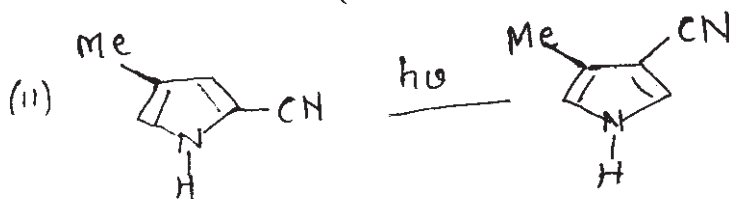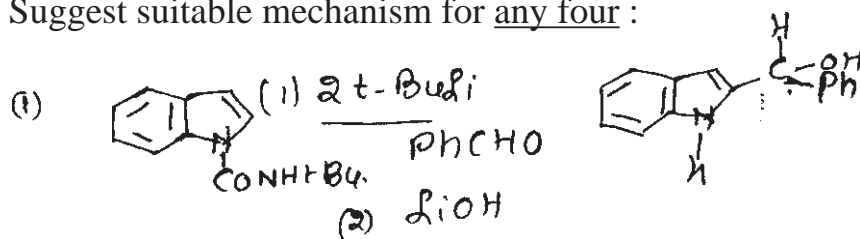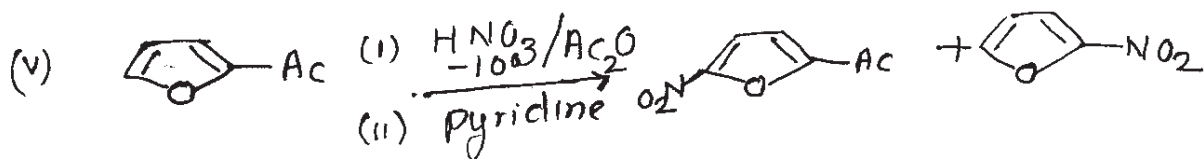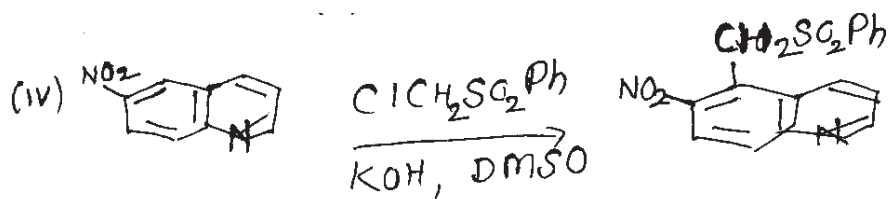
b)  Complete the following reaction sequence for <u>any two</u> :  [8]

(i) [thiophene] $\xrightarrow[48\% \text{ HBr}]{3Br_2}$ ? $\xrightarrow[\text{reflux}]{Zn, AcOH}$ [Br-thiophene] $\xrightarrow[THF]{LDA}$ ? → [Br-thiophene-CHO]

(ii) [benzofuran/OMe structure, OMe] $\xrightarrow[\text{heat}]{PhNMe_2}$ ? $\xrightarrow[\text{(ii) } H_3PO_4]{\text{(i) } O_3}$ $C_9H_8O_2$ $\xrightarrow[NaOH]{DMF, POCl_3}$

$C_{10}H_9O_3$

(iii) [Cl-pyridine structure, Cl] $\xrightarrow{CH_3ONa}$ ? $\xrightarrow{\text{Iodomethane}}$ $C_7H_{10}INO$ $\xrightarrow{185^\circ C}$ $C_6H_7NO$.
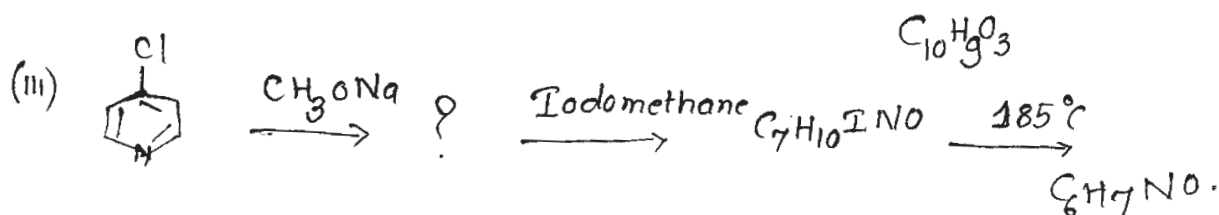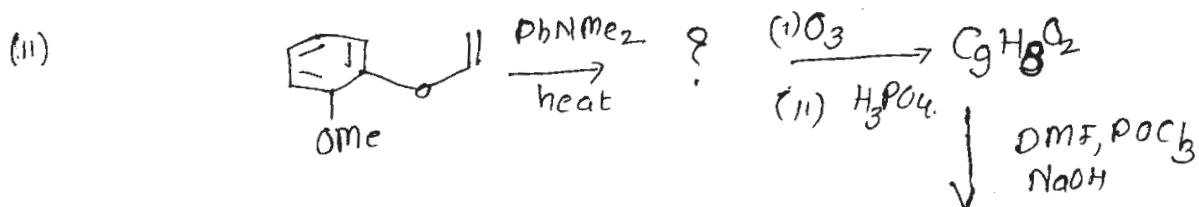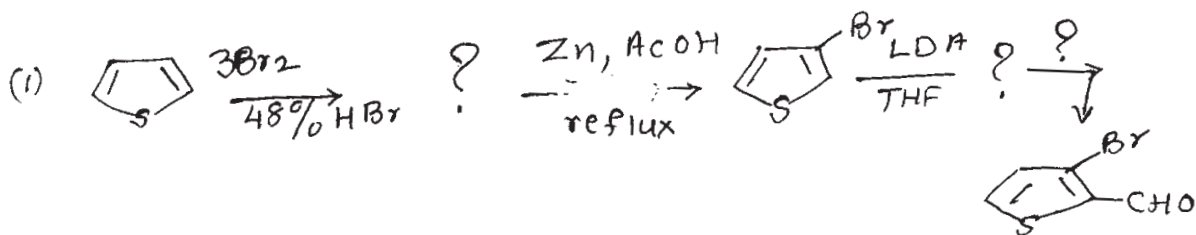
Q3) a)  Predict the products for <u>any two</u> :  [4]

(i) [pyridine-Cl structure] —$Cl$  (i) $Me_3N/PhH$  (ii) $Et_4N^+CN$  ?

(ii) [phenyl]—$N(H)$—$N=C\begin{smallmatrix}Ph\\CH_3\end{smallmatrix}$ $\xrightarrow{H^+}$ ?

(iii) [Br-pyrrole structure] (1) $2t$-$BuLi$ Pentane  (2) $Ph_2C=O$ THF  ?
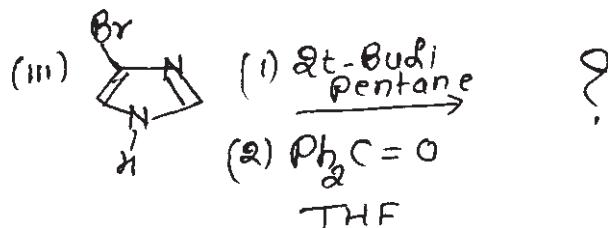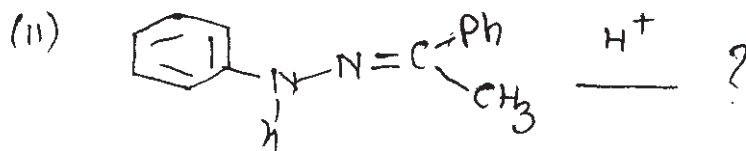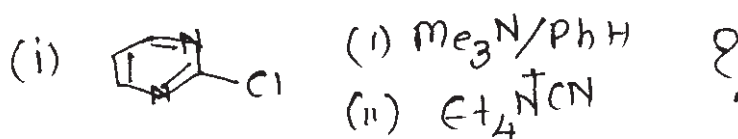
b) Write the reactions of Benzofuran with [4]
   i) $N_2O_4$.
   ii) n-Buli, hexane, ether then $CO_2$.
c) Reactions of quinoline with the following reagents (any two) : [4]
   i) $KNH_2$, $KMnO_4$
   ii) $H_2$, Pt rt.
   iii) $H_2O_2$.

## SECTION - II

**Q4)** a) Explain <u>any two</u> of the following : [6]
   i) Blue colour is observed when the solution of cumene and tetramethyl-p-phenylene diamine is treated with oxygen.
   ii) Irradiation of a mixture of benzophenone and naphthalene with 330 nm light produces phosphoresent emission from naphthalene.
   iii) Elemental oxygen may act as an initiator when no better initiator is available, but in the presence of more effective initiators, oxygen may act as a retarder.

   b) Write short notes on <u>any two</u> of the following : [8]
   i) Photoisomerisation of Benzene.
   ii) Stable free radicals.
   iii) Use of tributyltinhydride in free radical cyclisation.

**Q5)** Suggest mechanism for <u>any four</u> of the following : [12]

iv)



v)
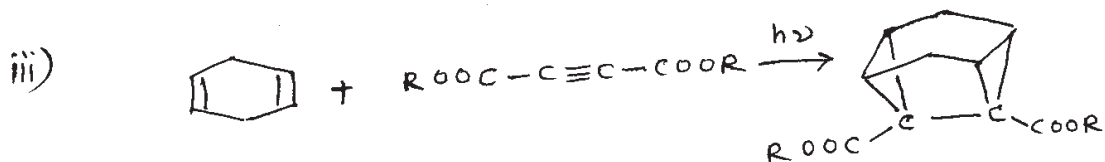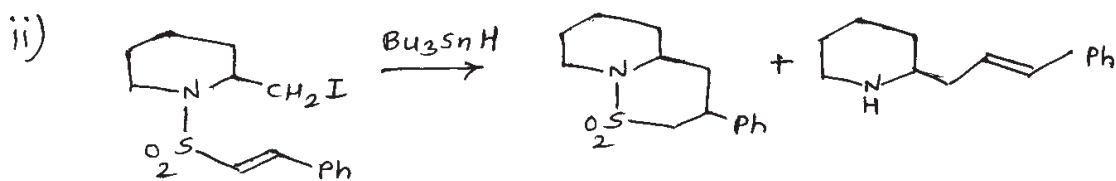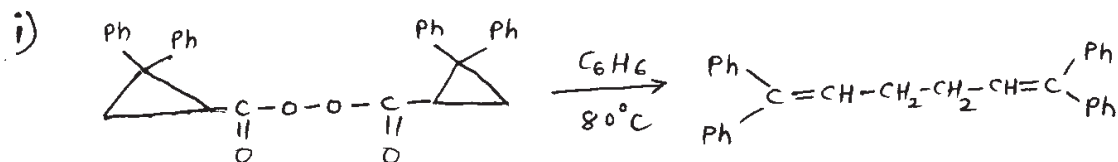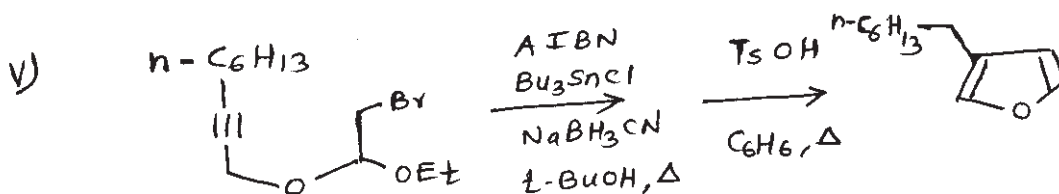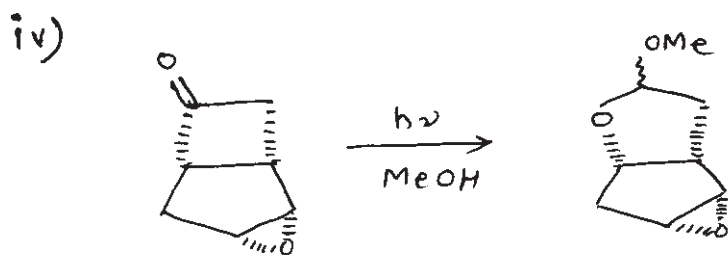


**Q6)** a) Explain photosensitisation and quenching with suitable examples. **[4]**

b) Predict the product/s for <u>any five</u> of the following : **[10]**

i)



ii) $Ph\,(CH_2)_5CH=CH_2$ $\xrightarrow[140°C]{R-O-O-R}$ ?

iii)



iv) $Ph-\overset{O}{\underset{||}{C}}-CH_2-CH_2-CH_2-CH_2\,OCH_3$ $\xrightarrow{h\nu}$ ?

v)



vi)



✦✦✦✦
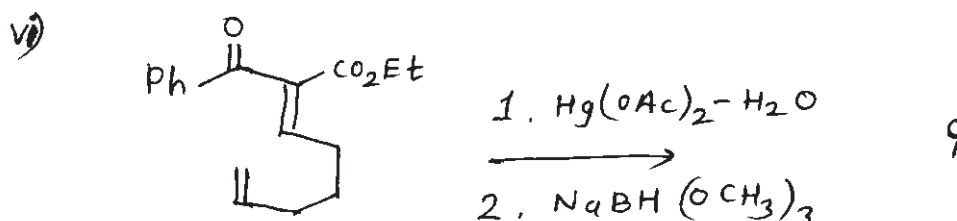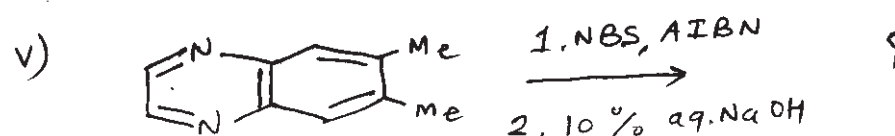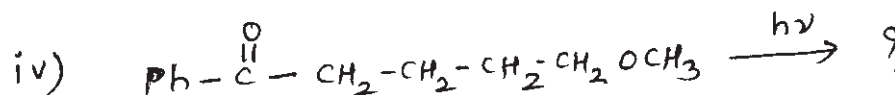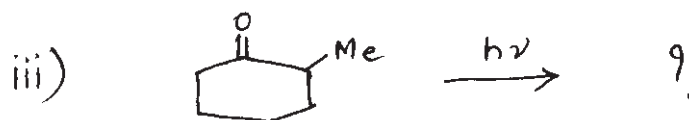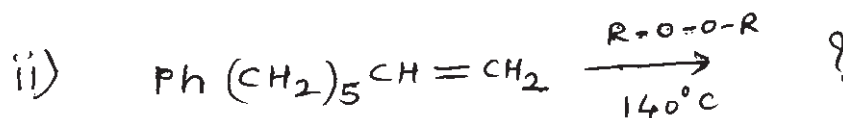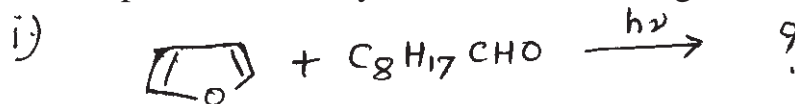
**P579**                            **[3823] - 47**

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CH-380 : Pharmaceutical Analysis**

**(Old Course)**

*Time : 3 Hours]*                              *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following :                    **[20]**

   a)   Give an account of impurities associated with the pharmaceutical product during inadequate storage.

   b)   Explain the terms - Ointments and creams. What precautions are to be taken at the time of their preparation and storage?

   c)   Explain the necessity and importance of drug rules.

   d)   2.5 g washing soda was dissolved in 20 ml water and diluted to 100 ml. 10 ml diluted solution was titrated with 0.5 N HCl using methyl orange indicator. The burette reading was 9.0 ml. Determine the amount of sodium carbonate in the sample.

   e)   Write short note on - Alkaloidal assay.

*Q2)* Answer <u>any four</u> of the following :                    **[20]**

   a)   What are aerosols? How are they prepared? Give advantages of aerosols?

   b)   What are aromatic waters? Give their method of preparation and applications.

   c)   Explain the term - dissolution and disintegration. Describe in detail dissolution test for capsule.

   d)   To 1.9 g oil sample, 25 ml (0.5 N) alcoholic potassium hydroxide was added and mixture was refluxed in a water bath for 1.5 hours. On cooling the excess alkali was titrated with 0.5N HCl solution. The titration reading was 15.0 ml. The blank titration reading was 25 ml. Determine sap. value of oil.

   e)   0.165 g ascorbic acid ($C_6H_8O_6$) sample was dissolved in a mixture of 25 ml water and 25 ml dilute sulfuric acid. The solution was diluted upto 100 ml. 10 ml of diluted solution was titrated with 0.01 N iodine solution using starch as an indicator. The burette reading was 16.3 ml. Determine the percentage of ascorbic acid in the sample.

## SECTION - II

**Q3)** Attempt <u>any four</u> of the following : **[20]**

    a) Explain the term ash value and mention different types of ash value. What is the significance of ash value with reference to given pharmaceutical compound.

    b) What is the necessity of limit test? Discuss in detail the limit test for iron and chloride.

    c) Explain the necessity of sterilization. Write a brief account of sterilization by radiations.

    d) 0.21 g phenobarbitone ($C_{12}H_{12}O_3N_2$) was dissolved in 40 ml of DMF and titrated with 0.1 N lithium methoxide using quinaldine red as an indicator. The burette reading was 8.1 ml. Determine the percentage of phenobarbitone in the sample.

    e) Describe in detail assay of sodium chloride.

**Q4)** Attempt <u>any four</u> of the following : **[20]**

    a) Assay of cholesterol from blood plasma.

    b) Novel drug delivery system.

    c) Identification tests.

    d) Tests for undue toxicity.

    e) Assay of antibiotics.

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**P580**                                       **[3823] - 49**

# M.Sc. - II

## ANALYTICAL CHEMISTRY

**CH-390 : Electro Analytical and Current Analytical Methods in Industries**

**(Old Course)**

*Time : 3 Hours]*                                                      *[Max. Marks : 80*

***Instructions to the candidates:***

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

*2)* *All questions are compulsory and carry equal marks.*

*3)* *Neat diagrams must be drawn wherever necessary.*

*4)* *Use of logarithmic tables / non programmable calculator is allowed.*

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following :                                    **[20]**

a) Give the Ilkovic equation. Explain the terms involved in it.

b) Distinguish between differential pulse polarography and square wave polarography.

c) Give the classification of voltammetric techniques and explain hydrodynamic voltammetry.

d) Calculate the diffusion current of bivalent metal ion in solution having concentration 5.5 mM, if drop time was measured at the rate of 3.51 sec. per drop, the mercury flow rate was 1.68 mg per sec.

   (Given : diffusion coefficient of bivalent metal ion is $7.58 \times 10^{-6}$ cm$^2$/s)

e) Calculate the weight of nickel deposited by passing constant current 3.5 ampere for 28.5 min. through the solution of nickel salt.

   (Given : At. wt. of Ni = 58.7).

*Q2)* Attempt <u>any four</u> of the following :                                    **[20]**

a) Discuss the advantages of DME compared with other electrodes.

b) Draw the block diagram and explain the working of controlled potential coulometer.

c) Explain in brief the working of 'chronopotentiometry'.

d) During the forward scan of a triangular wave voltamogram at a disk electrode, a peak current of 27.5 $\mu$A was observed at a scan rate of 0.560 V/s. Estimate the peak current at a scan rate of 70.0 mV/s, assuming a reversible electro-chemical reaction.

e) The normality of potassium dichromate is 0.150 N. Calculate the time required in coulometric titration, when 25 ml of potassium dichromate generates Iron (III) in solution.

   (Given : Current value = 265 mA, Eq. wt of potassium dichromate = 49)

*P.T.O.*

# SECTION - II

*Q3)* Attempt <u>any four</u> of the following : [20]

a) Explain in brief the preparation of radioactive samples. Give the limitations of neutron activation analysis.

b) Explain the principle and technique of double dilution analysis. Mention it's advantages.

c) Describe the differential thermal analysis technique with suitable examples.

d) Turbidimetry was used to examine a sample, the transmittance of the sample was 0.534, the cell path length was 1.00 cm and the concentration was 210 mg/L. Determine the turbidity coefficient of the sample.

e) A TG curve was obtained for 10.65 mg of a sample containing $CuSO_4.5H_2O$. When the monohydrate formation was complete at about 200°C, the loss in mass was 1.2 mg. Find the percentage of $CuSO_4.5H_2O$ in the sample.
(Given : At. wt. of Cu = 63.55, S = 32, O = 16, H = 1).

*Q4)* Attempt <u>any four</u> of the following : [20]

a) Write a note on Electro-Chemical sensors.

b) What is turn-over number? Sketch and explain the plot of the dependence of enzyme catalysed reaction rate on the substrate concentration.

c) Describe the technique of radiometric titration. Draw and discuss the nature of radiometric titration curve, when both the titrant and titrand are radioactive.

d) A 1 ml of a sample solution containing 2 $\mu$ Ci radioactivity due to tritium is injected into the blood stream of a laboratory animal. After sufficient time for circulation, equilibrium is established, a 0.10 ml of blood is found to have an activity of 130 dpm. Calculate the blood volume in the body of the animal.

e) 5 mg of manganese dioxide powder was irradiated in a neutron flux of $1 \times 10^7$ n cm$^{-2}$ S$^{-1}$ for a period of 15 min. Calculate the activity induced in the sample due to mangnese at the end of irradiation. Calculate the activity after a cooling period of half an hour.
Given :

i) $t_{1/2}$ $^{56}Mn$ = 2.58 hours.

ii) $\sigma(^{55}Mn)$ = 13.3 barn.

iii) Isotopic abundance of Mn = 100%.

iv) At. wt. of Mn = 54.93, O = 16.

✦ ✦ ✦ ✦

**P581**                           **[3823] - 50**

# M.Sc. - II
# ANALYTICAL CHEMISTRY
### CH-391 : Environmental and Analysis of Industrial Materials
### (Old Course)

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

**Q1)** Attempt <u>any four</u> of the following :

a) Describe a method used for estimation of nitrogen from sample of urea.

b) Explain the procedure for determination of zinc from cosmetics.

c) Enlist the major constituent of glass. Outline the procedure for estimation of cobalt from glass sample.

d) What is portland cement? Give the analytical method for the estimation of calcium from portland cement.

e) A sample of 0.258 gm of nitrogen fertilizer was Kjeldahlized and $NH_3$ evolved was absorbed in 50 ml of $\dfrac{N}{10}$ HCl, which requires 24.7 ml of $\dfrac{N}{10}$ NaOH for neutralisation. Determine the percentage of nitrogen. (Given : At. wt. N = 14, H = 1).

**Q2)** Attempt <u>any four</u> of the following :

a) What are pigments? Discuss the analytical method for the estimation of chromium from pigment sample.

b) Describe the method to estimate anionic surfactants.

c) Describe the method of determination of moisture by Karl Fischer titration from explosives.

d) A sample of face powder weighing 2.440 g was dissolved in acid and diluted to 250 ml. A aliquot of 50 ml sample was analysed for $SO_4^{2-}$ and gave 0.273 gm of $BaSO_4$. Calculate the percentage of sulphate and sulphur from given sample.
(Given : At. wt. Ba = 137.34, S = 32, O = 16).

e) 1.383 gm sample of ilmenite ore was dissolved in Cone. $H_2SO_4$. After removal of insoluble matter filtrate is diluted to 250 ml. 100 ml aliquot is used to precipitate Ti and Fe. The precipitate on ignition gave mixed oxides of Fe and Ti. The weight of mixed oxide was 0.375 gm. A 25 ml of stock solution was titrated against 0.1 N $K_2Cr_2O_7$ and burette reading was 7.5 ml. Calculate percentage of $TiO_2$ and $Fe_2O_3$ in sample?

(Given : At. wt. Fe = 55.85, Ti = 47.90, O = 15.99)

## SECTION - II

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

a) Give the composition of steel. Discuss the analytical method for determination of chromium from steel.

b) Explain the analytical procedure for estimation of Thorium from monazite sand.

c) Outline the analytical procedure for determination of any two of the following :
   i) Iron from bauxite.
   ii) Titanium from Ilmenite ore.
   iii) Nickel from cupronickel.

d) In the determination of COD of waste water sample, 50 ml of it was refluxed with 10 ml of 0.1 N $K_2Cr_2O_7$ solution and 20 ml cone. $H_2SO_4$ solution. The solution was titrated with FAS solution. The titration reading was 8.5 ml. 10 ml of aliquot of 0.1 N $K_2Cr_2O_7$ solution required 12.0 ml of the same FAS solution. Calculate Chemical Oxygen Demand (COD) of waste water sample.

e) From a 3.00 g of sample containing calcium was dissolved in acid, and calcium was precipitated as calcium oxalate. The precipitate was dissolved in dilute $H_2SO_4$ and the solution diluted to 100 ml. An aliquot of 10 ml was titrated with 0.025 N $KMnO_4$ and gave burette reading 6.5 ml. Calculate the percentage of calcium in the given sample.

(Given : At. wt. Ca = 40.08, O = 15.99, Mn = 54.93, K = 39)

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

a) Explain construction and working of cyclone separator.

b) How $NO_x$ is generated? Explain its hazardous effects and how is it controlled?

c) Explain an analytical method for the estimation of Arsenic from waste water.

d) Give a brief account of estimation of DO, (Dissolved Oxygen).

e) Write short note on (any one) :
   i) Settling chambers.
   ii) COD from waste water.

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**P582**        **[3823] - 51**

# M.Sc. - II

## ANALYTICAL CHEMISTRY

### CH-392 : Advanced Analytical Techniques

#### (Old Course)

*Time : 3 Hours]*           *[Max. Marks : 80*

*Instructions to the candidates:*

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

*2) All questions are compulsory and carry equal marks.*

*3) Neat diagrams must be drawn wherever necessary.*

*4) Use of logarithmic tables / non programmable calculator is allowed.*

*5) Use of graph paper is allowed.*

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following :          **[20]**

a) Explain the term zener diodes and describe how is it used for voltage regulation.

b) What is transistor? Draw circuit diagram showing forward and reverse biasing of p-n junction transistor.

c) Give the classification of amplifiers, on the basis of coupling and frequency response.

d) State and explain Faraday's law of electrolysis. Describe its important applications.

e) Write the binary equivalents of numbers 27 and 37 add these binary numbers and convert the answer into decimal equivalent.

*Q2)* Attempt <u>any four</u> of the following :          **[20]**

a) Explain the term transformers. Give their important classes and describe the working of step up and step down transformer.

b) Describe load and line regulation in power supply.

c) What is mean by rectification? Describe the working of crystal diode as half wave rectifier.

d) Give the classification of conductors, semiconductors and insulators on the basis of band theory of solid.

e) Explain the working of digital computer with neat block diagram.

## SECTION - II

**Q3)** Attempt <u>any four</u> of the following : [20]

a) Explain the following with respect to AAS.
   i) Spectral interference.
   ii) Releasing agent.
   iii) Chemical interference.
   iv) Protective agent.

b) Explain working of hollow cathode lamp.

c) Define spectrum. Describe the principle and mechanism of emission, Fluorescence and absorption spectra.

d) List the various mass analyser used in atomic mass spectrometer and explain working of any one.

e) A well water sample is analysed flame photometrically for sodium at 590.0 nm. The emission signal is 5.4 unit an emission scale. A series of standard solution give the following result.

| Standard Sodium in PPM | Emission Reading |
|---|---|
| 0.2 | 0.32 |
| 1.0 | 1.40 |
| 2.0 | 2.85 |
| 3.0 | 4.21 |
| 4.0 | 5.64 |
| 5.0 | 6.50 |

Determine sodium level in PPM in well water sample.

**Q4)** Attempt <u>any four</u> of the following : [20]

a) State and explain supercritical fluid chromatography and mention its merits and demerits.

b) Explain the principle and experimental procedure of rocket-electrophoresis method as immunological technique.

c) Name the various elements used as micro nutrients for healthy growth of plants. Discuss the suitable method for the determination of Boron.

d) 156 mg sample of mineral was dissolved in HCl diluted to 250 ml and analysed for calcium content by flame emission spectroscopy. The emission signal was 32 unit on the scale. The standard calcium solution gave the following readings.

| Calcium / PPM | 6 | 16 |
|---|---|---|
| Emission Signal | 15 | 41 |

Calculate the concentration of calcium in PPM.

e) Write short note on Protein blotting method.

✦✦✦✦

**P583**        **[3823] - 52**

## M.Sc.

## PHYSICAL CHEMISTRY

### CH-410 : Molecular Structure

### (Old Course)

*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*   *All questions are compulsory.*

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

    *3)*   *Neat diagrams must be drawn wherever necessary.*

    *4)*   *Figures to the right side indicate full marks.*

    *5)*   *Use of logarithmic tables / calculator is allowed.*

### <u>Physico - Chemical Constants</u>

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following :                     **[15]**

    a)    Explain the terms - chemical shift, coupling constant, Larmor frequency and spin-spin relaxation in NMR spectroscopy.

    b)    Briefly discuss the quantum theory of nuclear magnetic resonance.

    c)    Discuss the advantages of recording nmr spectra at high frequencies.

    d)    Discuss the advantages of FT NMR.

    e)    What do you understand by NQR group frequencies? Explain their use in molecular structure determination.

**Q2)** Attempt <u>any three</u> of the following :                     **[15]**

    a)    What is g-value? Discuss the factors affecting the g-value.

    b)    Explain the principle of ESR spectroscopy. Why are microwave radiations used to observe ESR signals?

    c)    With the help of a schematic diagram, explain the technique for photo acoustic spectroscopy (PAS).

    d)    Explain the terms - Kramers degeneracy, Zero field splitting and hyperfine coupling constant in ESR studies.

    e)    State the MC Connell relationship and give its applications.

**Q3)** Attempt <u>any two</u> of the following :                     **[10]**

    a)    With a brief explanation, draw the schematic high resolution ESR spectra of the following species

        i)    $CH_3$

        ii)   $C_6H_6^-$

    b)    Calculate the frequency, required to excite proton from $m_1 = \dfrac{1}{2}$ to $m_1 = -\dfrac{1}{2}$. (Given : $g_N = 5.585$, H = 1.4 T)

    c)    The benzene radical anion has g = 2.0025. At what field should one search for resonance in a spectrometer operating at 9.302 GHz?

## SECTION - II

**Q4)** Attempt <u>any three</u> of the following :                     **[15]**

    a)    Give a brief account of Braggs method used in the elucidation of crystal structure. What are the limitations of Bragg's method?

    b)    State the phase problem, and out line the technique for overcoming it.

    c)    Discuss the limitations of the electron diffraction method.

d) Describe the experimental arrangement for the study of electron diffraction of gases.
e) State and explain the principle of X-ray spectroscopy.

**Q5)** Attempt <u>any three</u> of the following : **[15]**
a) Explain the working of Faraday balance with a suitable diagram.
b) Distinguish between diamagnetism and paramagnetism with suitable examples.
c) Derive Langevin equation for magnetic susceptibility.
d) What is electron diffraction? What are its advantages over XRD?
e) How will you determine the crystalline dimensions by the broadening of diffraction lines?

**Q6)** Solve <u>any two</u> of the following : **[10]**
a) Calculate the mass and volume paramagnetic susceptibilities of a sample of a complex salt with five unpaired electrons at 27°C.
(Given : $\rho = 3.24$ g cm$^{-3}$, molar mass = 200 g mol$^{-1}$)

b) X-rays with wavelength of 1.54 $\overset{o}{A}$ are used to calculate the spacing of (200) planes in aluminium. The Bragg angle for first order reflection is 22.4°. What is the size of A1 crystal?

c) Calculate glancing angle. (Given : $\lambda = 153.9$ pm, d = 400 pm, n = 1).

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**P584**　　　　　　　　**[3823] - 53**

## M.Sc.

## PHYSICAL CHEMISTRY

### CH-411 : Solid State and Surface Chemistry

### (Old Course)

*Time : 3 Hours]*　　　　　　　　　　　　　　　*[Max. Marks : 80*

*Instructions to the candidates:*

　　*1)　All questions are compulsory.*

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

　　*3)　Neat diagrams must be drawn wherever necessary.*

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

　　*5)　Use of logarithmic table / calculator is allowed.*

#### Physico - Chemical Constants

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following : **[15]**

a) Define the term imperfection and give their classification in detail.

b) Show that in an intrinsic semiconductor $E_0 = \frac{1}{2}(E_v + E_c)$.

c) Discuss with suitable example, how the forbidden band gap can be determined by studying optical properties of semiconductor.

d) Write a note on photo conductivity.

e) With neat sketch explain the piezoelectric effect and inverse piezoelectric effect.

**Q2)** Attempt <u>any three</u> of the following : **[15]**

a) Describe the different mechanism of diffusion in ionic crystals. How is ionic-conductivity related to diffusion coefficient?

b) Describe the various processes of electric break down in insulator.

c) Discuss the addition reactions in the solid-solid type reactions giving a suitable example.

d) Give the kinetics of decomposition reaction.

e) Describe the different crystal growth techniques from melt.

**Q3)** Solve <u>any two</u> of the following : **[10]**

a) The average energy required to create a Frenkel defect in an ionic crystal $A^{2+}B^{2+}$, is 1.4 eV. Calculate the ratio of the number of Frenkel defects at 20°C and 300°C in 1 g of the crystal.

b) Determine the value of the forbidden energy band gap at 27°C in crystal containing $10^{15}$ and $10^{22}$ holes and electrons per cubic meter respectively.

c) Calculate the diffusion coefficient of aluminium in Silicon at 1300°C. Given $\Delta H = 306.6$ KJ $mol^{-1}$, $D_0 = 1.55 \times 10^{-4}$ $m^2 S^{-1}$.

## SECTION - II

**Q4)** Attempt <u>any three</u> of the following : **[15]**

a) Derive two dimensional ideal gas law for dilute solutions.

b) Define the terms wetting and non wetting and explain it interms of contact angle and spreading coefficient.

c) Distinguish between physical adsorption and chemisorption.

d) Describe the mechanism of chemisorption.

e) Write Harkin-Jura equation and explain the terms involved in it. How is the surface area of solid determined by using this equation?

*Q5)* Attempt <u>any three</u> of the following :                                    **[15]**
   a)   Give a critical comparison of various models used for multilayer adsorption.
   b)   Explain the adsorption behaviour of porous materials.
   c)   Write a note on heterohomogeneous catalysis.
   d)   Give the names of catalyst for following heterogeneous catalysis
        i)    Hydrogenation.
        ii)   Oxidation.
        iii)  Hydrocracking.
        iv)   Oxychlorination.
        v)    Oxidation of ammonia to NO.
   e)   What are Zeolites? How they are used as molecular sieves?

*Q6)* Solve <u>any two</u> of the following :                                       **[10]**
   a)   The adsorption of a gas described by the Langmuir isotherm with K or a = 0.77 $(KPa)^{-1}$ at 25°C. Calculate the pressure at which the fractional surface coverage is 0.20.
   b)   Hexadecanol $C_{16}H_{33}OH$ has been used to produce monomolecular film on reservoirs to retard evaporation of water. If the cross-sectional area of alcohol in the closed packed layer is 0.20 $nm^2$, how many grams of the alcohol are required to cover a 10 acre (40,000 $m^2$) lake?
   c)   A fatty acid forms a surface film on water that obeys two dimensional perfect gas law. If the lowering of the surface tension is 10 x $10^{-3}$ $Nm^{-1}$ at 25°C, what is surface excess concentration and surface area per adsorbed molecule?

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**P585** [3823] - 54

## M.Sc.

## PHYSICAL CHEMISTRY

### CH-414 : Polymer Chemistry - II (Old)

*Time : 3 Hours]* *[Max. Marks : 80*

*Instructions to the candidates:*

1) *Answers to the TWO sections should be written in SEPARATE answer books.*

2) *ALL questions are COMPULSORY.*

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

*P.T.O.*

# SECTION - I

**Q1)** Attempt <u>any four</u> of the following :                                    **[20]**

    a)    What are Silicone polymers? Describe the properties and uses of silicone fluids, silicone elastomers and silicone resins.

    b)    Distinguish between LDPE and HDPE.

    c)    Discuss the elastomer forming properties of a polymer.

    d)    What are different types of spinning techniques? Why is melt spinning preferred over the others?

    e)    Describe the properties and uses of viscose rayon and cellophane.

    f)    What are the probable configurations of monomer units in a polymer chain? Which of these is the most probable? Why?

**Q2)** Attempt <u>any four</u> of the following :                                    **[20]**

    a)    Distinguish between thermoplastic and thermosetting polymers. Explain the behaviour of polymeric substances on heating.

    b)    'It is almost impossible to obtain a 100% crystalline polymer'. Explain.

    c)    Why polyvinyl carbazole has high glass transition temperature than polymethyl acrylate? Explain.

    d)    Discuss the structure, properties and applications of polystyrene.

    e)    Write the structure of most suitable polymer for the following application.

        i)    bearings.             ii)    textile fiber.

        iii)    blow molded bottles.      iv)    automotive lenses.

        v)    Wire and cabale insulation.

    f)    Write a note on : Polyesters.

# SECTION - II

**Q3)** Attempt <u>any four</u> of the following :                                    **[20]**

    a)    Describe, with a diagram, the reaction injection molding.

    b)    What are different types of spinning techniques? Why is melt spinning preferred over the others?

    c)    Describe the preparation of high density polyethylene.

    d)    Write a note on : Acetyl resins.

    e)    Discuss, with suitable examples, the formation of linear, branched and network polymers.

    f)    What are polyamides? Discuss the properties and application (fiber and plastic) of any one polyamide.

*Q4)* Attempt <u>any four</u> of the following :                                         **[20]**

    a)   Explain :

        i)    Cellulose trinitrate, has high $T_g$ ($53^{\circ}$C).

        ii)   $T_g$ of polystyrene is $100^{\circ}$C while that of poly ($\alpha$ methyl styrene) is $170^{\circ}$C.

    b)   Discuss the structure and properties of polystyrene.

    c)   Describe the process of dyeing a fiber.

    d)   Describe, with a neat diagram, the technique pultrusion.

    e)   Describe the variation of the specific volume of a polymeric substance with temperature.

    f)   Write a note on : Polyurethanes.

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**P585**           **[3823] - 54**

# M.Sc.

# PHYSICAL CHEMISTRY

## CH-415 : Environmental Pollution (Old)

*Time : 3 Hours]*                 *[Max. Marks : 80*

*Instructions to the candidates:*

*1) Answers to the TWO sections should be written in SEPARATE answer books.*

*2) ALL questions are COMPULSORY.*

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

*P.T.O.*

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## SECTION - I

**Q1)** Attempt <u>any four</u> of the following : **[20]**

    a)    Explain the biochemical effect of CO and NOx.

    b)    Describe in brief nitrogen cycle with a neat diagram.

    c)    What are pollutants? Explain the effect of air pollutants on health.

    d)    Write a note on : Atmospheric photochemistry.

    e)    Explain particle composition and its deliquescent behaviour.

    f)    What are different reservoirs? Explain the reservoirs with respect to mass and mixing time.

**Q2)** Attempt <u>any four</u> of the following : **[20]**

    a)    What is acid rain? Explain rain water composition.

    b)    Write a note on : Deposition mechanism.

    c)    Explain the term 'exposure' and 'absorption' with reference to effects of pollutants.

    d)    Define deposition velocity. Explain the dry and wet deposition of gases.

    e)    What is residance time? Discuss with reference to cyclic pathway in environment.

    f)    Discuss chemistry of pollutants in the lower atmosphere with reference to droplets.

## SECTION - II

**Q3)** Attempt <u>any four</u> of the following : **[20]**

    a)    Explain the pollution hazards of the following impurities in a water sample.

        i)    Phosphates.

        ii)    Arsenic.

        iii)    Fluorides.

    b)    Explain the sulphurous smog.

    c)    'Ozone layer is protective shield' explain.

    d)    Describe the procedure for estimating BOD and OD in water sample.

    e)    What is tolerance limit? Give an account of qualitative and quantitative examination of water.

    f)    Describe any two methods used for determination of hardness in water sample.

*Q4)* Attempt <u>any four</u> of the following :                                    **[20]**
   a)   What is COD? Explain the method for determining COD.
   b)   What is acidity of water? How is it determined?
   c)   Describe briefly how residual chlorine is estimated from water sample.
   d)   What is noise pollution? What is effect of it on human health?
   e)   Write a short note on : 'Green house effect'.
   f)   Describe 'Solvent extraction method' for determination of oil and grease.

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**P585** **[3823] - 54**

## M.Sc.

## PHYSICAL CHEMISTRY

### CH-416 : Special Topics in Physical Chemistry (Old)

*Time : 3 Hours]* *[Max. Marks : 80*

*Instructions to the candidates:*

1) *Answers to the TWO sections should be written in SEPARATE answer books.*

2) *ALL questions are COMPULSORY.*

3) *Figures to the RIGHTSIDE indicate FULL marks.*

4) *Use of logarithmic table / calculator is ALLOWED.*

5) *Neat diagrams must be drawn WHEREVER necessary.*

### Physico - Chemical Constants

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any four</u> of the following :                                                    **[20]**

    a)    Discuss the basis of classification of sensors according to

        i)    the materials used and

        ii)    the principle of conversion.

    b)    Write the charge balance and proton condition for 0.3 M $Na_2S$.

    c)    Write a note on potentiometric sensors.

    d)    Derive the expression for saturation kinetics of an enzyme - catalyzed reaction.

    e)    Explain the adsorption isotherm of type I and IV.

    f)    Write proton condition for $H_2C_2O_4$ and NaHS.

**Q2)** Attempt <u>any four</u> of the following :                                                    **[20]**

    a)    Find the concentration of $H_2CO_3$, $HCO_3^-$ and $CO_3^{2-}$.
        [Given : pH = 5.4, $Ka_1 = 4.47 \times 10^{-7}$, $Ka_2 = 5.62 \times 10^{-11}$]

    b)    Explain the catalysis in dilute aqueous solution.

    c)    Discuss general and specific acid - base catalysis?

    d)    Draw a logarithmic concentration diagram for 0.01 M $CH_3COOH$.
        [Given : $Ka = 1.85 \times 10^{-5}$]

    e)    What are active and passive sensors?

    f)    Write mass balance for

        i)    mercury.

        ii)    chlorine and

        iii)    saturated solution of $HgCl_2$ having solubility 'S' moles per litre.

## SECTION - II

**Q3)** Attempt <u>any four</u> of the following :                                                    **[20]**

    a)    Discuss the advantages and disadvantages of a thermister as a temperature measuring device.

    b)    Write a note on 'nano robot'.

    c)    State the four types of actuators. Give one example of each. Which actuator can produce maximum mechanical force?

    d)    Discuss the characteristics of actively smart materials.

    e)    Write a note on silicon rubbers.

    f)    What are the applications of aerosoles?

*Q4)* Attempt <u>any four</u> of the following :                                    **[20]**
   a)   Describe the chemical methods of synthesis of nanoparticles.
   b)   Explain how the active smart materials are used to reduce vibrations in a machine or a vehicle.
   c)   Explain why nano particles behave anamolously.
   d)   Explain the working of a scanning funneling microscope.
   e)   A galvanometer has 18 $\Omega$ internal resistance. It shows maximum deflection for 10 mA current. What should be the resistance of a shunt so that it can be used to measure 0.A current?
   f)   Write a note on resistance thermometer.

<center>✦ ✦ ✦ ✦</center>

**P586**                       **[3823] - 58**

**M.Sc.**

**ORGANIC CHEMISTRY**

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

**(2005 Pattern) (Old Course)**

*Time : 3 Hours]*                              *[Max. Marks : 80*

*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 in separate answer books.*

## SECTION - I

*Q1)* Outline the steps in any four of the following synthetic sequences. Indicate the reagent used & discuss the mechanism & stereochemistry involved.       **[16]**
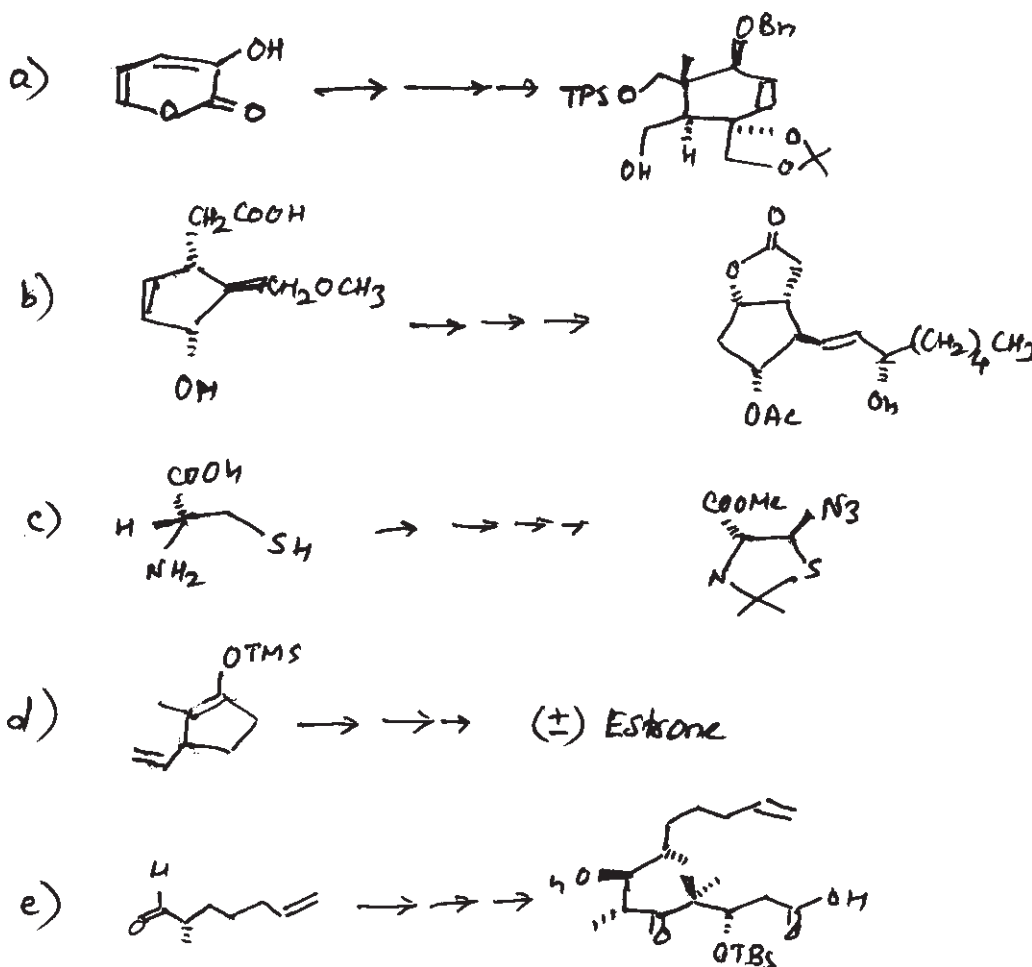
*Q2)* Give evidences to prove the presence of the following structural features (any three) **[12]**

a) Nature of double bond & position of methyl groups in the following compound 'A'
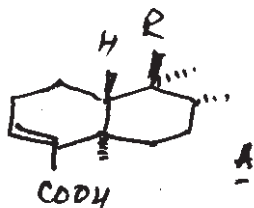


b) The presence of 1, 2, 4 - trioxane ring & its stereochemistry in Artemesinin.

c) Stereochemistry at $C_8$ & $C_9$ position of Hardwickiic acid.

d) Pyrolloquinoline ring in hydroxy camptothecin.

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

a) Variecolactone was synthesised via the steps shown below, explain the mechanisms for the steps involved.
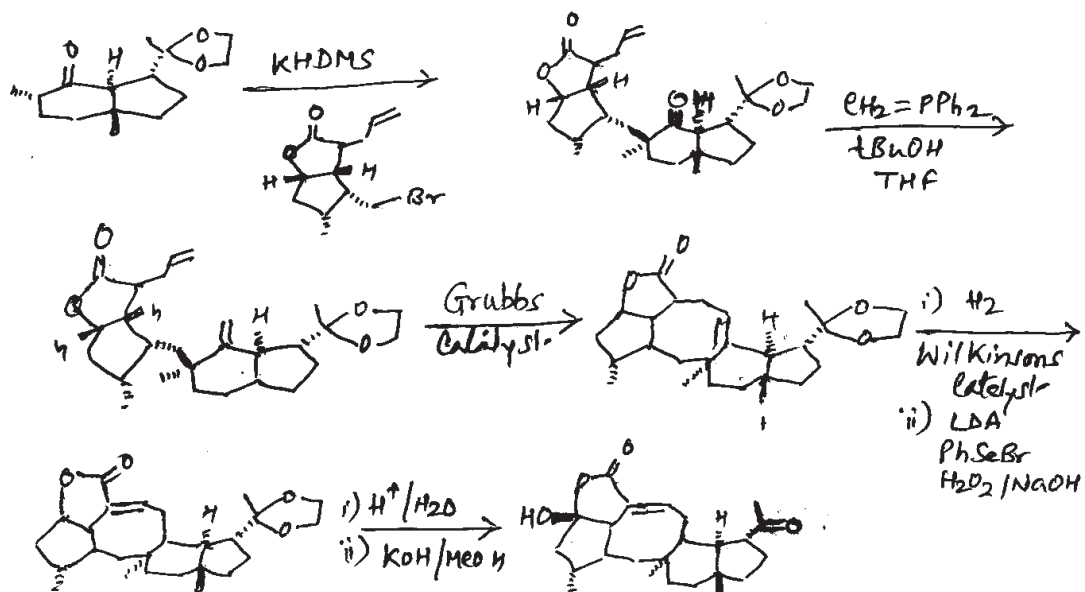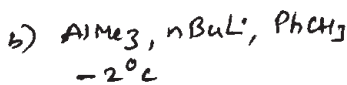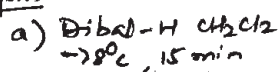


b) An intermediate for the synthesis of Zargozic acid was made by the following steps. Insert the appropriate missing reagents & explain the steps. (Reagents are shown below)

**Reagents**

a) Dibal-H CH₂Cl₂ −78°C, 15 min
b) AlMe₃, nBuLi, PhCH₃ −2°C
c) $\overset{O}{\underset{COOH}{\|}}P\overset{OCH_2CF_3}{\underset{OCH_2CF_3}{\diagdown}}$ KN(SM₃)₂, THF
d) tBuOOH, Ti(OiPr)₄ DIT, CH₂Cl₂ −20°C
e) [furan structure] ~MgBr COCl₂, DMSO −78°C
f) DDQ, CH₂Cl₂ Dibal H, CH₂Cl₂ −78°C → RT
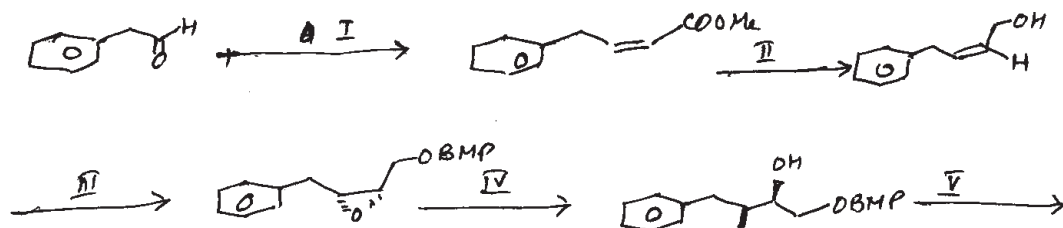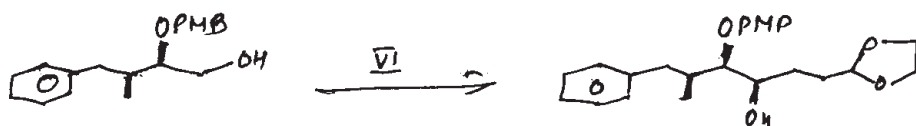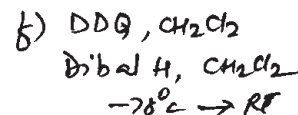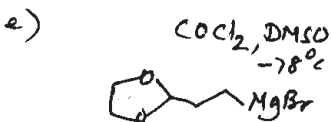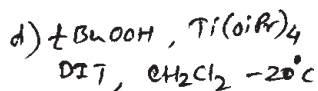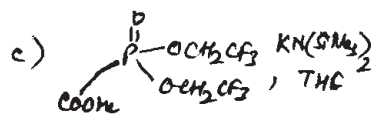
## SECTION - II

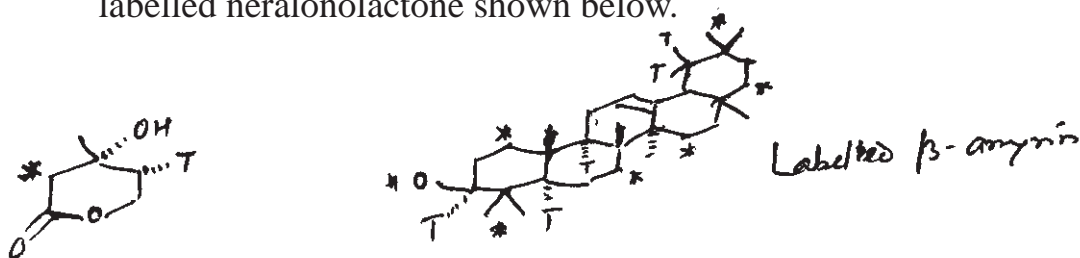**Q4) a)** Answer <u>any two</u> of the following : **[12]**

**i)** Give the steps in the biogenetic formation of the three compounds shown below. Labelling experiments demonstrate that DMAPP is an intermediate but geranyl or nerylphosphate are not. The scheme should explain the role of sulphur containing enzymes in all the three cases.
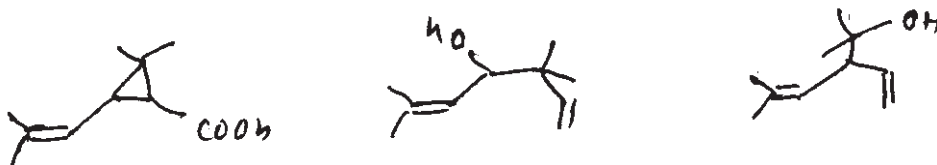


**ii)** The three compounds shown below cooccur. Suggest their biogenesis from farnesylpyrophosphate (FPP).
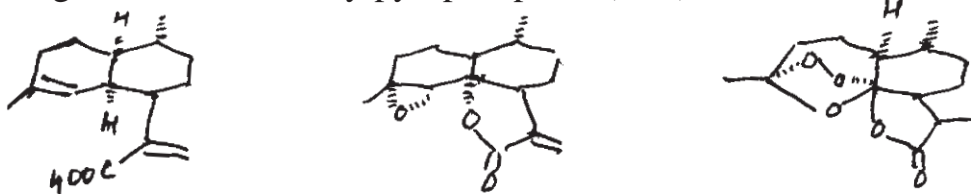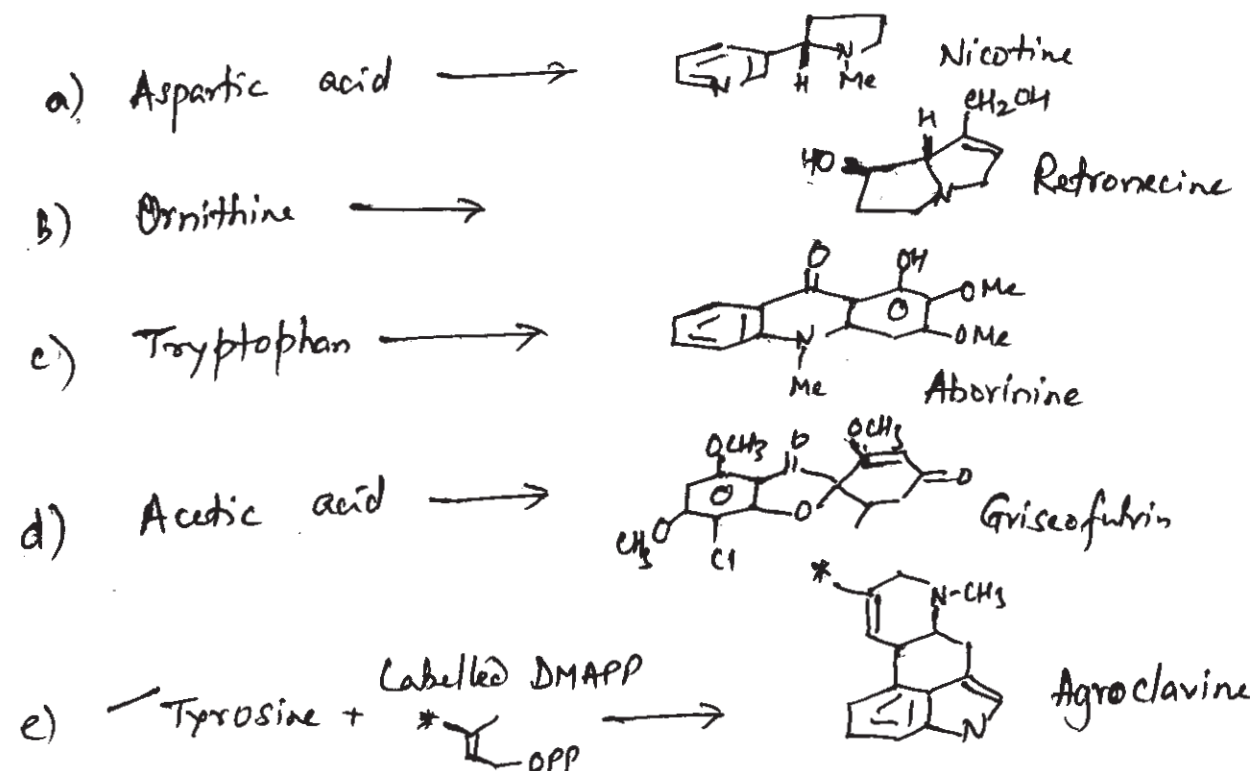


**iii)** Suggest the pathway for the biogenetic conversion of squalene to β-amyrin. The pathway should explain how the labelling pattern indicated in the structure of β-amyrin is obtained starting from the labelled neralonolactone shown below.



Labelled β-amyrin

b) Discuss in brief the role of oxidoreductase enzyme system in biosynthesis with suitable examples. **[4]**

**Q5)** Give biogenetic pathway for <u>any four</u> of the following : **[16]**

a) Aspartic acid ⟶  Nicotine

b) Ornithine ⟶  Retronecine

c) Tryptophan ⟶  Aborinine

d) Acetic acid ⟶  Griseofulvin

e) Tyrosine + Labelled DMAPP $\underset{\text{OPP}}{*\text{Y}}$ ⟶  Agroclavine

**Q6)** Answer <u>any two</u> of the following : **[8]**
   a) Explain the steps involved in conversion of Acetate to Geranyl pyrophosphate - discuss using $C_1$ & $C_2$ labelled acetate.
   b) Outline the steps in the conversion of lanosterol to cholesterol.
   c) Give a brief commentary on secondary metabolites of mixed biogenetic origin.

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**P589**                                    **[3823] - 61**

# M.Sc.

## BIOCHEMISTRY

**BCH-470 : Biochemical Endocrinology and Tissue Culture (New)**

**Biochemical Endocrinology and Plant Biochemistry (Old)**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

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

### SECTION - I

### Biochemical Endocrinology

*Q1)* Answer <u>any five</u> of the following :                                    **[15]**

   a) Explain the mechanism of action of hormone that acts Via intracellular receptor.

   b) Give the structural aspects of glucocorticoid hormone.

   c) Explain the biochemical reactions involved in estrogen and progestin synthesis.

   d) Give the physiological role of prolactin.

   e) How secretion of insulin is regulated?

   f) Give the pathogenesis of Grave's disease.

   g) Give the structural aspects of glycoprotein hormones.

*Q2)* Attempt <u>any three</u> of the following :                                    **[15]**

   a) Describe the metabolic conversions that are required to produce active form of calcitriol.

   b) Give the structural features and physiological functions of ACTH.

   c) Explain the defeciency manifestations of insulin and thyroid hormones.

   d) What do you understand the terms Osteomalacia, primary and secondary aldosteronism?

*Q3)* Answer <u>any two</u> of the following :                                    **[10]**

   a) Describe the structural features and physiological functions of GH.

   b) Discuss the physiological role and defeciency syndrome of mineralocorticoids.

   c) Explain, how insulin affects the gene expression?

## SECTION - II
### Tissue Culture (New)

*Q4)* Answer <u>any five</u> of the following :                                      **[15]**
  a)   Explain the term contact inhibition.
  b)   Describe various physical and chemical agents used for sterilization.
  c)   What are cytokinins? Explain their role in PTC with suitable example.
  d)   Enlist various types of equipments required for ATC lab.
  e)   Discuss the techniques used for tissue disaggregation.
  f)   What are transformed cells? Give the characteristics of transformed cells.
  g)   Give the disadvantages of serum when used in media.

*Q5)* Attempt <u>any three</u> of the following :                                   **[15]**
  a)   Explain in detail the different techniques used for production of somatic hybrids.
  b)   What are cell repositories? Give its maintenance and importance.
  c)   Explain the term organ culture? Describe the various methods involved in organ culture.
  d)   Discuss the technique and establishing and maintenance of fibroblast culture.
  e)   Discuss the process of callus culture and give its significance.

*Q6)* Write notes on <u>any two</u>                                                 **[10]**
  a)   Somatic embryogenesis.
  b)   Methods of cell preservation.
  c)   Anther culture.

## SECTION - II
### Plant Biochemistry (Old)

*Q7)* Attempt <u>any three</u> of the following :                                   **[15]**
  a)   Comment on cyclic and non cyclic electron flow in Photosynthetic system.
  b)   What are positive and negative aspects of fertilizers?
  c)   What is Plant breeding? Give applications of plant breeding in crop improvement with suitable examples.
  d)   Give the biochemical changes occuring during Seed germination.

*Q8)* Attempt <u>any three</u> of the following : **[15]**

    a)    What is plant defence? Give the role of defence components in this process.

    b)    What are plant hormones? Give their role in plant development.

    c)    What do you know about organ culture? Explain.

    d)    Discuss the role of nitrogenase system and nitrate reductase in plant.

*Q9)* Write short note on <u>any two</u> of the following : **[10]**

    a)    Somatic hybridization.

    b)    Polyploidy & Euploidy.

    c)    Plant diseases.

✦ ✦ ✦ ✦

**P590**　　　　　　　　**[3823] - 62**

# M.Sc.

# BIOCHEMISTRY

## BCH-471 : Fermentation & Enzymes Technology and Food Technology
### (New) (Sem. - IV) (Part - II)

*Time : 3 Hours]*　　　　　　　　　　　　　　　　*[Max. Marks : 80*

*Instructions to the candidates:*

　　*1)　All questions are compulsory.*

　　*2)　Draw neat diagrams wherever necessary.*

　　*3)　Figures to the right indicate full marks.*

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

### SECTION - I
### (Fermentation and Enzyme Technology)

*Q1)* Explain <u>any three</u> of the following :　　　　　　　　　**[15]**

　　a)　Continuous culture.

　　b)　Media optimization.

　　c)　Antifoams.

　　d)　Isolation of auxotropic mutants.

　　e)　Physical treatment of effluent.

*Q2)* Answer <u>any three</u> of the following :　　　　　　　　　**[15]**

　　a)　What are different nitrogen sources that are used in fermentation?

　　b)　What are the various methods of feedback control?

　　c)　What are the basic requirements for expression of foreign DNA in microbes?

　　d)　What are different steps involved in sterilization?

　　e)　How product is recovered by chromatographic techniques?

*Q3)* Write notes on <u>any two</u> :　　　　　　　　　　　　　　**[10]**

　　a)　Methods of maintainenance & preservation of culture.

　　b)　Encapsulation and covalent linking of enzyme immobilization.

　　c)　Oxygen requirement for industrial fermentation.

## SECTION - II
### (Food Technology)

**Q4)** Attempt <u>any three</u> of the following :  **[15]**

    a)    Explain why Brown bread is better preferred than white bread?

    b)    'Monitoring of food quality is essential'-Why?

    c)    What are genetically modified foods? Give their consequences.

    d)    Explain the role and significance of various food preservatives.

**Q5)** Attempt <u>any three</u> of the following :  **[15]**

    a)    "SCP are unconventional source of good proteins", Justify the statement.

    b)    Discuss in detail the process of preparation of clear and cloudy juice.

    c)    How different enzymes are used in food analysis? Explain with suitable examples.

    d)    Write a short note on : Food spoilage.

**Q6)** Write short notes on <u>any two</u> of the following :  **[10]**

    a)    OCP.

    b)    Flavouring agents.

    c)    Sweetners.

✦ ✦ ✦ ✦

**P591**                                    **[3823] - 69**

**M.Sc. (Sem. - III)**

# DRUG CHEMISTRY

**CH-361 : Chemistry of Heterocycles & Biologically Active Compounds**

**(2005 Pattern) (Old)**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

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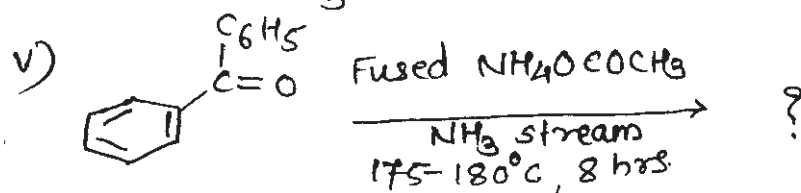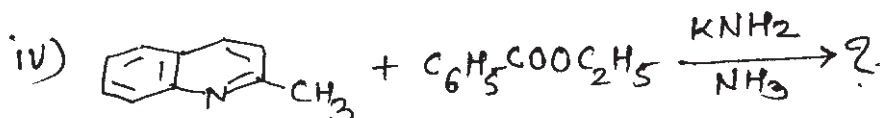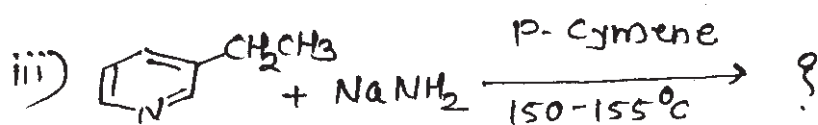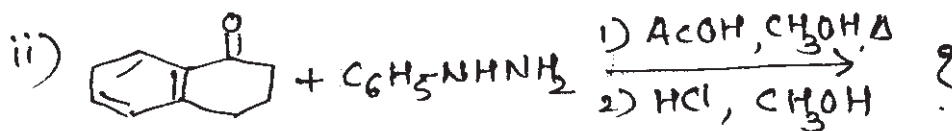3) *Answers to the two sections should be written in separate answer books.*

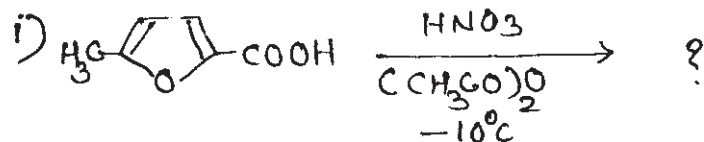## SECTION - I

*Q1)* Explain <u>any four</u> of the following :                                    **[12]**

   a) 4-Chloro-3-nitropyridine hydrolyzes readily in warm water.

   b) Indole on reaction with chloroform, KOH and ethanol as a solvent gives 3-chloroquinoline as one of the product.

   c) Electrophilic substitution reaction occurs at C-2 in pyrrole & at C-4 in 1, 2 azoles.

   d) Coumarin is easily attacked by electrophilic as well as nucleophilic reagents.

   e) Electrophilic substitution in pyrimidine occurs at C-5 position.

*Q2)* Suggest the suitable mechanism for <u>any four</u> of the following conversions :



**[12]**
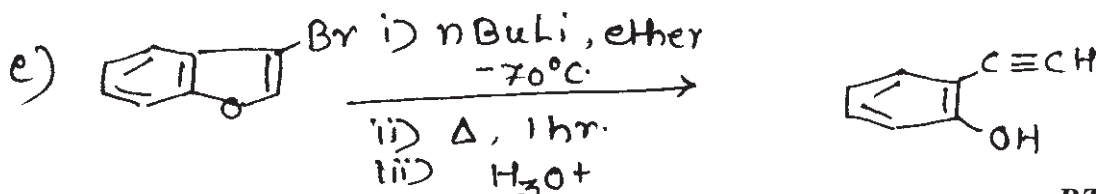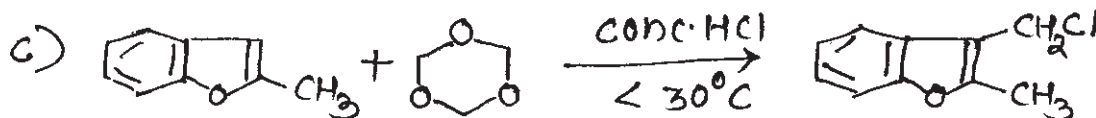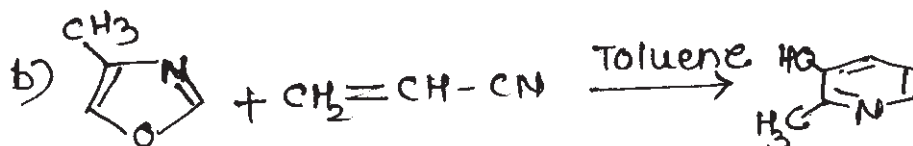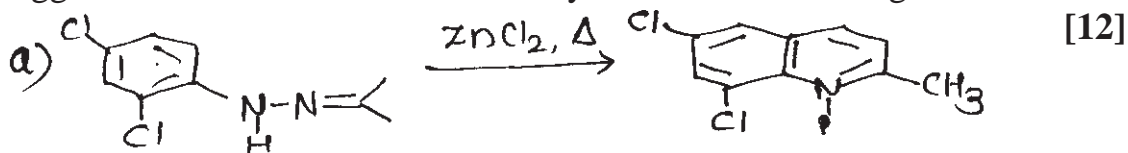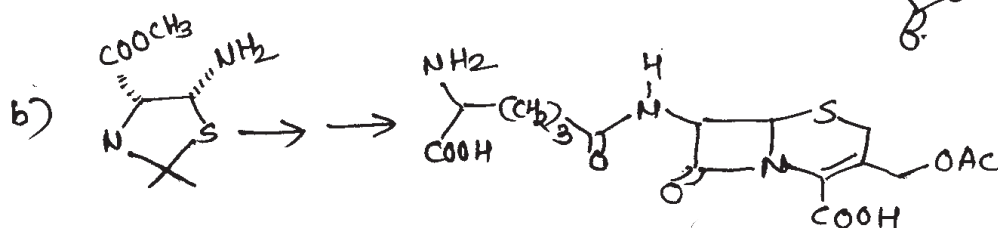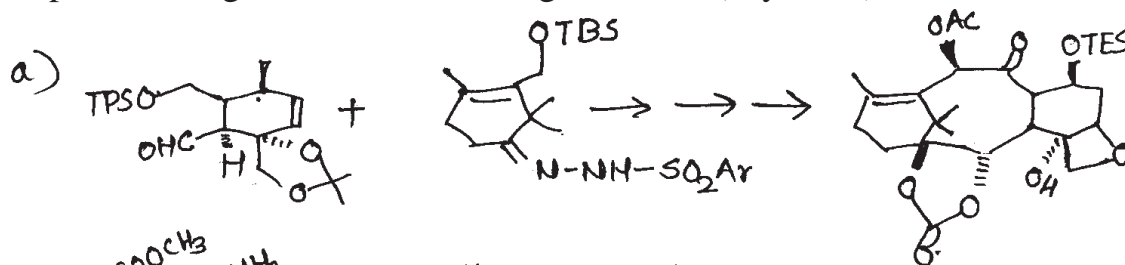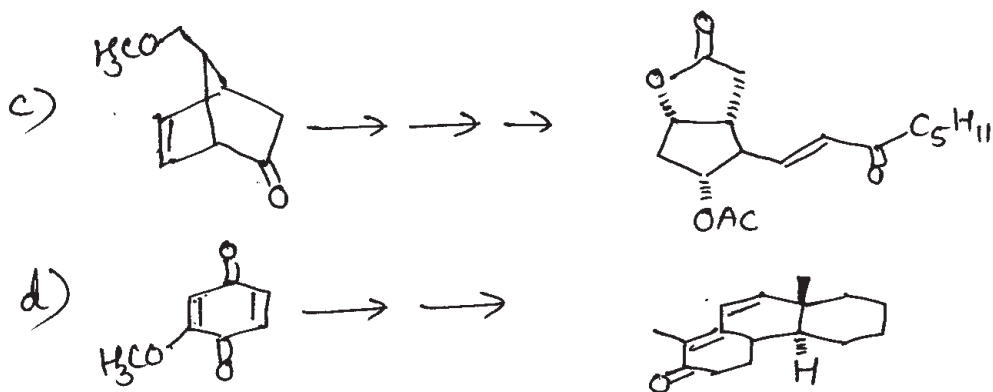
*Q3)* a)   Discuss <u>any two</u> of the following :                                  [7]
   i)    Hinsberg Thiophene synthesis.
   ii)   Reissert Indole synthesis.
   iii)  Pomeranz Fritsch synthesis.

   b)   Predict the products with mechanism (any three) :             [9]

i) $H_3C$—furan—$COOH$ $\xrightarrow[\substack{(CH_3CO)_2O \\ -10^\circ C}]{HNO_3}$ ?

ii) indanone $+ C_6H_5NHNH_2$ $\xrightarrow[\substack{2)\ HCl,\ CH_3OH}]{1)\ AcOH,\ CH_3OH,\ \Delta}$ ?

iii) pyridine—$CH_2CH_3$ $+ NaNH_2$ $\xrightarrow[150-155^\circ C]{P\text{-}Cymene}$ ?

iv) indole—$CH_3$ $+ C_6H_5COOC_2H_5$ $\xrightarrow[NH_3]{KNH_2}$ ?

v) benzene—$\overset{C_6H_5}{\underset{}{C}}=O$ $\xrightarrow[\substack{NH_3\ stream \\ 175-180^\circ C,\ 8\ hrs.}]{Fused\ NH_4OCOCH_3}$ ?

## SECTION - II

*Q4)* Discuss the steps involved in the following transformations. Comment on the steps indicating mechanism and reagents used. (any three).          [15]

a) [structure with TPSO, OHC, H groups] $+$ [structure with OTBS, N-NH-SO$_2$Ar] $\rightarrow \rightarrow \rightarrow$ [structure with OAc, OTES, OH groups]

b) [structure with COOCH$_3$, NH$_2$, N, S] $\rightarrow \rightarrow$ [structure with NH$_2$, (CH$_2$)$_3$, COOH, N, S, OAc, COOH]

c)

d)

**Q5)** Discuss the steps involved in the synthesis of following drug molecules. Explain the mechanism (any four) : **[16]**

a)

b) $H_2N-\overset{O}{\overset{\|}{C}}-NH_2 \longrightarrow \longrightarrow$

c) $MeO-C\equiv C-H \longrightarrow \longrightarrow$
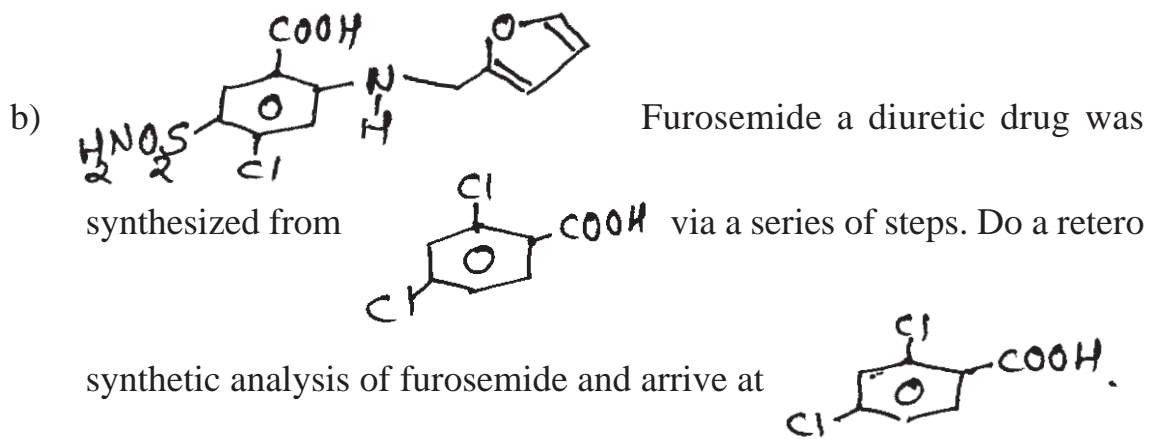
d)

e)
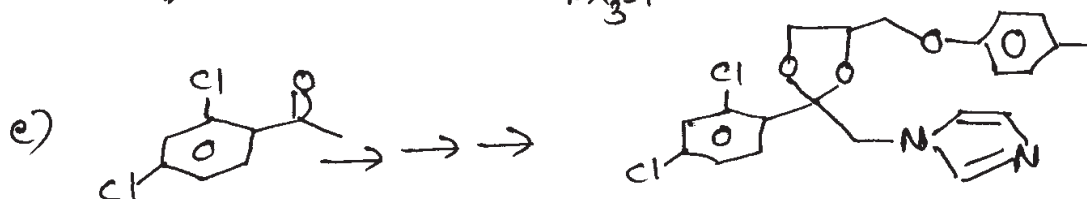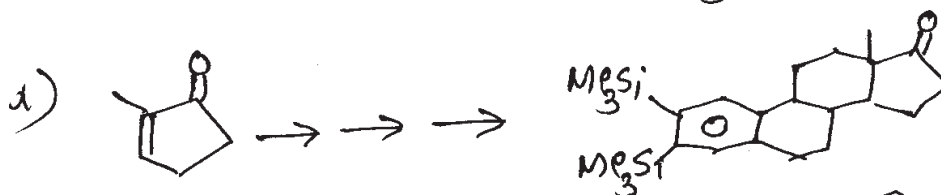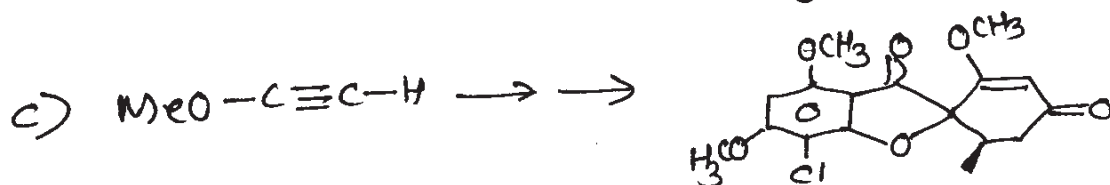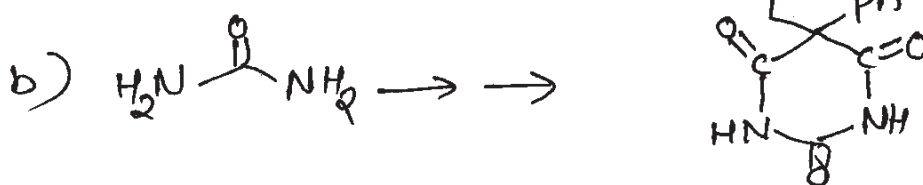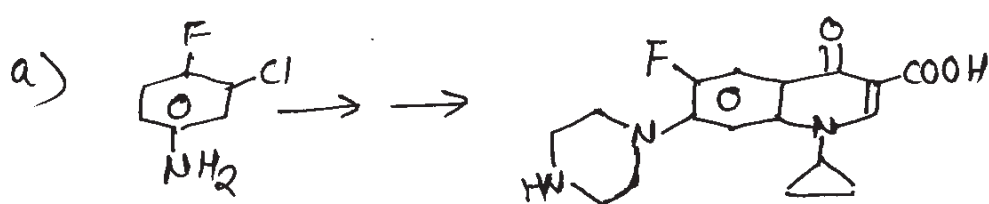
*Q6)* Answer <u>any two</u> of the following : [9]

   a) Explain the following (any two) :

      i) Ring closing metathesis & its application.

      ii) Boron template strategy for Diels-Alder Reaction.

      iii) McMurry coupling.

   b)  Furosemide a diuretic drug was synthesized from  via a series of steps. Do a retero synthetic analysis of furosemide and arrive at .

     Discuss the synthetic route.

   c) Insert the missing reagents in the following sequence of reactions. Explain the steps with mechanism.



✦ ✦ ✦ ✦

       **[3823] - 70**

# M.Sc.
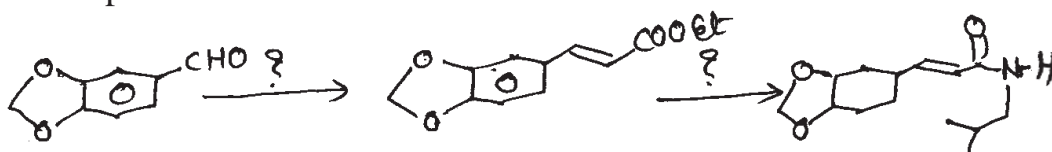
## DRUG CHEMISTRY

### CH-362 : Advanced Analytical Methods

### (2005 Pattern) (Old)
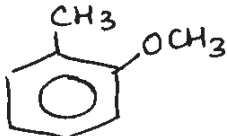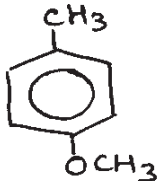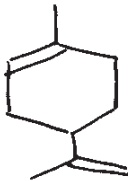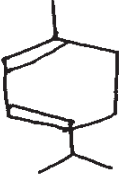
*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates:*

     *1)*    *All questions are compulsory.*

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

     *3)*    *Figures to the right indicate full marks.*

## SECTION - I

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

b) Explain <u>any two</u> of the following : **[4]**
   i) Axial-equatorial coupling is smaller than axial-axial coupling in cyclohexane system.
   ii) Dimethyl sulphoxide $d_6$ shows seven lines in $^{13}C$ NMR at $40.1\,\delta$.
   iii) Lanthenide shift Reagents could be used to simplify a complex spectra of a molecule with polar functional group.

*Q2)* Answer <u>any four</u> of the following : **[16]**
   a) Deduce the structure from the mass spectral data.
      M.F.  $C_7H_{14}O$
      Mass : m/e(%)  114(10) 85(20) 72(20) 57(100) 29(70)
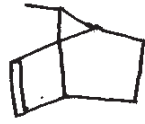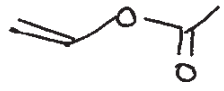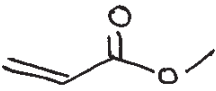   b) Deduce the structure from the given spectral data
      M.F.  :  $C_{11}H_{11}NO_2$
      IR    :  1707 cm$^{-1}$
      Mass  :  189, 107, 91, 55
      PMR   :  7.3(d, 8Hz, 2H); 7.1(d, 8Hz, 2H); 2.8(s, 4H); 2.4(s, 3H)
      CMR   :  176(s) 139(s) 130(d, str.) 129(s) 126(d, str.) 30(t, str.) 22(q)
   c) Deduce the structure and justify your answer
      M.F.  :  $C_{10}H_{14}$
      Mass  :  m/e(%) 134(M$^+$, 20) 119(8) 105(100) 77(10)
      CMR   :  148(s) 129(d) 128(d) 126(d) 42.3(d) 31(t) 22(q) 12(q)
      PMR   :  7.1(m, 5H); 2.5(apparent sextet, 7Hz, 1H); 1.6(apparent quintet, 7Hz, 2H); 1.22(d, 7Hz, 3H); 0.81(t, 7Hz, 3H)
   d) Find the probable structure using following spectral data
      M.F.  :  $C_7H_9NO$
      PMR   :  2.1(s, 3H); 3.92(s, 3H); 6.10(dd, 2.5 & 3.5 Hz, 1H); 6.77(dd, 3.5 & 1.5 Hz, 1H); 6.92(dd, 2.5 & 1.5 Hz, 1H)
   e) Deduce the structure
      M.F.  :  $C_6H_{11}N$
      CMR   :  4.1(q); 16.1(t); 32.5(t); 41.2(t); 75.9(s); 78.5(s)
      PMR   :  1.45(bs, 2H, exch.); 1.63(m, 2H); 1.78(s, 3H); 2.2(t, 7.1Hz, 2H); 2.8(t, 6.8 Hz, 2H)

*Q3)* Write short notes on <u>any three</u> of the following : **[12]**
   a) DEPT Technique in CMR.
   b) HETCOR.
   c) Double focussing Mass spectrometer.
   d) Factors affecting geminal coupling constants.

*Q4)* a) Write the genesis of the ions given below (any three) :　　　　**[9]**

i) 　　　96, 95, 81, 53, 43
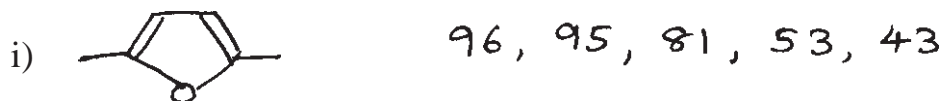
ii) Ethyl isobutyl ether  102, 87, 73, 59, 57, 45, 31.

iii) 2 - Methyl 3 - heptanone  128, 86, 85, 71.

iv) n - butyl benzene  92, 91, 77, 65.

b) Three isomeric compounds with M.F. $C_6H_{14}O$. Show base peak at 56, 45, 59 respectively. Write the three structures and justify your answer.

**[3]**

*Q5)* a) Assign the signals given below to the various protons in compound $\underline{X}$. Use the spin decoupling data for assignments and justify your answer.
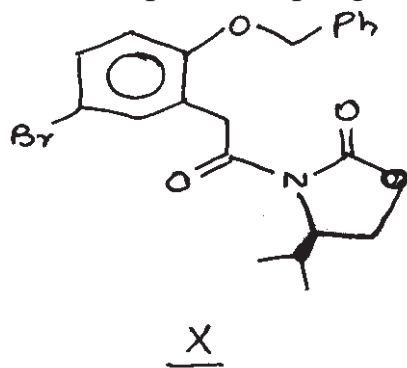


7.35 - 7.38 (m, 7 H); 6.79 (d, 8.7 Hz, 1 H)

5.05 (d, 11.7 Hz, 1 H); 5.0 (d, 11.7 Hz, 1 H)

4.21 (d, 17.5 Hz, 1 H); 4.31 (m, 1 H)

4.18 (d, 17.5 Hz, 1 H); 4.14 (dd, 9.1 & 3 Hz, 1 H)

4.07 (t, 9 Hz, 1 H); 2.29 (m, 1 H)

0.85 (d, 7.1 Hz, 3 H); 0.77 (d, 7 Hz, 3 H)

Spin decoupling Expt :

| Irradiate at | Change at |
|---|---|
| 4.31 $\delta$ | 2.29 (septet) |
| | 4.14 (d, 9.1 Hz) |
| | 4.07 (d, 9.1 Hz)　　**[8]** |

b) Answer <u>any two</u> of the following :　　　　　　　　　　　　**[8]**

i) Draw the schematic diagram of double focussing mass spectrometer and explain the working of the magnetic analyzer.

ii) Draw the schematic diagram of HPLC and describe the factors responsible for resolution.

iii) Define the following :

1) Theoretical plates.

2) Reverse phase chromatography.

*Q6)* A compound shows spectral information provided on the next page. Deduce the structure and Justify your answer.　　　　　　　　　　**[12]**

IR: 1720, 1620
1580, 1560
1508, 1464
1125 cm⁻¹

M.F.: $C_{10}H_8O_3$

DEPT-90

DEPT-135

NORMAL CARBON

CDCl₃

COSY

CDCl₃

(ppm)

(ppm)

(ppm)

✦ ✦ ✦ ✦

**P593**                    **[3823] - 71**

# M.Sc.

## DRUG CHEMISTRY

### CH-363 : Drug Development

### (2005 Pattern) (Old Course)

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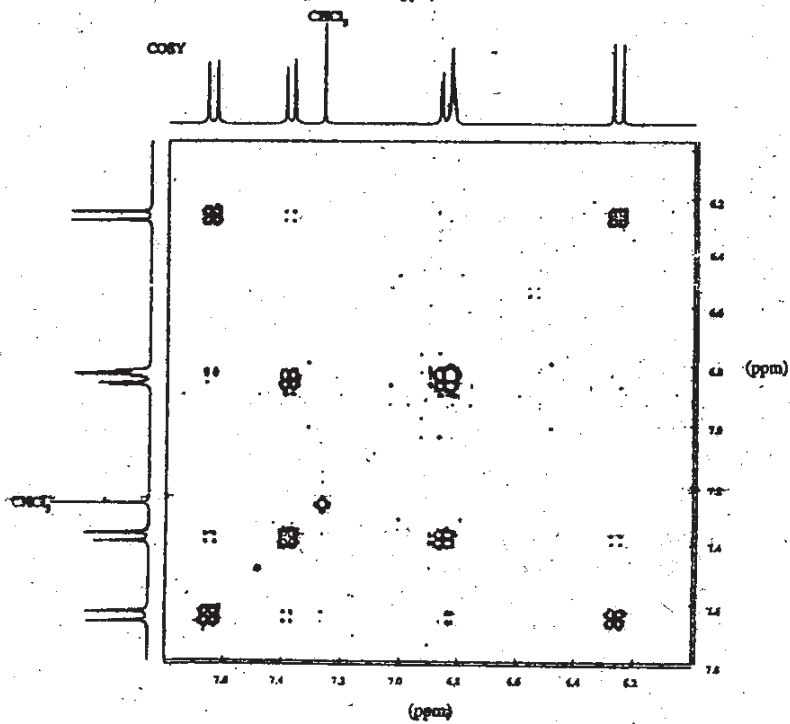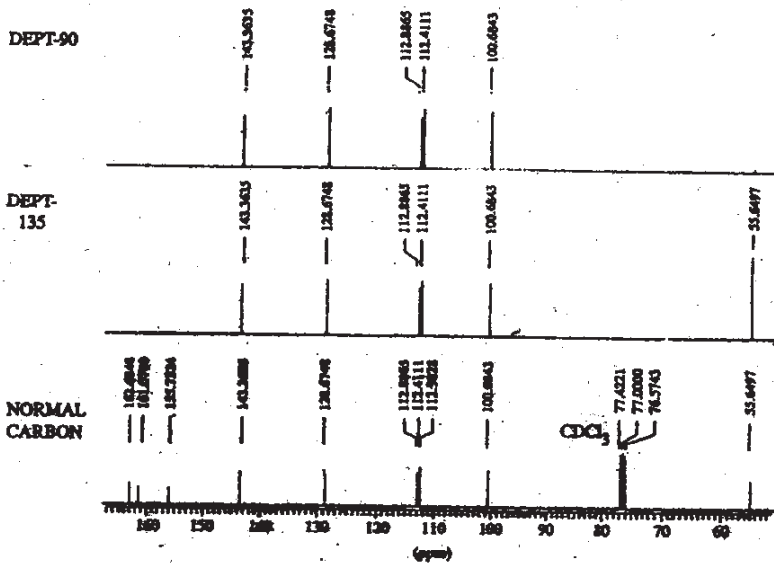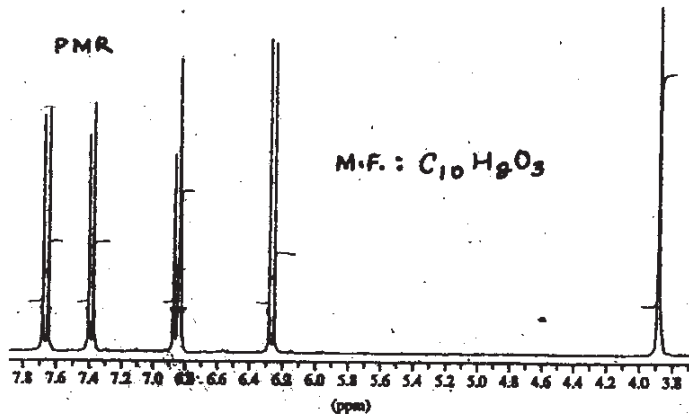
*Instructions to the candidates:*

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

## SECTION - I

*Q1)* Answer <u>any three</u> of the following :                    **[15]**

    a)    Define complex and synthetic medium. Give composition of a typical complex medium used in bacteriology.

    b)    List the different components of a fermenter and explain role of any two.

    c)    What is antimicrobial assay? How is it performed?

    d)    Why effluent form industrial fermentation processes are to be chemically & biologically treated before its disposal?

    e)    How bacteria are classified based on requirement of 'C' & energy source?

*Q2)* Answer <u>any three</u> of the following :                    **[15]**

    a)    Differentiate between innate and adaptive immunits.

    b)    Explain briefly passive immunity.

    c)    Define following terms :

        i)    Fever.

        ii)    Immunugen.

        iii)    Phagocytosis.

    d)    Comment on classical pathway of complement activation pathway.

    e)    Explain role of cytokines in immune response.

*Q3)* Answer <u>any two</u> of the following :                    **[10]**

    a)    Give a brief account of drugs obtained by serentipitious discovery.

    b)    Explain the concept of rational drug discovery. Discuss in brief how this is achieved.

    c)    Explain in brief :

        i)    Pharmacological assays.

        ii)    Enzyme assay.

        iii)    Antimicrobial assay.

## SECTION - II

*Q4)* Answer <u>any three</u> of the following :                                [18]

    a)   Discuss in brief ADME of drug action. What are the ways to improve the drugs bioavailability?

    b)   Explain the following terms :

       i)   Lead.              ii)   Pharmacophore.

       iii)  $ED_{50}$.           iv)  Antagonist.

       v)   Allosteric inhibition.     vi)  SAR.

    c)   Explain in brief the following toxicological evaluation

       i)   $LD_{50}$.          ii)  Mutagenicity.

       iii)  Teratogenicity.      iv)  Hepatotoxicity.

    d)   Discuss in brief the various routes of drug administration. What properties of the drug dictates which route of administration should be followed? Why are some drugs given sublingually?

*Q5)* Answer <u>any two</u> of the following :                                [14]

    a)   Explain in brief the design & conduct of clinical trials. Discuss the role of FDA, Principal Investigator & Institutional review boards. What are the objectives of phase II? How does the outcome of phase II affect the further studies?

    b)   Give an account of Intellectual Property Rights? What are the benefits if an NCE is patented? Explain in brief the terms in provisional specification?

    c)   Discuss in brief how a chemical process for drug synthesis is selected, developed & made into a industrial process. Critically explain the roles of various departments involved.

*Q6)* Answer <u>any two</u> of the following :                                [8]

    a)   Explain Xenobiotic metabolism process.

    b)   Strategies involved in lead development.

    c)   Role of computers & databases in drug discovery.

✦ ✦ ✦ ✦

**P594**                        **[3823] - 72**

## M.Sc.

## DRUG CHEMISTRY

### CH-364 : Stereochemical Principles and Applications
### (2005 Pattern) (Old)

*Time : 3 Hours]*                        *[Max. Marks : 80*

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

### SECTION - I

*Q1)* Answer the followings :                        **[16]**
  a) How many unsubstituted structural isomers for the following fused compounds are possible.
     i)   Bicycloheptanes.
     ii)  Bicyclooctanes.
     Give systematic names to each isomer.
  b) State and explain conformational rule? Why this rule is not applicable to alkyl cyclohexanol?
  c) Estimate the energy difference between (A) & (B) conformations of trimethyl cyclohexanes.
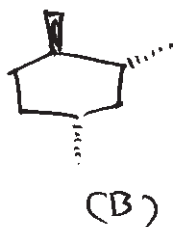


  d) Neomethyl chloride undergoes base catalysed de elimination 200 times faster than methyl chloride.

*Q2)* Predict the product/s and explain the stereochemical principles involved. (any four)                        **[12]**

b)


$\xrightarrow{HNO_2/H^{\oplus}}$ ?

c)


$\xrightarrow{H_2/Ni}$ ? + ?

d)


$\xrightarrow{CH_3OH}$ ? + ?

e)


$\xrightarrow{OsO_4}$ ?
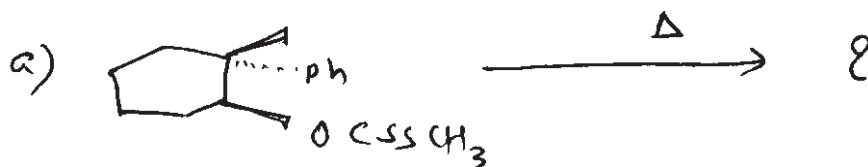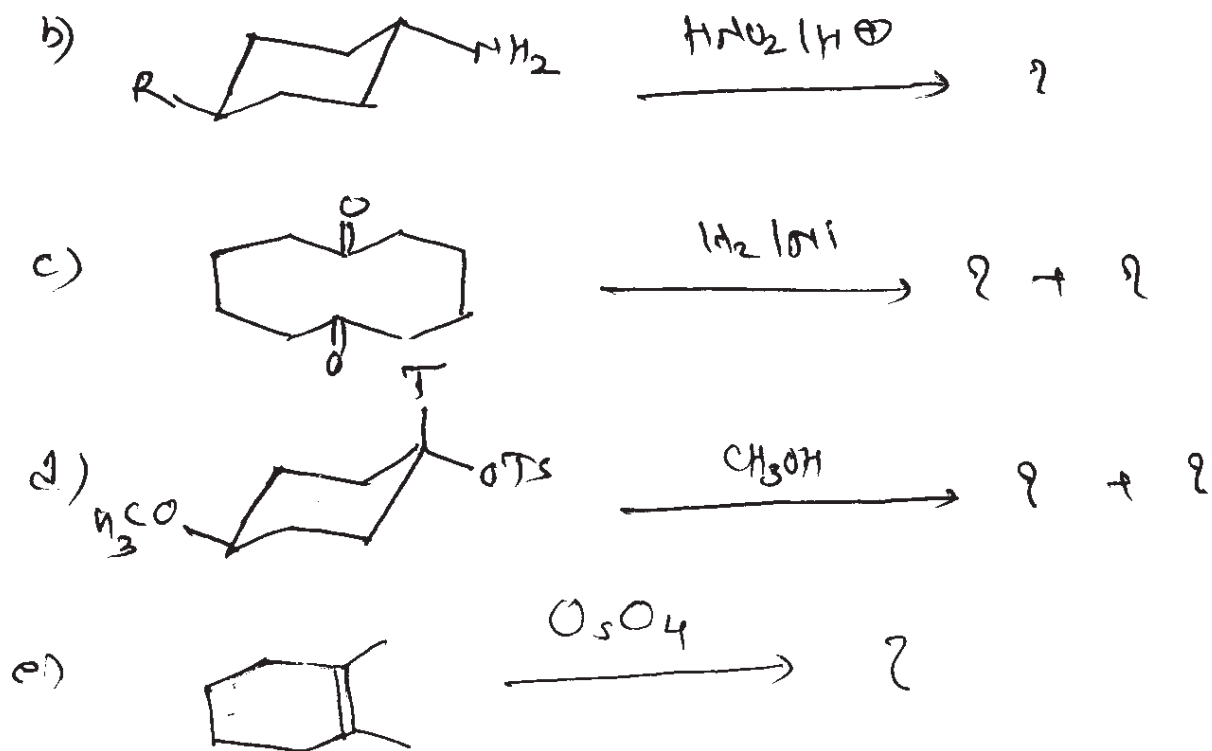
Q3) Write short note on (any three) :                                                          [12]
   a)   Alder rule.
   b)   Effect of trans annular interaction on IR and UV spectra of the compound.
   c)   2 - Alkylketone effect.
   d)   I - strain.

## SECTION - II

Q4) Attempt the followings :
   a)   Using Octant rule predict the sign of cotton effect (any two).          [4]



(Steriodal Conformation)
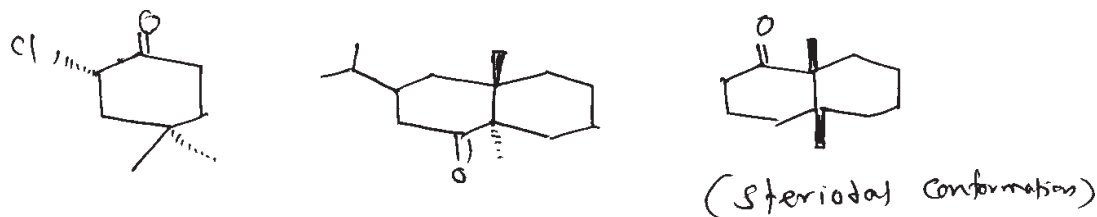
   b)   Explain the following terms (any two) :                                      [4]
   i)    Circular dichroism (CD).
   ii)   Curve with –ve cotton effect.
   iii)  Plane curve.
   c)   Write structure of Re and Si faces for compound '(A)'
        Ph(CH$_3$)CH CO CH$_3$      OR      PhCOCH$_3$                             [3]
           (A)

d) Calculate diastereomeric excess in the following reaction : **[2]**
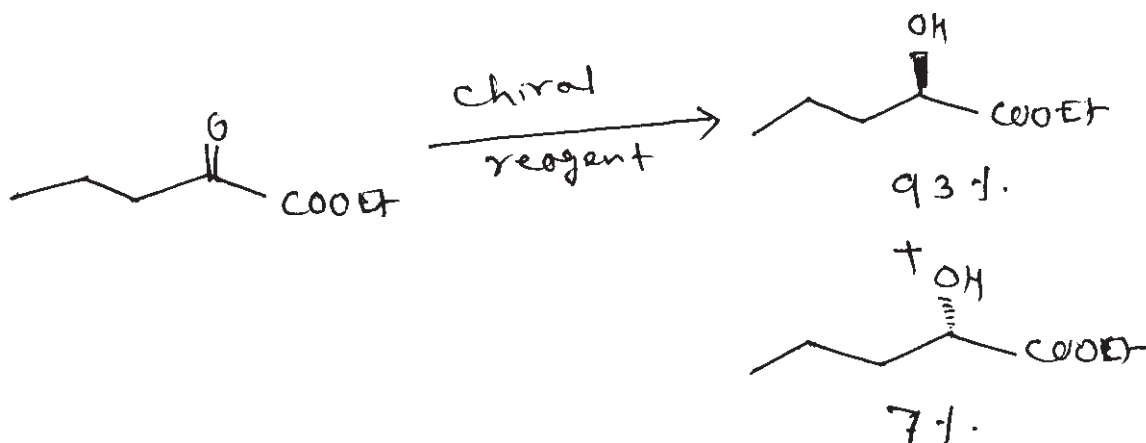


e) Using Cram's rule explain the mechanism giving major and minor products. **[3]**
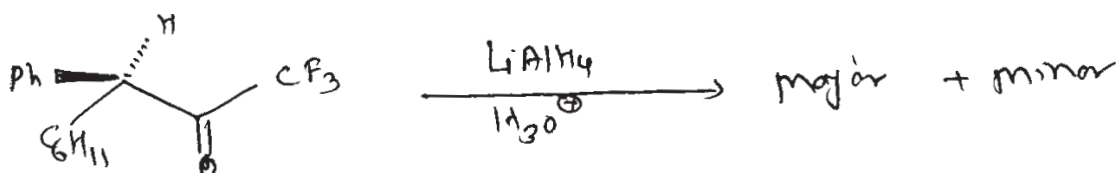


**Q5)** a) Consider the cycloaddition of two molecules of Cis-2 butene to produce 1, 2, 3, 4 - tetramethylcyclobutane. What are the products of **[3]**

i) Supra-supra cycloaddition?

ii) Supra-antra cycloaddition?

b) Deduce Con/dis rotatory motions involved in the following processes. Indicates the conditions. **[3]**
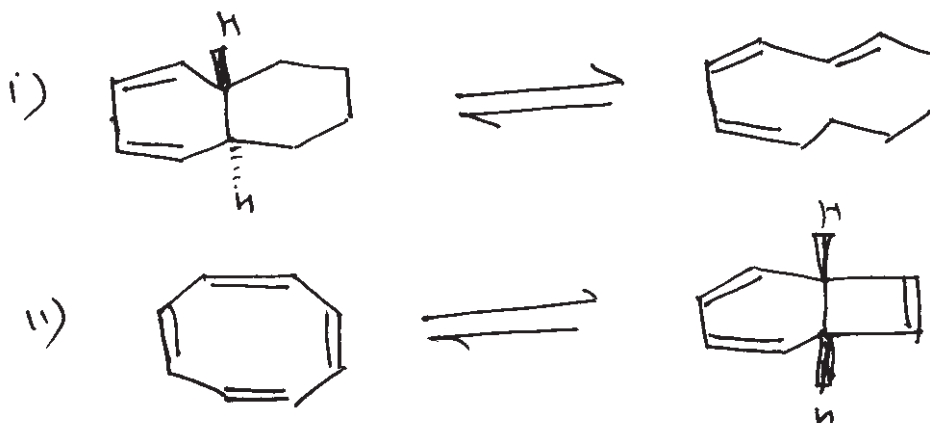


c) Predict the product/s in the following reactions (any two) : **[6]**

ii)  $\xrightarrow{\Delta}$ ?

iii)  $\xrightarrow{\Delta}$ ?
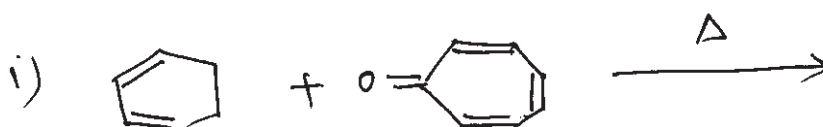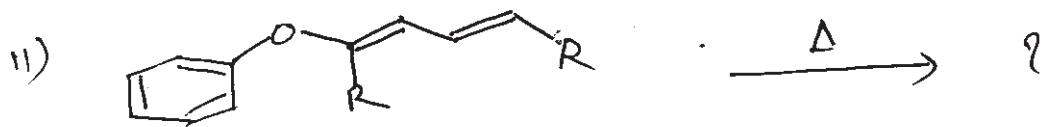
**Q6)** Complete the following reactions. Write their mechanism (any four) : **[12]**

a)  $\xrightarrow[\text{ii) LAH}]{\text{i) TsCl}}$ A $\xrightarrow{\text{LAH}}$ ? $\xrightarrow{\text{B}_2\text{H}_6}$ C

iii) B$_2$H$_6$

b)  $\xrightarrow[\text{H}_2 \text{ Cat.}]{\text{ZnCl}_2}$ ?

c)  $\xrightarrow[\substack{(S)-BNAAP \\ RuCl_2}]{H_2}$ ?

d)  $\xrightarrow[\text{ii) LiOBn}]{\text{i) cyclopentadiene}}$ ?

e)  $\xrightarrow[\text{Glucose}]{\text{baker's yeast}}$ major product ?

✦✦✦✦
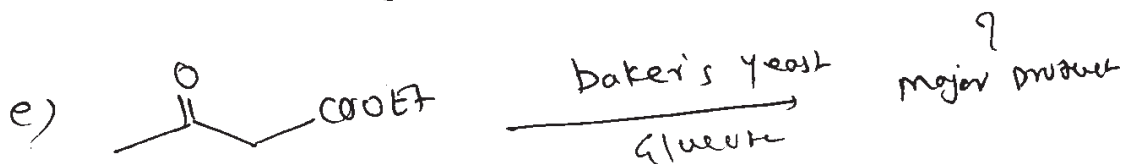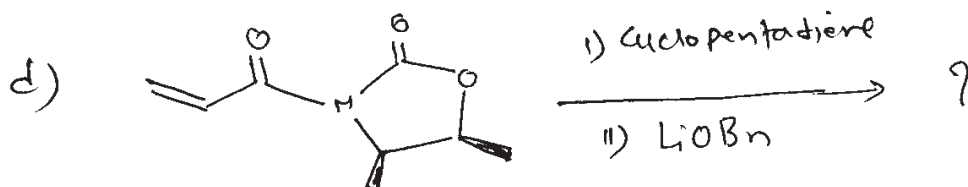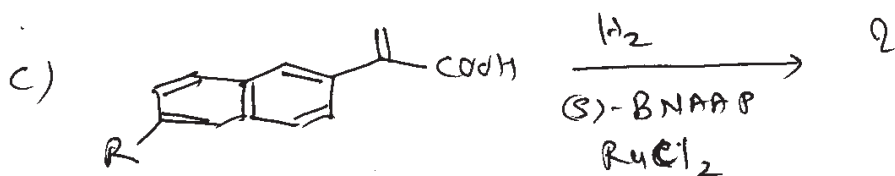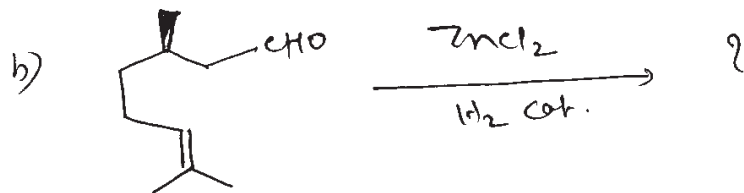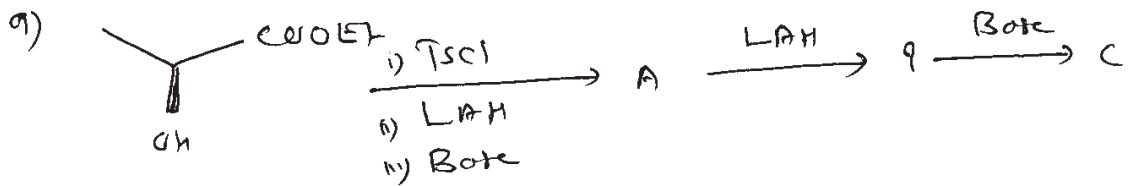
**P1015**

**[3823]-55**

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CH - 430 Inorganic Solids, Heterogeneous Catalysis & Structural Methods**

**(Revised) (Sem. - IV)**

*Time : 3 Hours]*                                                    *[Max. Marks :80*

*Instructions to the candidates:*
1) *All questions are compulsory.*
2) *Answers to the two sections should be written in same answer book.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of logarithmic tables and calculators is allowed.*

### SECTION - I

*Q1)* Answer the following (any four):                                    **[16]**

   a)  What are inorganic polymers? List their characteristic features.

   b)  Explain with suitable chemical reactions, the reactions of poly-organo-siloxanes.

   c)  Write a note on ultramarines.

   d)  Giving suitable schemes explain the synthesis of porphinoid and corrinoid compounds.

   e)  Discuss the use of NMR technique to explain the structure of borane compounds.

*Q2)* Answer the following (any four):                                    **[16]**

   a)  What do you understand by "Zeolites"? Give suitable examples of zeolites and explain the characteristics of zeolite framework.

   b)  What is meant by Heterogeneous catalysis? Explain the formation of Ammonia from Nitrogen and Hydrogen which is the catalyst used in this process?

   c)  i)   Define the terms.
       1) Carboranes   2) Polyboranes   3) Polyphosphates
       ii)  Give a brief account of the framework of bonding orbitals of closo-$CB_5H_6$.

   d)  Write in details about the double silicate structure with suitable examples.

   e)  Write an account of Heteropolyanions of Molybdenum.

                                                                    *P.T.O.*

**Q3)** Attempt any two. [8]

a) Fill in the blanks.
   i) $B_5H_{11} + 2CO \rightarrow H_3BCO + ?$
   ii) $HN = PCl_3 + [PCl_4]^+ [PCl_6]^- \rightarrow ?$
   iii) $S_4N_4 + Ag \rightarrow ?$
   iv) $B_3N_3H_6 + Br_2 \rightarrow ?$

b) Complete the reactions and explain the type of reaction involved.

   i)

   

   ii)

   

c) Draw the structures of

   $[Ta_6O_{19}]^{8-}$; $[(NPCl_2)_5]$; $[S_4N_4]^{2+}$; $[Pt_{19}(CO)_2]^{+4}$
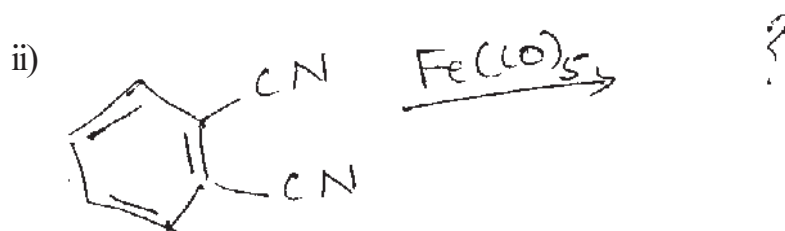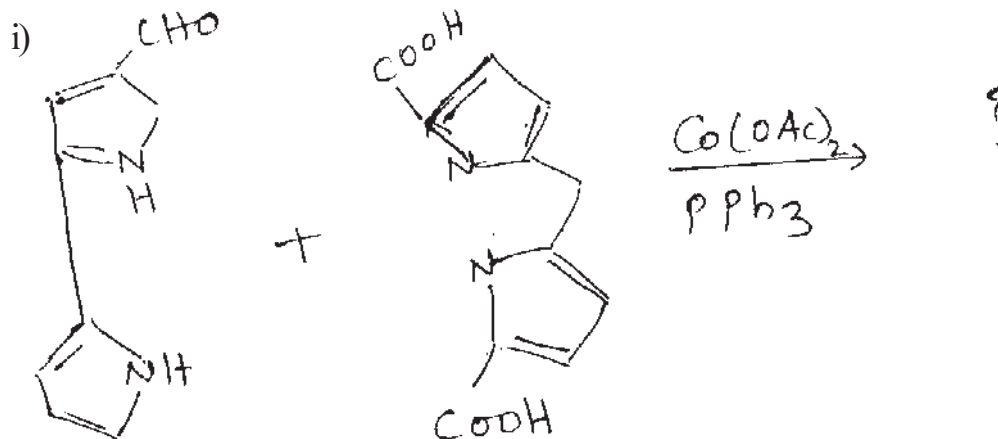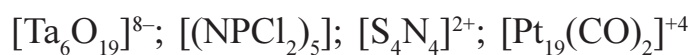
## SECTION - II

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

a) Explain the importance of the following in thermal analysis. Giving suitable examples.
   i) Sample size
   ii) Furnace atmosphere
   iii) Particle size.

b) Write a note on Differential Scanning Calorimetry.

c) Explain in detail how X-ray Crystallography can be used to determine crystallite size.

d) A sample of polymer was analysed simultaneously by TG and DTA. Out of the changes given below which changes will be detected by TG and which will be detected by DTA and why?

Melting; degradation, phase transformation, oxidation, crystallization, residual curing, plasticizer loss.

e) What is the principle of diffraction? Why are X-rays suitable for diffraction studies?

**Q5)** Solve any four. **[20]**

a) A sample containing Zinc was dissolved and oxalic acid was added to it, a white precipitate Ⓐ was obtained. Decomposition of the product Ⓐ was followed by TG and DTA, which showed two steps. A weight loss of 19% was observed at 200°C, a total loss of 57% was seen at 400°C.

What is A? Suggest the reactions involved in decomposition.

b) A diffraction pattern of a cubic crystal of lattice parameter a = 3.16Å is obtained with a monochromatic X-ray beam of $\lambda$ = 1.54 Å. The first four lines on this pattern were observed to have the following values.

| Line | $2\theta$ (in degrees) |
|------|------------------------|
| 1    | 20.3                   |
| 2    | 29.2                   |
| 3    | 36.7                   |
| 4    | 43.6                   |

c) $CaC_2O_4 \cdot 2H_2O$ decomposes to CaO in three steps. Calculate percentage weight losses for each step and predict the decomposition reactions for respective steps.

(At.wts Ca = 40.08, C = 12.00, O = 16.00, H = 1.0)

d) 500 mg of a sample of $KClO_3$ was heated to 500°C, the residue weighed 250 mg write the reaction and determine the purity of the sample.

e) Draw and compare the DTA curves for the decomposition of $CaC_2O_4 \cdot H_2O$. in the following atmospheres.
   i) Air.
   ii) $CO_2$.
   iii) Argon.

**P1016**

**[3823]-56**

# M.Sc.

## INORGANIC CHEMISTRY

### CH - 431 : Material and Industrial Inorganic Chemistry

### (Part - II) (Revised Course)

*Time : 3 Hours]*                                                    *[Max. Marks :80*

***Instructions to the candidates:***

1) *All questions are compulsory.*
2) *Answers to the two sections must be written in same answer book.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of log tables and calculator is allowed.*

## SECTION - I

**Q1)** Answer <u>any three</u> of the following.                                    **[15]**

a) What are molecular magnets? Draw the structure of First organic Ferromagnet.

b) Write about 'Carbon based super conductors'.

c) Explain What is meant by macrodefectfree cement.

d) Give the applications of ceramic oxides.

**Q2)** Attempt <u>any three</u> of the following.                                    **[15]**

a) Write about 'Oxide based superconductors'.

b) What are the environmental applications of cement?

c) Give the free ion ground term and ligand field ground term for $V^{2+}$ and $Mn^{3+}$, (At. no. : V= 23, Mn = 25)

d) With the help of flow sheet explain important stages of the sol-gel process and their applications.

**Q3)** Write notes on <u>any two</u>.                                    **[10]**

a) Magnetic Recording Materials.

b) Portland and Non-portland cement.

c) SQUID.

## SECTION - II

**Q4)** Answer <u>any three</u> of the following. **[15]**

    a) Explain the silver dye bleach process and the role of co-ordination compounds in this process.

    b) Explain how the behaviour of an electrode can be modified using polymers.

    c) Explain with appropriate chemical equations, the preparation of any two white pigments.

    d) What do you understand by silver image stabilization? How is image stabilization achieved in photography.

**Q5)** Answer <u>any three</u> of the following. **[15]**

    a) Write in brief about Nafion modified electrodes.

    b) Explain nature of bonding observed in complexes of 'Bidentate Azo compounds.

    c) Give an account of 'Metal complexes of hydroxy anthraquinones.

    d) How is Iron Oxide prepared synthetically? Give the reactions involved in any two processes and explain.

**Q6)** Write notes on <u>any two</u>. **[10]**

    a) Green Pigments.

    b) Alloy Plating.

    c) Over Voltage and Polarization.

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**P1017**

**[3823]-57**

## M.Sc. (Part - II)
## INORGANIC CHEMISTRY
### CH - 445 Inorganic Applications in Material Science, Biotechnology and Environmental Chemistry
### (Revised Course)

*Time : 3 Hours]*                                              *[Max. Marks :80*

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

### SECTION - I
### Material Science

**Q1)** Attempt <u>any three</u> of the following.                     **[15]**

  a)   What are the factors affecting corrosion? Explain any two.
  b)   Distinguish between Thermosoftening plastics and thermosetting plastics.
  c)   Distinguish between cathodic protection and anodic protection.
  d)   Show on the basis of the energy level diagram that metal n-type semiconductor contact (Where $Øm \geq Øs$) works as rectifier.

**Q2)** Attempt any <u>three</u> of the following.                     **[15]**

  a)   Discuss the principles underlying the operation of thermocouples and solid-state refrigerators.
  b)   Quote the name of fluorine containing polymer. Give the structure of monomer used for its preparation. State whether the above polymer is thermosetting or thermoplastic type. Give properties and uses.
  c)   Explain the working of a P-N-P type transistor as on amplifier.
  d)   For cathodic protection a shiphull requires a current density of 15 mA/m$^2$. Zinc (divalent) is used as the sacrificial anode. What is the quantity of zinc required per m$^2$ of the hull for the protection of last 10 years. One mole zinc has a mass 0.06537 kg. What will be the coating thickness of zinc. (Given-density of zinc 7.133 gm/cm$^3$)

                                                              *P.T.O.*

*Q3)* Write a short notes on <u>any two</u>.                                                    **[10]**

    a)    Photoconductivity.

    b)    Pilling-Bedworth ratio (PBR).

    c)    Silicone Rubbers.

## SECTION - II
## Biotechnology

*Q4)* Attempt <u>any three</u>.                                                                  **[15]**

    a)    Comment on the role of various branches of science in biotechnology.

    b)    Give an account of production of lactic acid.

    c)    Describe with the help of two examples the method of food processing.

    d)    What is sewage? How is it converted into useable water?

*Q5)* Answer the following <u>any three</u>                                                      **[15]**

    a)    Differentiate between respiration with and without oxygen with respect to alcohol production.

    b)    Give examples of earlier applications of biotechnology in India.

    c)    Compare between food production by agriculture and by using microbes.

    d)    Explain how microbes help in production of Pruteen.

*Q6)* Write notes on <u>any two</u>.                                                             **[10]**

    a)    Food processing.

    b)    Gasohol.

    c)    Importance of enzymes.

## SECTION - III
## Environmental Chemistry

*Q7)* Attempt <u>any three</u> of the following.                                                **[15]**

    a)    What are Xenobiotics? Suggest the pathways by which xenobiotics might from trichloroacetic acid metabolically.

    b)    Give two examples of reactions in which manganese and Iron compounds that may occur in water logged soil.

    c)    Explain how air, water, earth, life and technology are inter connected with each other.

    d)    What is Flyash? Describe the range of composition as found in different investigations.

*Q8)* Attempt <u>any three</u> of the following. **[15]**

    a) Which are the air pollutants emitted from internal combusion (I.C.) engine? How is it possible to control pollution due to I.C. engine.

    b) Name the instrumental methods for estimation of metals such as Hg, As, Cd, Se, Be, Cu, Ag, Zn. Explain the spectrophotometric method for the determination of Hg, and Cu from polluted water.

    c) Compare aerobic treatment process with anaerobic treatment process.

    d) Draw a schematic diagram of a X-Ray fluorescence spectrophotometry and elucidate how X-Ray fluorescence spectrophotometry is handy for the global environmental monitoring.


*Q9)* Write short notes on <u>any two</u>. **[10]**

    a) Reverse Osmosis.

    b) Carbon Monoxide pollution and its control.

    c) Tertiary treatment in a sewage treatment plant.

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**P566**

## [3823] - 31

## M.Sc.

## PHYSICAL CHEMISTRY

## CH - 310 : Quantum Chemistry, Statistical Thermodynamics and Phase Rule (Old)

*Time : 3 Hours]*                                             *[Max. Marks :80*

*Instructions to the candidates:*

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

### Physico - Chemical Constants

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any four</u> of the following : [20]

a) State briefly the postulates of quantum mechanics.

b) Deduce the quantum mechanical operator for linear momentum.

c) Show that $U_{(x)} = e^{ax^2}$ is eigen function of operator $\left( \dfrac{d^2}{dx^2} - x^2 \right)$ for $a = 0.5$.

d) Define term symbol. Find the terms corresponding to $d^2$ configuration.

e) Show that eigen functions of a hermitian operator corresponding to different eigenvalues are orthogonal.

f) Formulate the Hamiltonian operator for

    i)    $Be^{+2}$    and    ii)    $H_2^+$ ions

State the terms involved in each case.

**Q2)** Attempt <u>any four</u> of the following : [20]

a) Using $\phi = xl - x^2$ as trial function for $0 \leq x \leq l$ calculate G.S. energy of a one dimensional system.

b) Show that if $\hat{H}$ and $\hat{H}^0$ are hermitian $\hat{H}'$ must also be hermitian. (Given :

$\hat{H} = \hat{H}^0 + \hat{H}')'$.

c) Explain Coulomb, exchange, resonance and overlap integrals.

d) Set up secular determinant for hexatriene molecule and obtain the energies of the MO's there in.

e) Apply Hückel theory to butadiene molecule and estimate its delocalization energy.

f) State the Hückel '4m +2' rule and explain it accounts for the stability of cyclo Octatetraene dianion.

*Q3)* Attempt <u>any three</u> of the following : [15]

    a)    Derive the Sackur-Tetrode equation.

    b)    What is the need of an ensemble in statistical thermodynamics? Give it types.

    c)    Show that $\beta = \dfrac{1}{KT}$.

    d)    Derive the expression for translational partition function.

    e)    Obtain the relationship between the Gibbs energy and the partition function for indistinguishable independent particles.

*Q4)* Attempt <u>any three</u> of the following : [15]

    a)    What are Super Critical Fluids? State their advantages and applications.

    b)    Sketch and explain the phase diagram of water. Comment on the slope of the solid-vapour phase boundary in this diagram.

    c)    State the equipartition principle. How it is useful in estimating the value of heat capacity at higher temperatures? What is its limitation?

    d)    What are the salient features of Bose-Einstein statistics? How does the distribution law expression obtained from these compare with that obtained from the Boltzmann Statistics?

    e)    What is lever rule? Sketch and explain the phase diagram for nitrobenzene.

*Q5)* Solve <u>any two</u> of the following : [10]

    a)    Calculate the standard molar entropy of neon gas at 300 K. (The mass of Ne atom is 20.18u).

    b)    The moment of inertia for nitrogen is $14 \times 10^{-40}$g cm$^2$. Calculate the rotational partition function for $N_2$ at 30ºC.

    c)    Using the equipartition principle, calculate the molar heat capacities of the following molecules at 27ºC.

        i)    $CH_4$            ii)    $CO_2$

        iii)   $I_2$             iv)   Water Vapour.

✪✩✪✩

**P567**

## [3823] – 32

## M.Sc.

## PHYSICAL CHEMISTRY

## CH - 311 : Nuclear and Radiation Chemistry (Old)

*Time : 3 Hours]* *[Max. Marks :80*

*Instructions to the candidates:*

   *1)*   *Answers to the TWO sections should be written in SEPARATE answer books.*

   *2)*   *ALL questions are COMPULSORY.*

   *3)*   *Figures to the RIGHT SIDE indicate FULL marks.*

   *4)*   *Use of logarithmic table/calculator is ALLOWED.*

   *5)*   *Neat diagrams must be drawn WHEREVER necessary.*

### <u>Physico - Chemical Constants</u>

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following :                                    **[15]**

    a)    Describe the square-well potential. What are the other forms of potentials?

    b)    What are thermonuclear reactions? Discuss the mechanism of such reactions occuring within the sun.

    c)    Discuss the evidences in support of the magic numbers in the shell model of the atomic nucleus.

    d)    Explain the term critical size and reactor power.

    e)    Explain the working of a breeder reactor.

**Q2)** Attempt <u>any three</u> of the following :                                    **[15]**

    a)    Derive the four factor formula.

    b)    What are prompt and delayed neutrons in nuclear fission? What is their origin?

    c)    Derive the Breit-Winger formula.

    d)    Discuss with suitable examples the various types of nuclear reactions.

    e)    Describe how nuclear reactors are classified on the basis of i) fuel ii) moderator iii) coolent.

**Q3)** Solve <u>any two</u> of the following :                                    **[10]**

    a)    Calculate fission energy, fission barrier and hence activation energy of symmetric fission of $^{114}_{50}Sn$ [$r_0 = 1.5F$] [masses of $^{114}Sn = 113.9030$amu, $^{57}Mn = 56.9383$amu].

    b)    Predict the spin and parity of $^{127}_{52}Te$ and $^{100}_{43}Tc$ .

    c)    Determine the most stable isobar with A = 180.

## SECTION - II

**Q4)** Attempt <u>any three</u> of the following :                                    **[15]**

    a)    Give an account of natural sources of radiation.

    b)    Discuss the mechanism of working of organic scintillators. Enlist the commonly used organic scintillators.

    c)    Discuss the nuclear reasons for retention in Szilard-Chalmer's reaction.

    d)    What is the role of cupric ions in modified ferrous sulphate dosimeter?

    e)    Explain the working of surface barrier detector.

*Q5)* Attempt <u>any three</u> of the following :   **[15]**

a)   Discuss the effects of chernobyl nuclear accident.

b)   Write down the various products formed during radiolysis of water.

c)   Distinguish between somatic and genetic effect.

d)   Discuss the use of thermo luminiscent detector in personal dosimetry.

e)   Explain the ICRP recommendations for maximum permissible dose.

*Q6)* Solve <u>any two</u> of the following :   **[10]**

a)   The linear mass absorption coefficient of lead is $0.57 \text{ cm}^{-1}$. What thickness of lead is required to reduce the activity from 15000 cpm to 7000 cpm.

b)   Calculate the dose absorbed in 6 hours by chloroform at a position at which the radiation dose from $^{60}Co$ measured by Fricke dosimeter is 4.06 Gy/min. Given $\overline{Z/A}$ for Fricke solution is 0.553.

c)   If $G_{(OH)} = 2.95$, $G_H = 3.65$, $G_{H_2O_2} = 0.8$ and $G_{Fe^{3+}} = 15.5$. Predict the mechanism for radiolysis of aqueous Fricke solution.

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**P568**

**[3823] - 33**

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CH - 312 : Electrochemistry and Physicochemical Methods of Analysis (Old)**

*Time : 3 Hours]*                                                                *[Max. Marks :80*

*Instructions to the candidates:*

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

## Physico - Chemical Constants

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

*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following : **[15]**

a) What are structural changes taking place when ion is introduced in liquid water?

b) State the Debye Huckel limiting law, explaining the terms involved. Why is it called limiting law? How can it be modified for oppreciable concentrations?

c) Explain the term ionic strength. How does it affect i) thickness of ionic atmosphere ii) the mean activity coefficient of an electrolyte?

d) What is exchange current density? How is the concept understood using Butler-Volmer equation?

e) What are the three methods of ion transport in solution? Derive Fick's first law of steady state diffusion.


**Q2)** Attempt <u>any three</u> of the following : **[15]**

a) Explain the terms i) outer potential ii) surface potential iii) inner potential iv) electrochemical potential.

b) Describe with a neat diagram the detail structure of metal solution interface. What is outer Helmholtz and inner Helmholtz plane?

c) Explain the terms corrosion current and corrosion potential. Write the equation for the rate of corrosion.

d) Discuss in brief the local cell theory for corrosion of metals.

e) Describe the working of hydrogen-oxygen fuel cell.


**Q3)** Solve <u>any two</u> of the following : **[10]**

a) If the Tafel constants a and b have values 1.50V and 0.12V respectively for electronation reaction of monovalent ion of a cathode, calculate the transfer coefficient $\alpha$ and exchange current density $i_o$ at 300 K.

b) Calculate the constants A and B in the Debye-Huckel equation of mean activity coefficient for 0.01m aqueous NaCl solution at 30°C. The dielectric constant of water is 78.3.

c) The drift velocity of a univalent ion is $4 \times 10^{-4}$ cms$^{-1}$ under a potential gradient of 0.08 Vcm$^{-1}$. Calculate the absolute ionic mobility and conventional mobility.

## SECTION - II

**Q4)** Attempt <u>any three</u> of the following : **[15]**

a) Describe with a suitable example how a mixture of two ions can be titrated radiometrically where in ion precipitating second is labelled.

b) Define cross section of a reaction. Explain the term geometric cross section and reaction cross section.

c) Explain the principle of PIXE technique. What are the advantages of this technique?

d) Discuss the choice of post irradiation treatment in activation analysis.

e) Give an account of radiometric titration based on neutralization reactions.

**Q5)** Attempt <u>any three</u> of the following : **[15]**

a) Derive the equation $\dfrac{M}{Z} = \dfrac{B^2 r^2}{2E}$ and explain the terms involved therein.

b) Write a note on ESCA chemical shift.

c) Enlist various thermal methods of analysis along with instrument used, parameter measured and graph to be plotted.

d) Describe the applications of DTA.

e) Discuss in brief the application of mass spectrometry.

**Q6)** Solve <u>any two</u> of the following : **[10]**

a) 500 mg sample containing 20% nickel was irradiated in a neutron flux of $5 \times 10^7$ n cm$^{-2}$s$^{-1}$ for 8 hrs. Find out activity of the sample in dpm at the end of irradiation. Given : $\gamma = 0.95\%$, $\sigma = 1.49$ b, t½ of 65Ni = 2.5 hr.

b) In a particular time of flight mass spectrometer an ion with $\dfrac{M}{Z}$ 198 required 1.16 μs to strike the detector after emission from the source. Determine the time needed for an ion with $\dfrac{M}{Z}$ 330 to strike the detector.

c) 100 ml K*I solution was titrated with 0.01 m AgNo$_3$. Addition of 10 cc of AgNo$_3$ followed by removal of precipitate showed a decrease in activity from 15,800 counts for 6 min to 1,200 counts in 3 min. Find out concentration of K*I in the original solution.

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**P569**

**[3823] – 34**

# M.Sc.

## PHYSICAL CHEMISTRY

### CH - 314 : Polymer Chemistry - I (Old)

*Time : 3 Hours]* *[Max. Marks :80*

*Instructions to the candidates:*

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

## <u>Physico - Chemical Constants</u>

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

**SECTION - I**

*Q1)* Attempt <u>any three</u> of the following :                                                      **[15]**

   a)   Distinguish between thermoplastic and thermosetting polymers. Explain the behaviour of cellulose.

   b)   Discuss the salient features of addition polymerization. Is the polymer obtained from caprolactum an addition polymer? Justify your answer.

   c)   Describe the experiments which prove that chemical reactivity is independent of molecular weight.

   d)   Predict the type of polymerization, the following monomers undergo. Justify your answer. Ethylene, styrene, methyl methacrylate, vinyl chloride and acrolein.

   e)   When polymers were accepted as long chain compounds it was assumed that their reactivity would below. Why?

*Q2)* Attempt <u>any one</u> of the following :                                                      **[5]**

   a)   Write the reaction of formation of polyurethane from ethylene glycol and p-phenylene diisocyanate. How do you classify it condensation or addition?

   b)   Classify the copolymer formed in the following cases. Justify your answer.

| | $r_1$ | $r_2$ |
|---|---|---|
| Case I | $\to o$ | $\to o$ |
| Case II | $\to o$ | $\to \infty$ |
| Case III | $\to \infty$ | $\to \infty$ |

*Q3)* Attempt <u>any three</u> of the following :                                                      **[15]**

   a)   Discuss with suitable example, the mechanism of cationic chain polymerization.

   b)   Derive the copolymer equation.

   c)   Derive expression for i) overall rate of polymerization and ii) degree of polymerization for anionic polymerization.

   d)   Describe with a neat diagram the solution polymerization when all components are soluble.

   e)   Write a note on emulsion polymerization.

*Q4)* Attempt <u>any one</u> of the following : **[5]**

   a)   Show by chemical equations, the four necessary and sufficient steps of free radical chain polymerization of butadiene using t-butyl peroxide as initiator.

   b)   A linear step polymerization is 99% complete. Calculate $\bar{x}_n, \bar{x}_w$, polydispersity index and the weight fraction of $\bar{x}_n$ - mers.

## SECTION - II

*Q5)* Attempt <u>any three</u> of the following : **[15]**

   a)   Describe the instrument used for membrane osmometry.

   b)   What are different ways of expressing average molecular weight of a polymer? Explain the term polydispersity index. What are the factors affecting it?

   c)   Discuss the principle of membrane osmometry.

   d)   Describe the effect of radiation exposure on silicone polymers.

   e)   Explain the light-scattering technique for the determination of molecular weight of polymers.

*Q6)* Attempt <u>any one</u> of the following : **[5]**

   a)   Show by chemical equilibrium the four steps in polymerization of vinyl acetate using azobis isobutyronitrite as initiator.

   b)   Calculate $\overline{M}_n, \overline{M}_w$ and PI from the data

| % | 5 | 10 | 45 | 25 | 15 |
|---|---|---|---|---|---|
| Mol. wt. | 40,000 | 55,000 | 70,000 | 80,000 | 90,000 |

*Q7)* Attempt <u>any three</u> of the following : **[15]**

   a)   Describe the fractional precipitation method used for fractionation of a polymer sample.

   b)   Describe, with a neat diagram the high speed membrane osmometer. What are its limitations?

   c)   Write a note on GPC.

   d)   Describe the viscosity method of determination of molecular weight of a polymer-what precaution should be taken.

   e)   Define $\overline{M}_n, \overline{M}_w$ and polydispersity index. What is the effect of polydispersity index on physical properties of polymer?

*Q8)* Attempt <u>any one</u> of the following : **[5]**

   a)   The molecular weight of a polymer is determined by sedimentation equilibrium method. It was found that the aqueous solution was 1.9 times as concentrated at a distance 10cm from the axis of rotation as at a distance 6cm. rotar speed = 6000 rpm, Temp = 25°C, $\rho$ = 1.2 g/cc and $\bar{v}$ = 0.6.

   b)   From the following light scattering data for solution of polystyrene in methyl ethyl ketone, determine the molecular weight of the polymer.

| C(g/100 ml) | 0.105 | 0.215 | 0.315 | 0.435 |
|---|---|---|---|---|
| $\dfrac{HC}{\Pi} \times 10^6$ | 6.21 | 6.95 | 7.62 | 8.34 |

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**P570**

# [3823] - 36

# M.Sc.

## PHYSICAL CHEMISTRY

## CH - 316 : Environmental Chemistry (Old)

*Time : 3 Hours]*                                              *[Max. Marks :80*

*Instructions to the candidates:*

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

### Physico - Chemical Constants

| | | | |
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| 5. | 1 eV | | $= 23.06$ k cal mol$^{-1}$ |
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| | | | $= 1.602 \times 10^{-19}$ J |
| | | | $= 8065.5$ cm$^{-1}$ |
| 6. | Gas Constant | R | $= 8.314 \times 10^{7}$ ergK$^{-1}$ mol$^{-1}$ |
| | | | $= 8.314$ J K$^{-1}$ mol$^{-1}$ |
| | | | $= 1.987$ cal K$^{-1}$ mol$^{-1}$ |
| 7. | Faraday Constant | F | $= 96487$ C equiv$^{-1}$ |
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| 11. | Bohr magneton | $\beta_e$ | $= -9.274 \times 10^{-24}$ J T$^{-1}$ |
| 12. | Nuclear magneton | $\beta_n$ | $= 5.051 \times 10^{-27}$ J T$^{-1}$ |
| 13. | Mass of an electron | $m_e$ | $= 9.11 \times 10^{-31}$ kg |

## SECTION - I

*Q1)* Attempt <u>Any Four</u> of the following : [20]

    a) Describe how $SO_x$ pollution is controlled.

    b) Give the classification of air pollutants and discuss the sources of oxides of nitrogen.

    c) Define 'biochemical effect'. Discuss biochemical effects of lead.

    d) Write and explain all reactions of oxides of sulphur.

    e) Explain troposphere and stratosphere zones of the atmosphere with label diagram.

    f) Discuss in brief the segments of environment.

*Q2)* Attempt <u>any four</u> of the following : [20]

    a) Discuss the nature and composition of surface water and sea water.

    b) How does environment get polluted by organic pollutants?

    c) Describe physical examination of water sample with reference to different properties.

    d) Discuss the type of water pollution according to the effect exerted by the polluting water.

    e) Give an account of anionic and nonionic surfactants.

    f) Write a note on lithosphere.

## SECTION - II

*Q3)* Attempt <u>any four</u> of the following: [20]

    a) What is noise? Describe the sources of noise pollution.

    b) Explain the harmful effects of radio active pollutants on soil.

    c) What are soil indicator plants? Discuss these in detail.

    d) Discuss the effect of synthetic fibres and their degradation products on environment.

    e) How do the modern agricultural practices pollute the soil?

    f) Describe the 'cooling tower' to prevent thermal pollution.

*Q4)* Attempt <u>any four</u> of the following :                                          [20]

    a)   Describe chemical examination of water with reference to cyanide, fluoride and Arsenic.

    b)   Explain the effects of cadmium poisoning and discuss the sources of cadmium pollution.

    c)   Give an account of biotic damage due to thermal pollution.

    d)   What is environmental noise? Give the noise level in decibel of the following.

        i)    Rocket engine

        ii)   Bus and

        iii)  Hospitals.

    e)   What are carcinogenic compounds? Discuss in detail.

    f)   Describe the biochemical effects of mercury on human beings.

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**P571**

**[3823] - 37**

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CH - 326 : Organometallic Compounds in Synthesis and Homogeneous Catalysis**

**(Revised)**

*Time : 3 Hours]*                                                    *[Max. Marks :80*

*Instructions to the candidates:*

    *1)*    *All questions are compulsory.*

    *2)*    *All questions carry equal marks.*

*Q1)* Attempt the following (Any Four) :                           **[20]**

    a)    What do you understand by hydrosilylation on alkenes? Which catalyst are used in these reaction? Explain the catalytic cycle for hydrosilylation on alkenes.

    b)    Explain the typical reactions of Iron Pentacarbonyl.

    c)    Explain different steps involved in any homogeneous catalytic cycles in activation of small molecules.

    d)    Propose methods for converting carbon monoxide to carbene acyl ligand.

    e)    Explain the Mosanto Acetic acid process.

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

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

        i)    $Ph_4Sn$

        ii)    Trans $RhCl.Co.(PPh_3)_2$

        iii)    $Co_2(CO)_8$

        iv)    $[Mn (CO)_4No]^o$

        v)    $Co (\eta^5 - C_5H_5)_2$

        vi)    $(\mu-Br)_2-[Mn(CO)_4]_2$

        vii)    $Ru(PPh_3)_2 (CO)_2$

        viii)    $Fe_2 (CO)_9$

b) List the similarities and differences in the metallocenes of metal arene, complexes giving suitable reactions.

c) $Co_2 (CO)_8$ and $Fe_2 (CO)_9$ are considered as "carbonyl deficient compounds" explain.

d) The complex $[Cr (CO)_4 (PPh_3)_2]$ has one very strong IR-absorption band at $1889$ $cm^{-1}$ and two other very weak bands in the carbonyl streaching region. What is the probable structure of the compound.

e) How are metal carbonyl is prepared? Discuss the properties of metal carbonyls. What are uses of metal carbonyl?

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

a) Give the reactions of ferrocene depicting its aromatic behaviour.

b) Which is the model used for explaining the bonding interactions in the metal alkenes. Name and explain it.

c) What is olefin epoxidation? Which transition metal complexes play's important role in it?

d) What do you understand by oxidative addition reaction? Explain the effect of the following on these reactions.
   i) Nature of the metal.
   ii) Oxidation state of the metal.
   iii) Nature of ancillary ligand.

e) What are "Fischer" and "Schrock" carbenes? Give the synthetic routes to any one type of metal carbene compounds.

**Q4)** a) Write notes on (Any Two) : **[12]**
   i) Organometallic compounds in medicine.
   ii) Transition metal thiocarbonyls.
   iii) Cobalt carbonyl compounds in the hydroformylation reactions.

b)  Predict the product.                                              [8]

i) $HCo(CO)_3 + RCH = CH_2 \longrightarrow ?$

ii) $Fe(CO)_5 + C_5H_5N \longrightarrow ?$

iii)



$+ I_2 \longrightarrow ?$

iv) $Mn_2(CO)_{10} + H_2 \longrightarrow ?$

v) $Ni(\eta^5-C_5H_5)_2 \xrightarrow[THF]{Na|Hg} ?$

vi)



$\xrightarrow{CH_3COCl} ?$

vii) $Mo(CO)_6 +$



$\longrightarrow ?$

viii)



$\xrightarrow[CH_2Cl_2]{Br_2} ?$

$(Fp = FeCp(CO)_2)$

✪☆✪☆
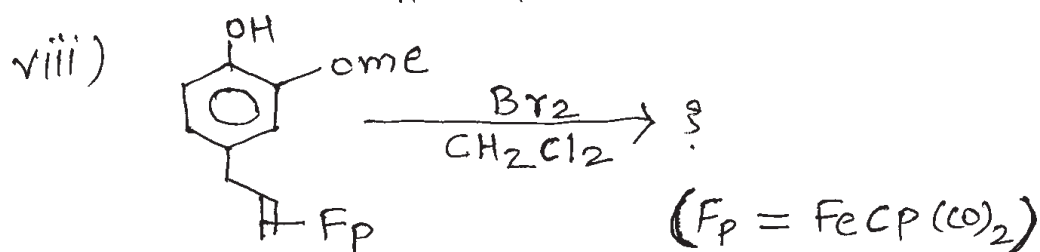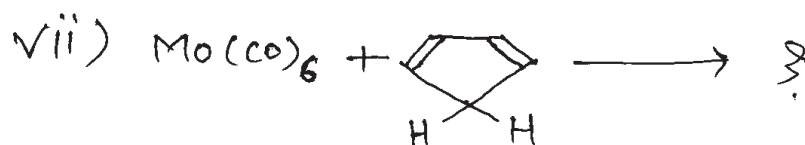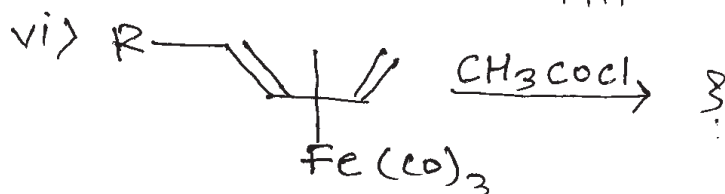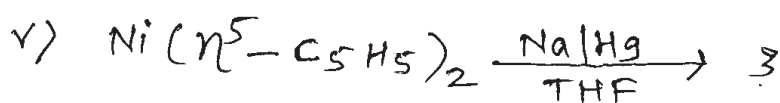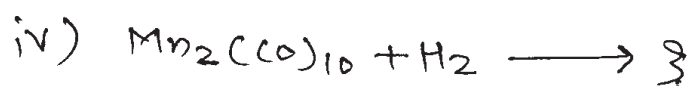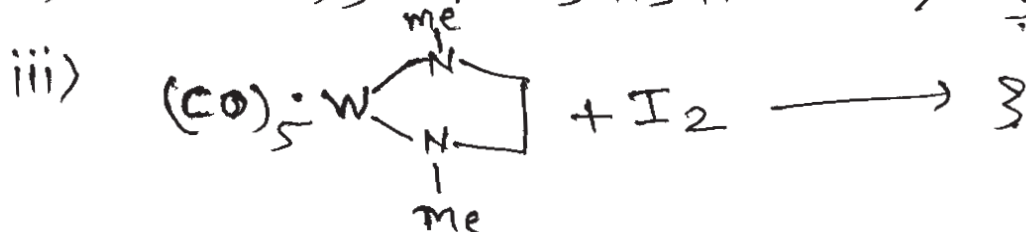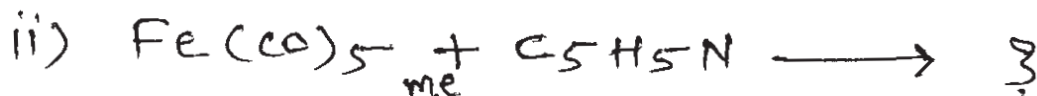
**P572**

[3823] - 38

## M.Sc. - II

## INORGANIC CHEMISTRY

## CH - 330 : Coordination Compounds and Structural Methods
## (Revised Course)

*Time : 3 Hours]*                                                           *[Max. Marks :80*

***Instructions to the candidates:***

1) *All questions are compulsory & carry equal marks.*

2) *Neat diagrams must be drawn wherever necessary.*

3) *Use of log tables & calculator is allowed.*

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

5) *Atomic numbers : - Cu = 29, V = 23, Mo = 42, Cr = 24, Fe = 26.*

**Q1)** Attempt any <u>four</u> of the following :                                **[20]**

a) Give the nomenclature of the following compounds.

  i)   $Li [Co (NCNH_3)_4]$

  ii)  $[Cr(en)_3] [ClO_4]_3$

  iii) $[Br_4Re - Re Br_4]$

  iv)  $Fe (CO)_2 (\eta' - C_5H_5)$

  v)   $Mn (CO)_4 NO$

b) Draw the structures of following compounds

  i)   $Ir_4 (CO)_{12}$

  ii)  $(\eta^5 - C_5H_5) (\eta' - C_5H_5) Fe (CO)_4$

  iii) Bis (benzoyl acetonato) beryllium

  iv)  Cis - tetraamine dichloro cobalt (III)

  v)   $Mn_2Co_{10}$

c) Explain nature of bonding in $W_2 Cl_g^{2-}$ ion.

d) Discuss any two factors that affect CFSE.

e) Write a note on mixed valence complexes.

*Q2)* Attempt any <u>four</u> of the following : **[20]**

   a)  Which of the following ions show orbital contribution to magnetic moment.

      i)   $[Cr(H_2O)_6]^{3+}$

      ii)  $[V(H_2O)_6]^{3+}$

      iii) $[Fe(CN)_6]^{3-}$

   b)  Suggest the mechanism of magnetic exchange that operates in copper (II), Vo (II) & $M_oO$ (V) complexes on the basis of the electron occupation in the d orbital of these metal ions?

   c)  C –Indicate the difference between antiferromagnetic spin-spin exchange and spin pairing.

   d)  Write a note on magnetically dilute and magnetically concentrated systems.

   e)  The extent of exchange interaction in the $Cu_2O_2$ ring system is greater than that in $Cr_2O_2$ ring system. Explain.

*Q3)* Attempt any <u>four</u> of the following : **[20]**

   a)  Low resolution $^{19}F$ nmr of $[WF_6.L]$ shows three lines of relative intensities 4 : 1 : 1. Assign the peaks & elucidate the structure of the complex.

   b)  How ESR technique is used for study of catalysts?

   c)  Discuss the effect of change of concentration on the nature of cyclic voltammogram of 4mm $K_3$ Fe(CN)$_6$ in 1 M $KNO_3$. How concentration of unknown $K_3$ Fe(CN)$_6$ seln is measured from this experiment?

   d)  In $Cl_3$ Sn Co (CO)$_4$ for $^{59}$CO (I = 7/2) NQR frequencies occur at

     $\nu_3$ = 35.02 MHz $\pm$ 5/2 → $\pm$ 7/2

     $\nu_2$ = 23.37 MHz $\pm$ 3/2 → $\pm$ 5/2

     $\nu_1$ = 11.68 MHz $\pm$ 1/2 → $\pm$ 3/2

     Calculate $e^2Q9$ /h parameter & theoretical ratios of observed frequencies if corrected with asymmetric parameter.

     Given $h = 6.6 \times 10^{-27}$ ergs.

     & Quadrupolar energy of the nucleus is given by

$$Em = e^2Q9 \frac{[3m^2 - I(I+1)]}{4I(2I-1)}$$

   e)  Give the parameters which are determined by Mösbauer spectroscopy. Explain the isomer shift in Mösbauer spectra.

*Q4)* Write notes on any <u>four</u> of the following : [20]

    a) Application of CV to determine mechanism of electron transfer reaction.

    b) Kramer's Degeneracy.

    c) Asymmetric parameter.

    d) Application of Mössbauer spectroscopy in structure determination.

    e) Factors affecting chemical shift in nmr.

✪✩✪✩

**P573**

### [3823] - 39

## M.Sc. II

# INORGANIC CHEMISTRY

### CH-331 : Inorganic Reaction Mechanism

### (Revised Course)

*Time : 3 Hours]*          *[Max. Marks : 80*

*Instructions to the candidates:*

1) *All questions are compulsory.*

2) *Use of log tables and calculators is allowed.*

3) *Neat diagrams must be drawn wherever necessary.*

*Q1)* Attempt <u>any three</u> of the following:       **[15]**

     a)    Write a brief note on topochemical reactions.

     b)    Give a brief account of 'Anation Reactions'.

     c)    Discuss in brief the mechanism of photographic process.

     d)    Give the characteristic and types of solid-state reactions. Mention the factors affecting these reactions.

*Q2)* Answer <u>any three</u> of the following:       **[15]**

     a)    What is conjugate base dissociation mechanism? How you will explain it in the case of octahedral Co(III) complexes.

     b)    What are 'Group transfer' reactions? Give two examples along with their mechanism.

     c)    Discuss the use of isotopic labelling technique to study the kinetics and mechanism of this reaction.

     d)    Which isomer can you obtain from the following synthetic pathways? Give precise explanation and correct structures of the products:

$$[ptCl_4]^{2-} \xrightarrow{NH_3} ? \xrightarrow{NH_3}$$
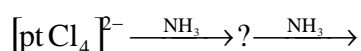
*Q3)* Attempt <u>any three</u> of the following: **[15]**

a) Derive the rate laws for nucleophilic substitution reaction:

$$[CoA_5X]^{2+} + Y^- \rightarrow [CoA_5Y]^{2+} + X^-$$
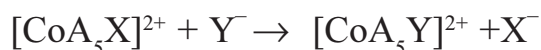
by using dissociative and associative mechanism. Distinguish between these two mechanism.

b) Give the differential aspects between the redox reactions and electron-exchange reactions.

c) Explain in brief the mechanism of oxidation addition with the help of a suitable example.

d) Give a brief account of the comparative aspects of $SN^1$ and $SN^2$ reactions.

*Q4)* Answer <u>any three</u> of the following: **[15]**

a) What are atom transfer reactions? Give any two typical examples of atom transfer reactions along with the reaction mechanism.

b) Compare the 'outer sphere' and 'inner sphere' mechanism for electron transfer reactions.

c) Discuss in brief account of photosubstitution reactions in rhodium complexes.

d) Dispite the bimolecular rate law, the reaction:

$$[Co(NH_3)_5Cl]^{2+} + OH^- \rightleftharpoons [Co(NH_3)_5 OH]^{2+} + Cl^-$$
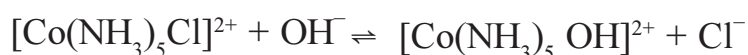
follow $SN^1$ mechanism. Explain.

*Q5)* Give a brief account of <u>any four</u> of the following: **[20]**

a) Bridged activated complexes.

b) Effect of metal ions on the chelating ligands.

c) Reduction and elimination reaction.

d) Inert and labile complexes.

e) 'Two electron' transfer reactions.

❦ ❦ ❦

**P574**

**[3823] - 40**

# M.Sc. - II

# INORGANIC CHEMISTRY

## CH 332 : Metallo Proteins and Bioinorganic medicines

*Time : 3 Hours]*                                                              *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*     *All questions carry equal marks.*

    *2)*     *All questions are compulsory.*

*Q1)* Answer the following: (Any four)

    a)     What was the impact of chernobyl incident on fishes and marine animals?

    b)     What are the long term effects of fall out of various nuclides?

    c)     Which is the enzyme responsible for nitrate reduction by cells? Propose a scheme for this.

    d)     Discuss the mechanism for mono-oxygenation and oxidation by tyrosinase?

    e)     Summarize the molybdenum containing hydroxylases and the reactions catalysed by them.

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

    a)     Describe the enzymes containing vanddium.

    b)     Write an account on oxygen transport by copper enzymes.

    c)     Write an account of model compounds of molybdenum which help to understand the biological function of its enzymes.

    d)     Explain the uptake of iron and the subsequent controlled distribution and metabolism.

    e)     What is the role of Manganese clusters in biology?

*Q3)* Answer any four:

a)   Why is milk considered as an excellent food stuff for comparitive measurement of radionuclide deposition.

b)   Write an account on the biological importance of Co, Fe, Mn.

c)   Write an account of copper proteins and enzymes with the reference to location and function.

d)   Write an account on biological chemistry of manganese.

e)   Explain the principles underlying Drug Development.

*Q4)* Write short notes on: (any four)

a)   Bone density measurements in diagnostic radio pharmaceuticals.

b)   Metal complex-DNA interactions.

c)   Nitrogenases.

d)   Cytochrome - c oxidase.

e)   Metallo regulatory proteins.

❧ ❧ ❧

**P587**

[3823]-59
# M.Sc.
## ORGANIC CHEMISTRY
## CH - 451 : Synthetic Methods in Organic Chemistry
## (2005 Pattern) (Old Course)

*Time : 3 Hours]*                                              *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

**Q1)  a)**    Write short notes on <u>any two</u> of the following :                    **[6]**

   i)    Hydroformylation reaction.

   ii)   Peterson reaction.

   iii)  Heck reaction.

   **b)**   Predict the product/reagents in the following conversions (any three) :

                                                                           **[6]**
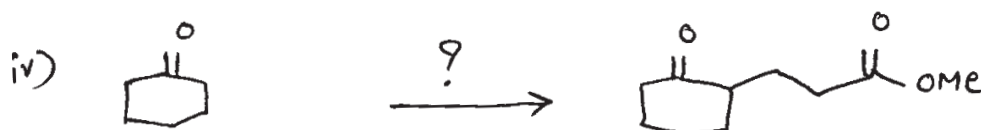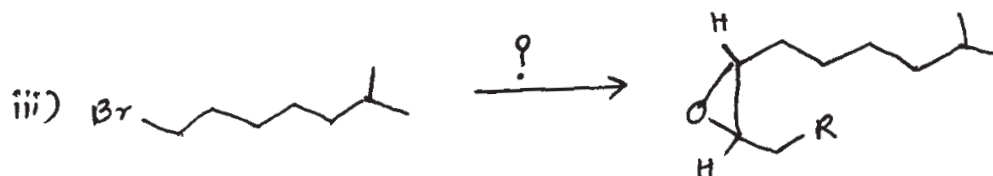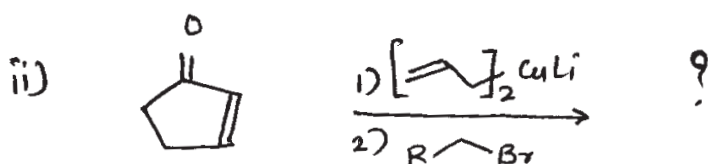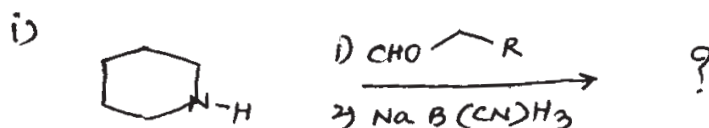
*Q2)* a) Give synthetic equivalents of <u>any two</u> and illustrate your answer with one suitable example each. **[4]**

i) 

ii) 

iii) 

iv) 
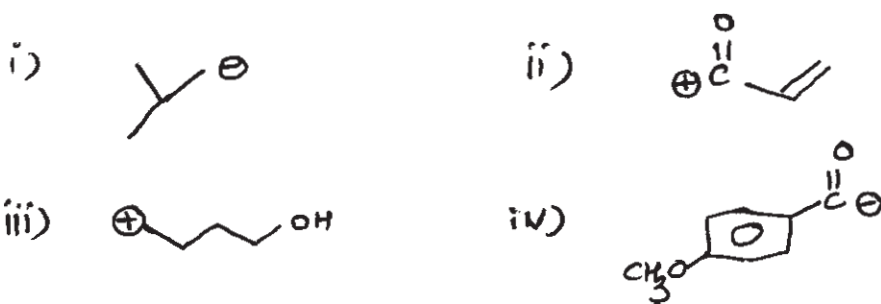
b) Complete <u>any two</u> of the following conversions by giving suitable reagents. **[6]**

i) 

ii) 

iii) 
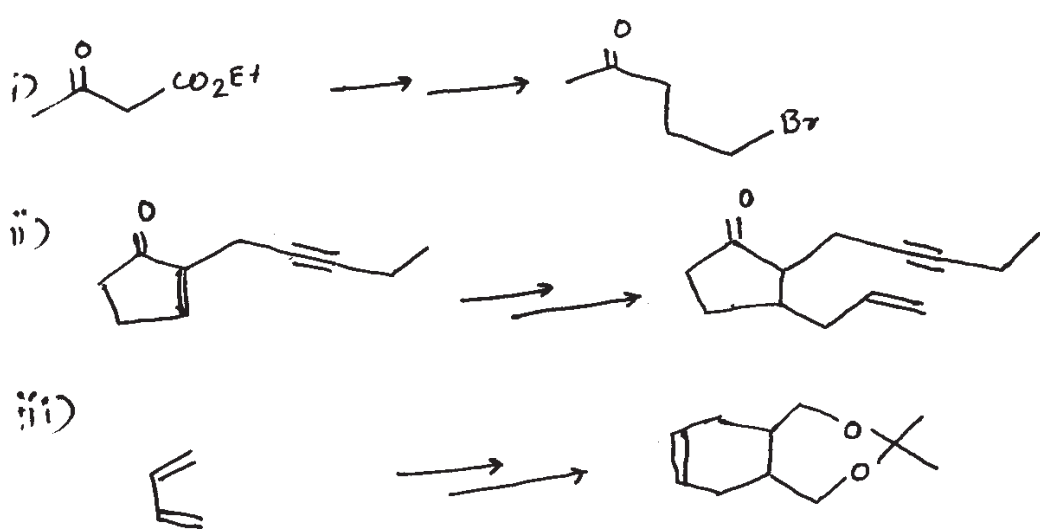
c) The reagents and conditions required for conversion of the following compounds to the products are shown. Arrange them in proper order to achieve the conversion. Write the structures of intermediate compounds.

Attempt <u>any two</u> : **[6]**

i) 

LiAlH (Ot-Bu)₃ ; 9-BBN ; H₂O₂, NaOH ; CO

ii) 

HNO₃, Ac₂O ; ; SOCl₂, Pyridine ; Mg, Et₂O

(iii)



$Ph_3P, K_2CO_3$ ; $NBS, H_2O$ ; $AcO\!\!-\!\!CH_2\!\!-\!\!C(=O)\!\!-\!\!OEt$, $(Ph_3P)_4Pd$
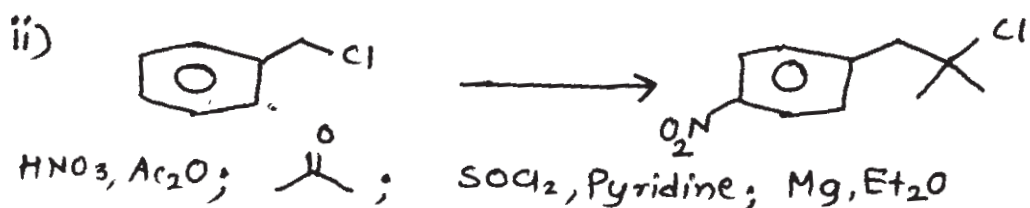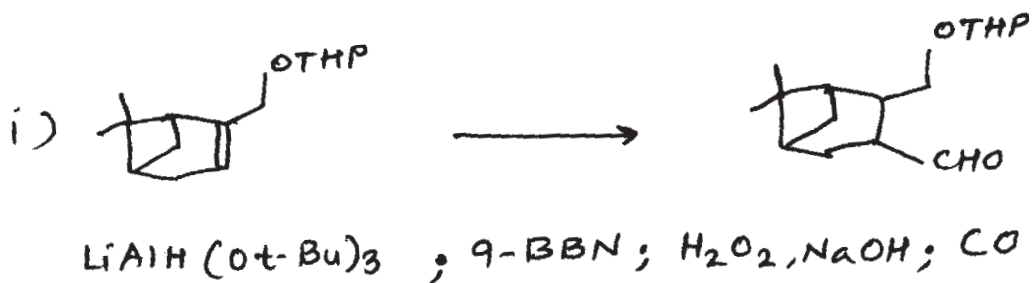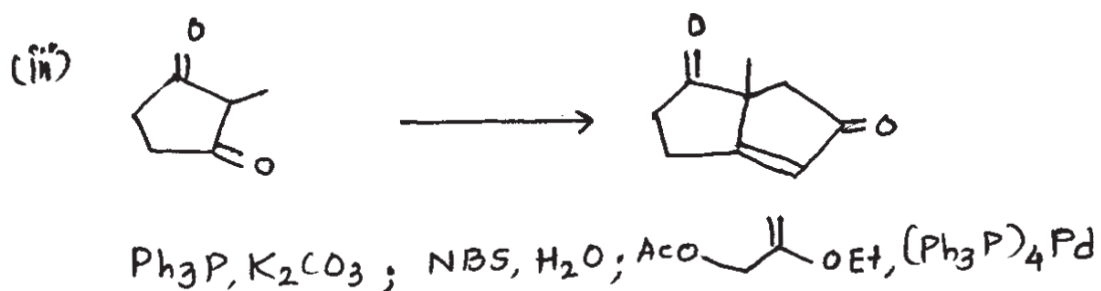
**Q3)** Explain the following (any four) : **[12]**

a) Reversal of polarity. Give one application of it in organic synthesis.

b) Use of Ziegler-Natta Catalyst in brief.

c) Selectivity of thexyl borane, disiamyl borane and 9-BBN in olefin reaction.

d) What is the advantage of using benzyl protection, of-OH, how it can be removed.

e) Explain use of DCC in peptide synthesis.

## SECTION - II

**Q4)** a) Use of following reagents in organic synthesis in brief (any three) : **[9]**

   i)   $Me_3SiCl$

   ii)  $Pd (PPh_3)_2 (CH_2 Ph) Cl$

   iii) $Ph_2 P (OEt)$

   iv)  $Ni (CO)_4$

b) Use of the following protecting groups in peptide synthesis in brief. **[3]**
(OCOBu-t) t-BOC, Fmoc, t Butyl ($CO_2$Bu-t).

**Q5)** Attempt <u>any four</u> of the following : **[12]**

a) Explain in brief use of Rhodium catalyst in homogeneous hydrogenation.

b) Use of triethyl aluminium in organic synthesis in brief.

c) Reppe synthesis using organometals.

d) Advantages of Stork Enamine approach in synthesis.

e) Sharpless asymmetric epoxidation in synthesis.

*Q6)* Using retrosynthetic analysis suggest suitable synthetic strategy for the synthesis of <u>any four</u> of the following compounds. **[16]**

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

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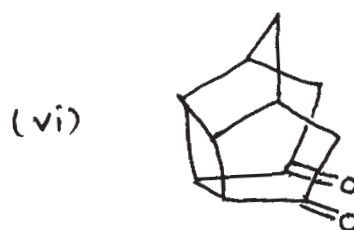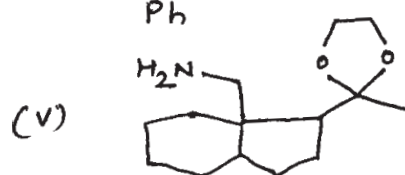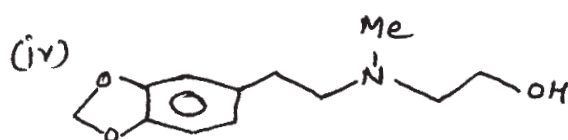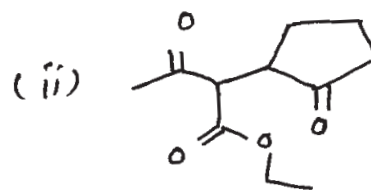
**P588**

[3823]-60

**M.Sc. - II**

**ORGANIC CHEMISTRY**

**CH - 452 : Pericyclic Reactions, Chiron Approach, Chemotherapy,**
**Medicinal Chemistry Vitamins, Antibiotics etc.**

**(2005 Pattern) (Old Course)**

**Section - I : Pericyclic Reactions, Photochemistry and Green Chemistry**

**Section - II : Medicinal Chemistry**

**Section - III : Chiron Approach and Newer Methods in Organic Synthesis**

**Section - IV : Vitamins, Antibiotics and Hormones**

*Time : 3 Hours]*                                               *[Max. Marks : 80*

*Instructions to the candidates:*

　　*1)*　　*Solve any two sections out of four.*

　　*2)*　　*All questions are compulsory from both sections.*

　　*3)*　　*Figures to the right indicate full marks.*

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

**SECTION - I**

*Q1)*　a)　construct correlation diagram for the disrotatory opening of cyclohexadiene to hexatriene and predict whether the reaction is thermally or photo chemically allowed on the basis of conservation of orbital symmetry.　**[6]**
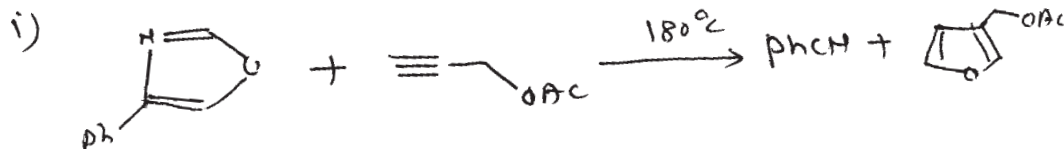
　　b)　Predict product/s in <u>any four</u> of the following and justify your answer.**[8]**
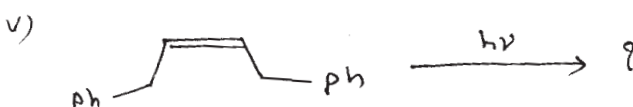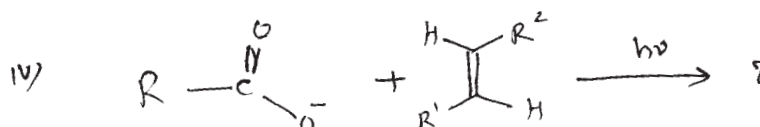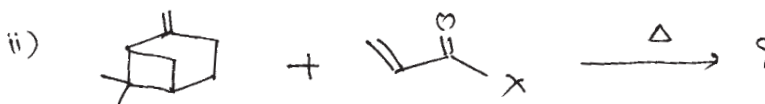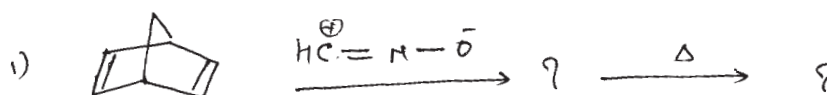
**Q2)** Solve the following :

a) Explain the orientation effects in Diels Alder reaction. **[4]**

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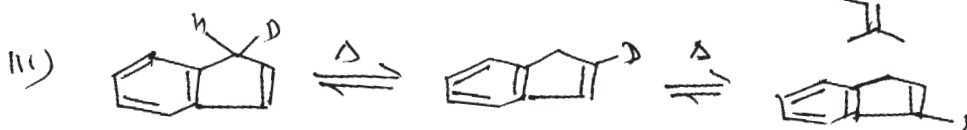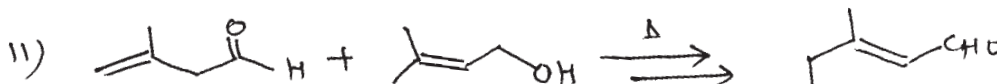


c) Write the basic principles of Green Chemistry. **[4]**

**Q3)** a) Complete the following synthetic sequence indicating all intermediates and reagents required (any one) : **[8]**



b) Explain what is mean by 'meta-arene alkene' photo cycloaddition. Give use of this addition reaction in the synthesis of natural products. **[4]**

## SECTION - II

**Q4)** a) Give structure of penicillin-G. Write why it is unstable to acids and bases? Explain with the help of reaction. How were the acid stable penicillins developed? Describe mode of action of penicillin. **[8]**
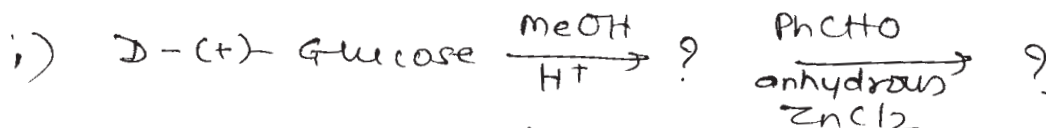
b) Solve <u>any two</u> : **[6]**

i) Give brief account of pharmacodynamics of drug action.
ii) Give an account of protein synthesis inhibitors.
iii) Discuss mechanism of action of 5 F.U. as an anticancer drug.

**Q5)** a) Give brief account of development of alkylating agents. What are the benifits achieved in these development. Explain mode of action of alkylating agents. **[8]**

b) Solve <u>any two</u> : **[6]**

   i) Describe in short antifungal chemotherapy.
   ii) Give mode of action of acyclovir.
   iii) Discuss the use of sulphonamides as antibacterials.

**Q6)** a) Explain parasite chemotherapy with suitable example. **[4]**

b) Solve <u>any two</u> : **[8]**

   i) Define Q.S.A.R. Explain in brief L.F.E.R.
   ii) Give an account of anticancer drugs from plant origin.
   iii) Comment on development of semisynthetic cephalosporins and their uses.

## SECTION - III

**Q7)** a) Write the chair conformation of α-D-glucopyranose. Convert it into an open-chain zig-zag structure and find out the absolute configuration of all the chiral centres. **[4]**

b) Write a short note on "Ruff degradation" and explain the importance of it in carbohydrate chemistry. **[4]**

c) Two isomeric compounds A and B having molecular formula $C_6H_{12}O_6$ give following reactions. **[4]**

   i) Both 'A' & 'B' form same osazone.
   ii) Both 'A' & 'B' form penta-o-acetate.
   iii) 'A' gets oxidised by Tollen's reagent while B does not.
   iv) Both are sweet to taste and crystalline. Identify A & B and write the reactions.

d) Predict the products in <u>any two</u> of the following : **[4]**

i) $D-(+)-$ Glucose $\xrightarrow[H^+]{MeOH}$ ? $\xrightarrow[\substack{anhydrous \\ ZnCl_2}]{PhCHO}$ ?

ii) $D-(+)-mannitol$ $\xrightarrow[\overset{O}{\overset{\|}{C}},H^+]{}$ ? $\xrightarrow{NaIO_4}$ ?

iii)  $\xrightarrow[CCl_4]{RuO_4}$ ? $\xrightarrow[MeOH]{NaBH_4}$ ?
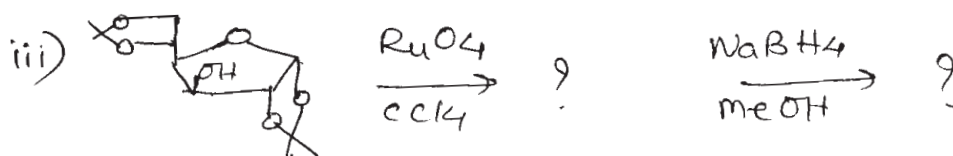
*Q8)* a) Give retrosynthetic analysis of (–) shicimic acid which is shown below : **[4]**
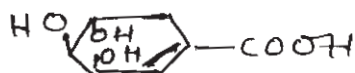


b) Write short note on <u>any one</u> of the following : **[4]**

i) $^4C_1$ and $^1C_4$ conformations in carbohydrate chemistry.

ii) Use of chiron approach in organic synthesis.

c) Write the appropriate reagents in the following course of reactions and rewrite the complete sequence of reactions. **[4]**
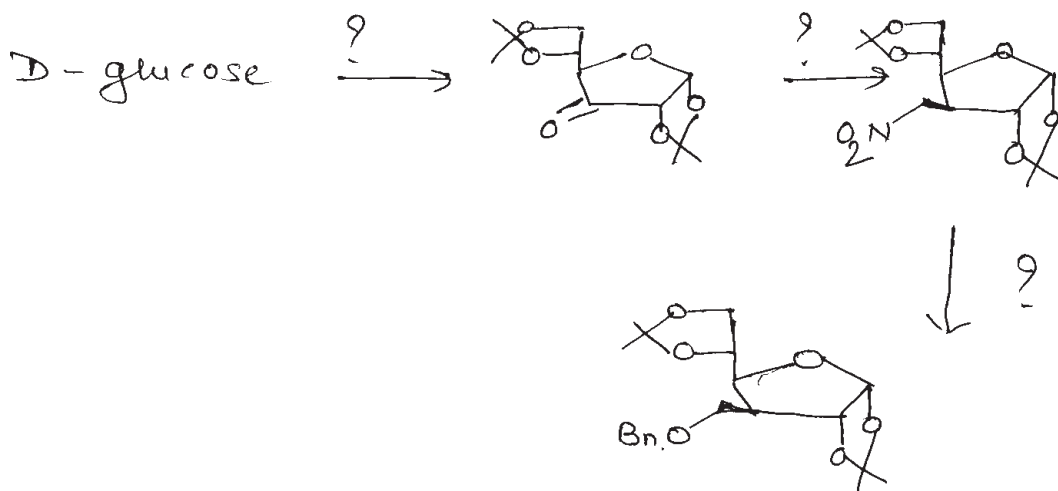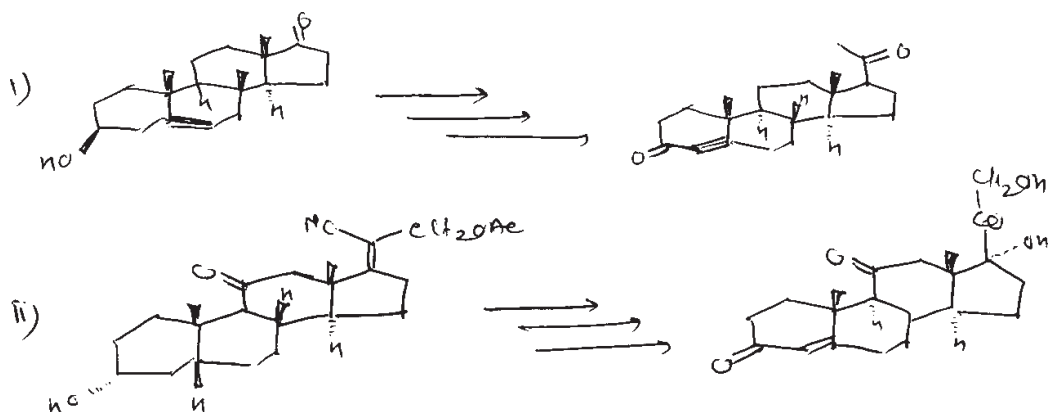


*Q9)* Answer <u>any three</u> of the following : **[12]**

a) Discuss the advantages and limitation of microwave in organic synthesis.

b) Describe the different types of sonochemical reactions.

c) Complete the following sequence of reactions.

i) 

ii) 
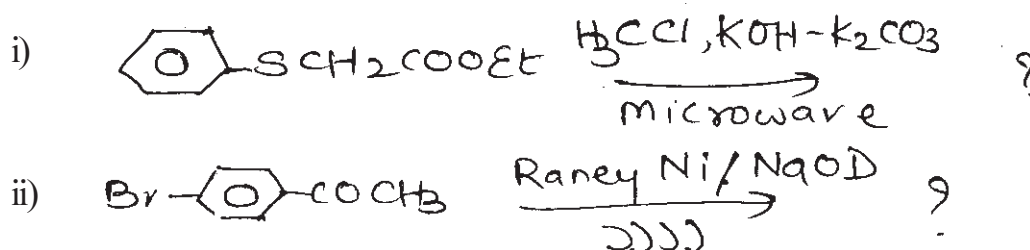
d) Explain three-point attachment rule.

## SECTION - IV

**Q10)** a) How will you effect the following transformations : **[4]**



b) Answer <u>any two</u> of the following : **[8]**

    i) Deficiencies caused by vit $B_2$ and vit $B_6$.

    ii) Describe the structural unit of streptomycin.

    iii) Synthesis of Grnseufulvin from phloroglucinol-dimethyl ether.

**Q11)** Solve <u>any three</u> of the following : **[12]**

a) How will you prove the presence of thiazole ring in thiamine.

b) Give the constitutional analysis of vitamin $B_2$.

c) Give the chemical constitution of testosterone.

d) Give the chemical constitution of vitamin 'K'.

**Q12)** a) Answer <u>any three</u> of the following : **[12]**

    i) What are antibiotics? How they are classified? Give at least one example of each class.

    ii) Describe the synthesis of D.Penicillamine.

    iii) Give the structure and bio chemical function of cortisone.

    iv) Explain mechanism of transformation reaction catalyzed by puridoxal phosphate.

b) What are hormons? Explain their functions. **[4]**

$$\boxtimes\boxtimes\boxtimes\boxtimes$$

**P603**

**[3823]-203**

**M.Sc. - I**

**ORGANIC CHEMISTRY**

**CH - 250 : Synthetic Organic Chemistry and Spectroscopy**

**(2008 Pattern) (Sem. - II)**

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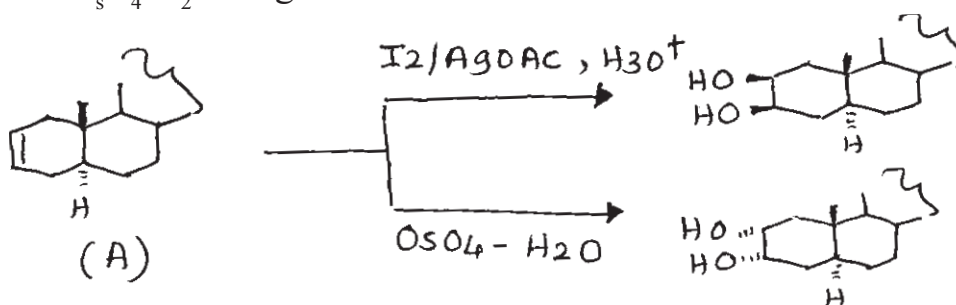
*Instructions to the candidates:*

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

**SECTION - I**

*Q1)* Explain <u>any four</u> of the following :                      **[16]**

a) Steroidal 2-alkene (A) gives two different products with $I_2$/AgOAC, $H_3O^+$ and $O_sO_4$-$H_2O$ reagents.



b) When benzophenone oxime is treated successively with $PCl_5$, then $H_2O^{18}$, $O^{18}$ is found in the resulting Benzanilide.

c) <u>Cis</u>-4-hydroxycyclohexanecarboxylic acid undergoes lactonisation readily on heating, whereas the trans isomer doesnot lactonise.

d) O-Tolylmagnesium bromide on reaction with benzil forms exclusively B.
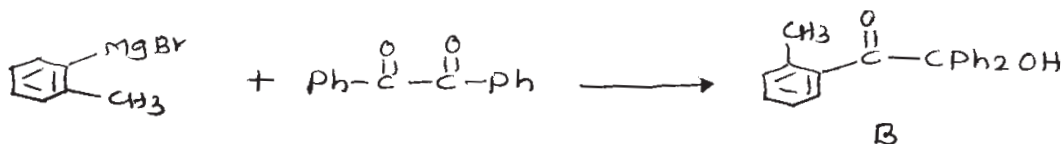


e) On reaction with $\alpha$, $\beta$-unsaturated carbonyl compound, dimethylsulphonium methylide yields on epoxide whereas dimethylsulphoxonium methylide gives cyclopropane.
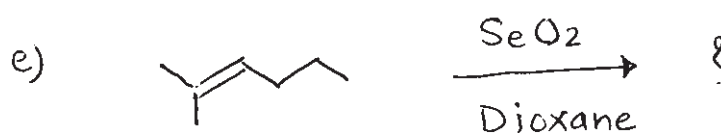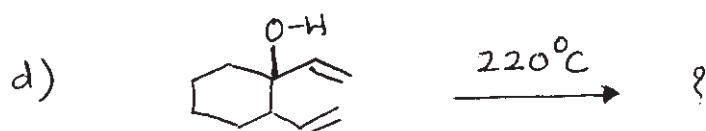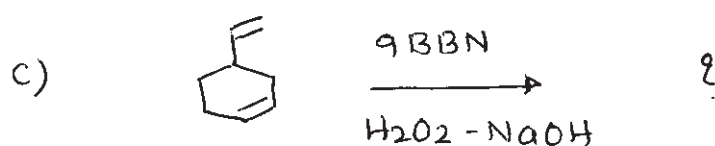
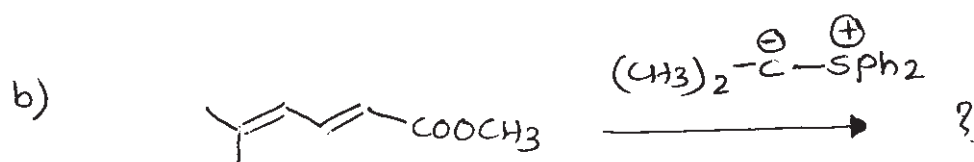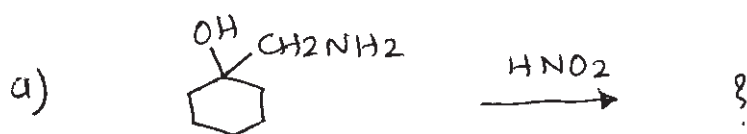*Q2)* Write short-notes on <u>any four</u> of the following :                                    **[12]**

    a)    Swern oxidation.

    b)    Fermi resonance.

    c)    Stevens rearrangement.

    d)    Wittig-Horner reaction.

    e)    Any two rearrangements involving nitrene as an intermediate.

*Q3)* Predict the products and suggest the mechanisms in <u>any four</u> of the following :
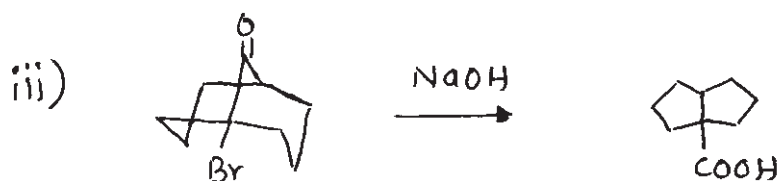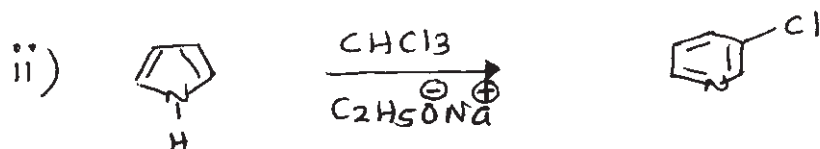
                                                                    **[12]**

    a)

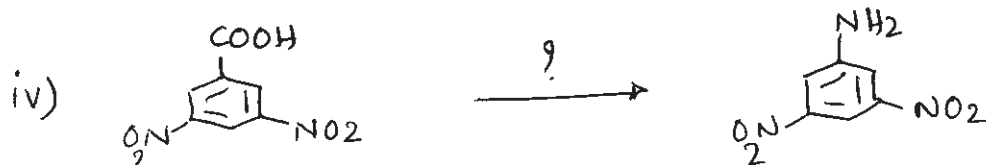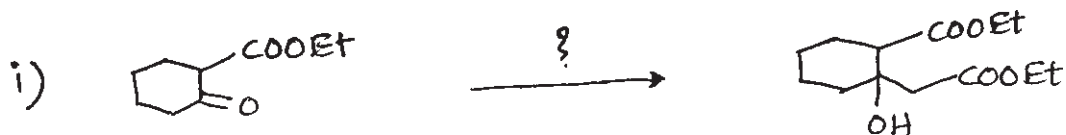

    b)



    c)



    d)



    e)

# SECTION - II

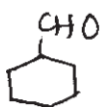**Q4)** a) Suggest the mechanism for <u>any two</u> of the following : **[6]**

i) 

ii) 

iii) 

b) Suggest the reagents in following conversions (any three) : **[6]**
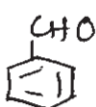
i) 

ii) 

iii) 

iv)

*Q5)* Answer <u>any four</u> of the following : **[16]**
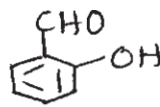
a) Arrange the following compounds according to the increasing carbonyl streching frequency. Justify.



I          II          III

b) Calculate $\lambda$ max for the following compound. Clearly show your calculations.
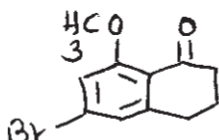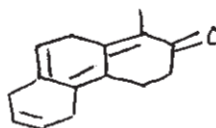


IV          V

c) Write a note on factors affecting chemical shift.

d) Deduce the structure from the following spectral data.

M.F. = $C_9H_{14}O$          IR = 1690, 1620 cm$^{-1}$

UV $\lambda$ max = 299 nm.

e) Esters of o-chlorobenzoic acid shows two C = O streching frequencies. Explain.

*Q6)* Deduce the structure of <u>any three</u> of the following using given spectral data and justify your answer : **[12]**

a) M.F. : $C_3H_6O$

IR : 1200 - 1280 cm$^{-1}$

PMR : 1.32 (3H, d, J = 6Hz),

($\delta$)        2.42 (1H, dd, J = 3.5 and 2.5Hz),

2.72 (1H, dd, J = 3.5 and 3.0 Hz),

2.98 (1H, ddq, J = 2.5 and 3 and 6Hz).

b) M.F. : $C_6H_5NO$

IR : 2720, 1690 cm$^{-1}$

PMR : 8.7 (2H, d, J = 5.5 Hz),

($\delta$)        7.3 (2H, d, J = 5.5 Hz),

10.0 (1H, s)

c) MF : $C_7H_{12}O_4$

IR : 1742 cm$^{-1}$

PMR : 2.6 (2H, s),

($\delta$) 1.3 (6H, t, J = 6.5Hz),

4.16 (4H, q, J = 6.5Hz)

d) MF : $C_{10}H_{10}O$

IR : 3600, 3320, 2210, 1600, 1490 cm$^{-1}$

PMR : 1.7 (3H, s),

($\delta$) 2.5 (1H, s),

2.9 (1H, s, D$_2$O exchange),

7.2 (3H, m), 7.55 (2H, m).

☒☒☒☒

**P604**

**[3823]-204**
# M.Sc.
## BIOCHEMISTRY
### BCH - 270 : Bioenergetics and Metabolism

*Time : 3 Hours]*                                             *[Max. Marks : 80*
*Instructions to the candidates:*
  1) *Answer to the two sections should be written in separate answer book.*
  2) *All questions are compulsory.*
  3) *Figures to the right indicate full marks.*

## SECTION - I

**Q1)** Answer <u>any five</u> of the following :                    **[15]**

  a)   Write note on the arrangement of electron carriers in Electron Transport Chain of mitochondria.

  b)   Draw the structure of chloroplast and write note on sites of light and dark reactions of photosynthesis.

  c)   Write short note on fate of pyruvate.

  d)   How does HMP shunt prevents hemolysis of RBC?

  e)   Why is TCA cycle highly aerobic, even though $O_2$ is not directly involved in any step of TCA cycle reactions?

  f)   What are feeder pathways of glycolysis? Give examples.

  g)   Show the regulation of TCA cycle in presence of excess of NADH, ATP and insufficient NADH and ATP.

**Q2)** Attempt <u>any three</u> of the following :                    **[15]**

  a)   Explain the steps involved in the synthesis of fatty acids from Acetyl CoA.

  b)   Discuss the reactions that lead to formation of carbohydrate from $CO_2$ in Calvin Cycle.

  c)   Explain the regulatory mechanisms that maintain normal blood glucose level in our body.

  d)   Describe the steps involved in the formation of ascorbic acid from glucose.

  e)   Discuss the biosynthesis of glucose from non carbohydrate precursors.

*P.T.O.*

*Q3)* Answer <u>any five</u> of the following : **[10]**

   a) Give the relation between internal energy, enthalpy and entropy and give their significance with respect to biochemical reaction.

   b) List out the significance of ATP in the cell.

   c) Differentiate between $\beta$, $\alpha$ and $\omega$ oxidation of fatty acids.

   d) Write note on the anabolic role of TCA.

   e) What is Hills reaction? Give its significance.

   f) Write note on photorespiration.

   g) What are the enzymes and coenzymes that constitute the pyruvate dehydrogenase complex.

## SECTION - II

*Q4)* Answer <u>any five</u> of the following : **[15]**

   a) Why ammonia is toxic to the brain? How it is transported from brain to liver for detoxication?

   b) Explain the fate of uric acid in different animal species.

   c) Explain the degradative pathway of pyrimidine nucleotide.

   d) Why branched chain amino acids are not degraded in liver? Explain the genetic disorder associated with branched chain amino acid degradation.

   e) Explain how 'NO' is synthesized in human body? What is its biochemical significance?

   f) Explain the regulation of heme biosynthesis.

   g) How activity of ribonucleotide reductase is regulated.

*Q5)* Give the biochemical reactions involved in the following conversions (any three) : **[15]**

   a) Methionine $\rightarrow$ ornithine to spermine.

   b) IMP to ATP and GTP.

   c) 3-phosphoglycerate to glycine via serine.

   d) Tryptophan to serotonin, indole acetate and nicotinate.

   e) Riboflavin to FMN and FAD.

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

   a)   Explain the enzymatic steps involved in heme degradation.

   b)   How biosynthesis of threonine and isolemine from as partate is regulated?

   c)   Explain the mechanism involved in transamination reactions.

☒☒☒☒

**P612**

**[3823]-306**

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CH - 326 : Organometallic Compounds of Transition Metals and Homogeneous Catalysis**

**(New) (Sem. - III)**

*Time : 3 Hours]*             *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*    *All questions are compulsory and carry equal marks.*

    *2)*    *Figures to the right indicate full marks.*

    *3)*    *Use of log.table and calculator are allowed.*

    *4)*    *At. No : Ti = 22, V = 23, Mn = 25, Fe = 26, W = 74.*

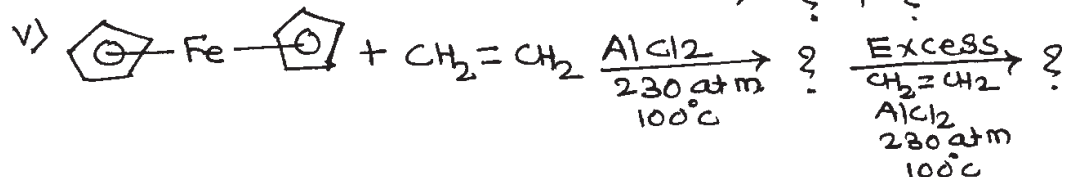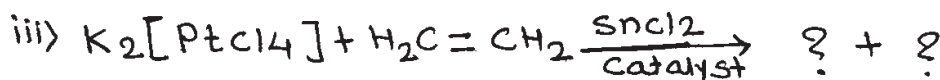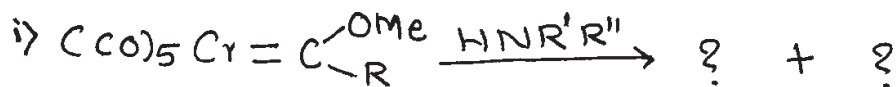**Q1)** Attempt <u>any four</u> of the following :                **[20]**

    a)    What is EAN rule? Do the following compounds obey the 18 $\bar{e}$ rule?

        i)     $[Mn(CO)_4\,NO]$,

        ii)    $(Cp)(NO)_2\,WH$,

        iii)   $[(\eta^5 - Cp)_2\,Ti\,(CO)_2\,(\eta^2 - C_2Ph_2)]$,

        iv)   $(Cp)\vee(CO)_4$,

        v)    $Fe_3(CO)_{12}$.

    b)    Describe the systematic classification and synthesis of $\eta^5$-cyclopentadienyl transition metal derivatives.

    c)    Explain the nature of metal-olefin interactions in transition metal olefin complexes.

    d)    Give the preparation and electrophillic substitution reactions of ferrocene.

    e)    Explain the typical reactions of $Mo(CO)_6$.

**Q2)** Attempt <u>any four</u> of the following :                **[20]**

    a)    In a metal alkyne complex $v\,(C \equiv C)$ is observed at 1850 cm$^{-1}$, while, in the free alkyne $v\,(C \equiv C)$ is observed approximately at 2200 cm$^{-1}$. Explain.

    b)    Explain giving appropriate examples the oxidative addition and reductive elimination reactions shown by organometallic compounds.

    c)    Explain ethylene oxidation reaction using Pd (II) compound as catalyst.

d) Write in brief about Tollman's catalytic cycle.

e) Complete the following reactions :

i) $(CO)_5 Cr = C \underset{\diagdown R}{\overset{\diagup OMe}{}} \xrightarrow{HNR'R''} ? + ?$

ii) $(\eta^5 C_5H_5)_2 H Re + H^+ \longrightarrow ?$

iii) $K_2[PtCl_4] + H_2C = CH_2 \xrightarrow[\text{catalyst}]{SnCl_2} ? + ?$

iv) $2 CoS + 8 CO + 4 Cu \xrightarrow{200°C, atm.} ? + ?$

v) $\underset{}{\bigcirc - Fe - \bigcirc} + CH_2 = CH_2 \xrightarrow[\substack{230\,atm \\ 100°C}]{AlCl_2} ? \xrightarrow[\substack{AlCl_2 \\ 230\,atm \\ 100°C}]{\substack{Excess \\ CH_2 = CH_2}} ?$

**Q3)** Attempt <u>any four</u> of the following : **[20]**

a) Write an account of applications of OMC's in agriculture and horticulture.

b) Explain the role of alkyne molybdate in the epoxidation of propylene.

c) Give the principal steps in the catalytic cycle for the hydrogenation of an alkene using Wilkinson's catalyst.

d) Explain that IR spectroscopy is important method to establish the structure of compounds with formula $M (PPh_3)_2 (CO)_4$.

e) Draw the structures -
   i) $OS_3 (CO)_{12}$;
   ii) $Mo (CO)_3 (\eta^6 - C_7H_8)$;
   iii) $Fe (CO)_5$;
   iv) $\mu$-CO-$\mu$ CRR' $- [- Cp*Rh]_2$,
   v) $CO_4 (CO)_{12}$.

**Q4)** Write short notes on <u>any four</u> : **[20]**

a) Organometallic compounds as protecting agents.

b) Fluxional behaviour of organometallics.

c) Industrial applications of the Heck reaction.

d) Pianostool compounds.

e) Group IV organometallic compounds in medicine.

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**P613**

**[3823]-307**

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CH - 330 : Co-ordination Chemistry and Reaction Mechanism**
**(New) (Sem. - III)**

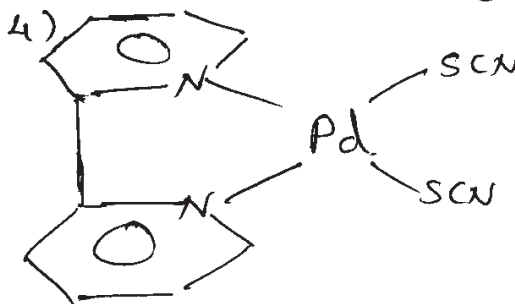*Time : 3 Hours]*                                        *[Max. Marks : 80*
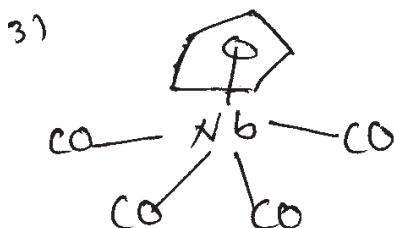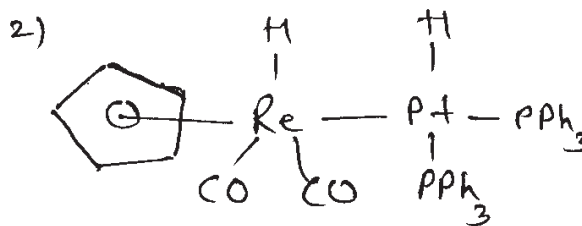
*Instructions to the candidates:*

1) *All questions are compulsory and carry equal marks.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Use of logarithmic tables and calculator is allowed.*
4) *Atomic number : Ni = 28, Mo = 42.*

**Q1)** Attempt <u>any four</u> of the following :                      **[20]**

a)   Give the nomenclature of the following :
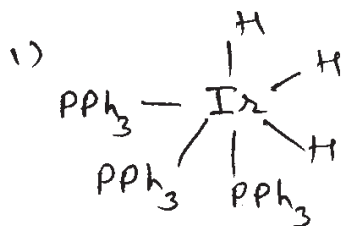


b)   Discuss various models to account for the anomalous magnetic behaviour of transition metal complexes?

c)   Predict the type of Magnetic exchange which occurs via the 90° exchange pathway in the systems $d^1 - d^1$, $d^2 - d^2$, $d^3 - d^3$, $d^8 - d^8$, $d^9 - d^9$.

d)   A certain Nickel (II) complex shows a magnetic moment 2.13 B M. Assuming that there is no antiferromagnetic interaction can we call this magnetic moment anomalous? Explain.

e)   Why are the complexes $K_4[Mo(CN)_8]$ & $K_2[Cl_5 Mo O Mo Cl_5]$ diamagnetic?

*Q2)* Answer <u>any four</u> of the following :                                      **[20]**

   a)   What are Neel temperature and the curie-temperature. State the significance of these temperatures?

   b)   Why is it that the second & third transition series metal ions give more low spin complexes than the first transition series metal ions?

   c)   Discuss the crystal field splitting of an octahedral, tetrahedral and square planar complexes.

   d)   Explain in detail charge transfer transitions.

   e)   Write a note on mixed valence complexes.

*Q3)* Attempt <u>any four</u> of the following :                                      **[20]**

   a)   Write a note on chelate effect and macro cyclic effect.

   b)   Explain in detail polarization theory.

   c)   How Frank-condon principle is important in electron transfer reaction? Explain with the support of P.E.diagram.

   d)   Explain sterric assistance in $SN^1$ & $SN^2$ mechanism with one example of each.

   e)   Explain in detail inner-sphere election transfer reaction.

*Q4)* Answer <u>any four</u> of the following :                                      **[20]**

   a)   Write a note on Marcus equation.

   b)   Explain the base hydrolysis of $[(NH_3)_5Co^{III}.Cl]^{2+}$ with evidances.

   c)   Explain in detail one $e^-$ transfer reactions.

   d)   Write down the difference between stoichiometric and intimate mechanisms.

   e)   Explain the formation of dithionate $(S_2O_6^{2-})$ & $N_2$ from sulphate $(SO_4^{2-})$ and hydrazine $(NH_2 - NH_2)$.

$$\boxtimes \boxtimes \boxtimes \boxtimes$$

**P620**

**[3823] - 314**

## M.Sc. - II

## ANALYTICAL CHEMISTRY

## CH - 390 : Electroanalytical and Current Analytical Methods in Industries

## (New Course)

*Time : 3 Hours]*                                                    *[Max. Marks :80*

*Instructions to the candidates:*

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

## SECTION - I

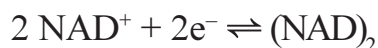*Q1)* Attempt <u>any four</u> of the following :                                    **[20]**

   a)   Draw a labelled polarographic curve. Explain the role of maximum suppressor and bubbling of nitrogen gas through the solution in polarographic analysis.

   b)   Describe in brief the analytical applications of stripping voltametry.

   c)   State the principle of coulometry. Describe the general procedure for coulometric determination at controlled cathode potential.

   d)   Determine Half-wave potential of Ag/Ag Br electrode having electrode potential $-2.240$ volt at $27°C$, the current generated by the rate of mass transport by diffusion is $2.82\ \mu A$. [Given : Cathodic diffusion current = $15.24\ \mu A$].

   e)   A constant current of 0.850 amperes is passed through a copper chloride solution for 15.2 min. Calculate the weight of copper metal deposited on the cathode. [At. wt. Cu = 63.54].

*Q2)* Attempt <u>any four</u> of the following :                                    **[20]**

   a)   State the principle of amperometry. Describe the nature of amperometric titration curves.

   b)   Describe the potential ramp that is used is square wave polarography. Mention important differences between pulse polarography and square wave polarography.

*P.T.O.*

c) What are nano-materials? Give it's general applications.

d) An electroactive species yielded a wave with a limiting current of 18.5 μA at an rotated disk electrode which was rotated at 15.0 rotations per sec. Calculate limiting current that would be expected at 45.0 rotations per sec.

e) $(NAD^+)$ can be coulometrically assayed at constant potential by reduction to the dimer $(NAD)_2$

$$2\ NAD^+ + 2e^- \rightleftharpoons (NAD)_2$$

If the area under the current-time curve for the reduction of 15.0 ml aqueous solution of $NAD^+$ is 54.3A min. Calculate the concentration of $NAD^+$ in the sample.

## SECTION - II

**Q3)** Attempt <u>any four</u> of the following : **[20]**

a) Explain the principle of activation analysis, mention the types of activation analysis. Describe the absolute method of neutron activation analysis.

b) Explain the principle of isotope dilution analysis. How isotope dilution analysis is used to assess the volume of blood in a patient.

c) State the conditions under which the radiometric titrations are performed. Draw and explain the nature of radiometric titration curve when the standard solution of radioactive silver nitrate is added into a non-radioactive sodium chloride solution.

d) Calculate the concentration of chloride in unknown solution having transmittance of 64.4 percent in the cell of path length 1.00 cm. The turbidity coefficient of the unknown sample is $5.78 \times 10^{-3}$ litre $mg^{-1}$ $cm^{-1}$.

e) The mixture of barium chloride and thermally stable salt was analysed by TGA. Initially the weight of mixture was 1.248g at room temperature and at 200ºC temperature, loss in weight was 65mg. due to dehydration of the crystalline salt. Calculate the percentage composition of the mixture. [Given : At. wt. Ba = 137.32, Cl = 35.5, Na = 23, O = 16 and H = 1].

**Q4)** Attempt <u>any four</u> of the following : **[20]**

a) Discuss the principle and techniques of radio-reagent methods of analysis. State it's important limitations.

b) Give the criteria to prefer turbidimetry or nephelometry as an analytical tool. Describe with suitable example any one important application of turbidimetry in analytical chemistry.

c) Discuss any two applications of TGA. What are the limitations of this technique compared to other thermal methods?

d) A ruby weighing 0.75g was irradiated in a neutron flux of $1 \times 10^{12}$ n cm$^{-2}$ s$^{-1}$ for exactly 24 hours and $^{51}$Cr activity counted immediately thereafter. It was found to give 35,000 counts per sec. Given that neutron capture cross section for $^{50}$Cr is 15.9 barn, the counting efficiency is 10%, isotopic abundance of $^{50}$Cr in natural chromium is 4.35% and mean life time of $^{51}$Cr is 27.7 days. Calculate the chromium content of the ruby.

e) Calculate the percentage of penicillin in the mixture when 1 litre mixture was assessed for it's penicillin content, 5mg of labelled penicillin with an activity of 20,000 counts for 5 min was added to this mixture. After thorough mixing 0.5mg of pure crystalline penicillin was isolated which gave an activity of 3,000 counts for 10 min.

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**P625**

## [3823] - 320
## M.Sc.
## BIOCHEMISTRY
## BCH 371 : Medical Biochemistry and Immunology
### (Old & New)

*Time : 3 Hours]*                                   *[Max. Marks : 80*

*Instructions to the candidates:*

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

### SECTION - I
### (Medical Biochemistry)

*Q1)* Answer <u>any three</u> of the following:                    **[15]**

a) Discuss the role of antibiotics that affect transcription and translation in Prokaryotes.

b) How does mutations produce abnormal hemoglobins? Give the physiological disabilities caused by such mutations.

c) Describe the role of phospholipids in initiation of blood coagulation cascade and how does the clotting factors help in the formation of fibrin?

d) Explain the medical importance of analgesics and write note on their mechanism of action with suitable example.

*Q2)* Answer <u>any three</u> of the following:                    **[15]**

a) Explain the term carcinogenesis with the help of common causative agents.

b) Elaborate the role of lysosomes in receptor mediated endocytosis with suitable example.

c) Describe the effect of Death - inducing signal complex or DISC in activating the extrinsic pathway of apoptosis.

d) Discuss the etiology, clinical features and treatment of myocardial ischaemia.

**Q3)** Answer <u>any two</u> of the following: **[10]**

a) Importance of genetic counseling in prevention of genetic diseases.

b) Fibrinolysis.

c) Health hazards due to resistance shown by pathogens to specific antibiotics.

## SECTION - II

## (Immunology)

**Q4)** Answer <u>any three</u> of the following: **[15]**

a) Give the appropriate meanings of the following terms with respect to antigens.

  i) Haptens  ii) Specificity  iii) Antigenicity  iv) Carrier

  v) Complete antigens.

b) Write an account of the general structure of an immunoglobulin molecule giving reference to IgG molecule.

c) Compare and contrast cell mediated immunity and humoral immunity with respect to their function.

d) What is a monoclonal antibody and how is it produced?

**Q5)** Answer <u>any three</u> of the following: **[15]**

a) Explain the causative factor for erythroblastosis fetalis and discuss the preventive measures that is needed.

b) Describe the ouchterlony method of precipitin testing and explain how the results are interpreted.

c)   Discuss the etiology and treatment of AIDS.

d)   Differentiate between classical and alternate pathway of complement fixation.

*Q6)* Answer <u>any two</u> of the following:                              **[10]**

a)   Immunologic memory.

b)   Anaphylactic shock.

c)   Graft rejection.

❦ ❦ ❦

**P626**

**[3823] - 321**

**M.Sc.**

**BIOCHEMISTRY**

**BCH - 372 : Signal Transduction Pathways (Old & New)**

**Membrane Biochemistry and Specialized Tissues (Old)**

*Time : 3 Hours]* *[Max. Marks : 80*

*Instructions to the candidates:*

1) *All questions are compulsory.*

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

3) *Figures to the right side indicate full marks.*

4) *Candidates of old course should attempt Membrane Biochemistry as Section I and Section I (Signal Transduction Pathways) of new course as Section II (specialized Tissues) of old course.*

**SECTION-I**

*Q1)* Answer <u>any two</u> of the following: **[10]**

a) What is relaxation? How $Ca^{++}$ is segregated in sarcoplasmic reticulum.

b) Explain the mechanism of nerve impulse transmission.

c) Write in brief about Neurotransmitters.

*Q2)* Answer <u>any three</u> of the following: **[15]**

a) Explain the biochemistry of hearing.

b) How colour vision is mediated by cone cell? Explain the causes of colour blindness.

c) Describe the structural features of thin filament.

d) Describe in detail the primary events in visual cycle.

*Q3)* Write short notes on (any three): **[15]**

    a)    Biochemistry of taste.

    b)    Inactivation of $K^+$ channel.

    c)    Chemotaxis.

    d)    Inhibitors of nerve conduction.

## SECTION-II

*Q4)* Answer <u>any one</u> of the following: **[10]**

    a)    Describe in detail how natural, genetical and environmental factors affect the development of central nervous system.

    b)    How is action potential generated and propagated.

*Q5)* Answer <u>any three</u> of the following: **[15]**

    a)    Write short note on blood brain barrier.

    b)    Give an account on turnover and regulation of neuropeptides.

    c)    Describe neuroanatomy of brain.

    d)    Explain the different types of receptors along with their properties.

*Q6)* Write short notes on (any three): **[15]**

    a)    Peripheral nervous system.

    b)    Sensory Perception.

    c)    Calcium signaling.

    d)    Synapse structure.

## SECTION-I

### (Membrane Biochemistry)

*Q1)* Answer <u>any three</u> of the following: **[15]**

    a)    Describe the molecular mechanism of valinomycin.

    b)    Describe antibody-induced patching and capping of cell surface protein on a WBC.

    c)    Discuss the mode of transport of any three drugs in bacterial cell.

    d)    Explain with suitable example how the transport of solute across the membrane is checked.

*Q2)* Answer <u>any three</u> of the following:                                        **[15]**

   a)   Describe in detail the mechanism of protein targeting.

   b)   With suitable diagram describe fluid mosaic model of membrane structure.

   c)   Write short note on phospho-transferase system.

   d)   What is cerebro-spinal fluid? Give its functions.

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

   a)   Osmoregulation

   b)   Zinc fingers

   c)   Gap junctions.

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**P627**

**[3823] - 322**

# M.Sc.

# BIOCHEMISTRY

## BCH-373 : Recent Trends in Biochemistry & Toxicology

## (Old & New)

*Time : 3 Hours]*                                   *[Max. Marks : 80*

*Instructions to the candidates:*

*1) All questions are compulsory.*

*2) Figures to the right indicate full marks.*

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


### SECTION-I

### (Recent Trends in Biochemistry)

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

   a)   Describe biological applications of ESR spectroscopy.

   b)   Explain the theory of protein folding.

   c)   Describe α–helical structure of proteins and its stabilisation.

   d)   Applications of CD/ORD in nucleic acid studies.


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

   a)   Explain the phenomenon of fluorescence.

   b)   Principle and applications of GC-MS technique.

   c)   What is a patent? How is it filed?

   d)   Protein folding by chaperonins.

*Q3)* Write short notes: (Any two) **[10]**

    a)    Electron spray assisted ionisation.

    b)    Ampherometric biosensors.

    c)    LCMS technique.

## SECTION-II

## (Toxicology)

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

    a)    What are the different areas of the toxicology? Explain their role.

    b)    How toxic agents are classified?

    c)    Explain the dose-response relationship.

    d)    Distinguish between

        i)     Local and systemic toxicity.

        ii)    Venomous and paisonous animals.

    e)    How mutagenic potential of chemical agent is evaluated?

    f)    How animals develop the tolerance against the toxicants.

    g)    Explain in detail the idiosyncretic reactions.

*Q5)* Give the pathogenesis and clinical manifestations of any three. **[15]**

    a)    Cellular injury and lipid peraxidation by carbon tetrachloride.

    b)    Haematopaietic effects due to lead intoxication.

    c)    Urticaria and phototoxicity due to plant toxins.

    d)    Aplastic anemia and leukemia by benzene.

    e)    Muscarinic, nicotinic and CNS effects due to organophosphrous insecticides.

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

    a)    Explain the toxic effects caused by arsenic.

    b)    Give the forensic applications of toxicology.

    c)    What is the effect of cadmium an kidney function.

**P628**

**[3823] - 324**

**M.Sc.**

**BIOCHEMISTRY**

**BCH-375 : Nutrition and Clinical Nutrition**

**(New)**

*Time : 3 Hours]*                                              *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)   All questions are compulsory.*

    *2)   Figures to the right side indicate full marks.*

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

## SECTION-I

*Q1)* Answer <u>any three</u> of the following:                    **[15]**

    a)   What do you mean by BMR and SDA? How they are measured? Discuss their significance.

    b)   With reference to nutritional significance describe calcium, phosphorus, iodine and iron.

    c)   Describe in detail the deficiency disorders of vitamin B complex and give their biochemical basis of causation.

    d)   How will you measure the energy content in the foods?

*Q2)* Answer <u>any three</u> of the following:                    **[15]**

    a)   Explain the disorders caused due to protein deficiency in diet.

    b)   Describe how the nitrogen balance changes as per age from positive to negative.

    c)   'Protein is a building material of the body', support this statement with suitable example.

    d)   Give the physico-chemical properties of the carbohydrates.

*Q3)* Answer <u>any two</u> of the following:                                        **[10]**

      a)   Anaemia  b)   Allergy   c)   Starvation    d)   Diabetes

## SECTION-II

*Q4)* Answer the following: (Any three)                                        **[15]**

   a)   Explain how the Douglas bag method is used for measuring oxygen consumption.

   b)   How the data generated from clinical examination is useful for assessment of nutrition.

   c)   What is alcoholism? Explain the adverse effects of it.

   d)   Explain the term inborn errors of metabolism and explain in detail their nutritional management.

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

   a)   What are the effects of irradiation on food quality.

   b)   What are the factors that affect digestion and absorption of amino acids?

   c)   Explain the effects of cooking, refining and sprouting on nutritional quality of food.

   d)   Write a short note on effects of malnutrition on mental development.

*Q6)* Write notes on (Any two):                                        **[10]**

   a)   Effects of fermentation on food quality.

   b)   Amino acid therapy.

   c)   Geratic nutrition.

**P629**

[3823] - 331

# M.Sc.

# DRUG CHEMISTRY

**CH - 361 : Chemistry of Heterocycles and Biologically Active Compounds**

**(2008 Pattern) (Sem. - III) (New)**

*Time : 3 Hours]*                                                  *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

*Q1)* Explain <u>any four</u> of the following :                              **[12]**

a)   2-formyl pyrrole does not take part in Benzoin or perkin condensation while furfural does.

b)   2-amino quinoline on diazotization gives 2-quinolone.

c)   Fischer Indole synthesis using unsymmetrical ketones.

d)   Pyridine undergoes nitration with low yield, whereas pyrimidine is resistant to electrophilic substitution.

e)   Use of 1,3 dipolar cycloaddition reaction in the synthesis of isoxazole.

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

**[12]**

d) 

e) 
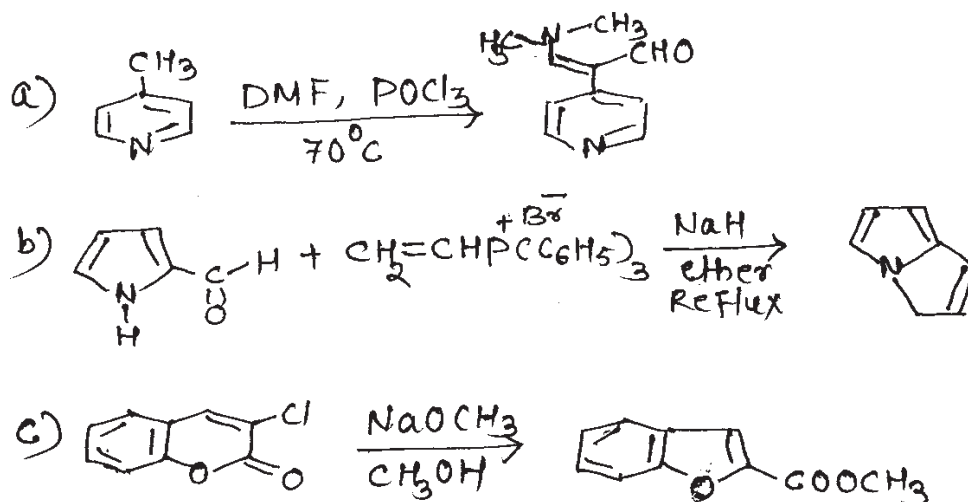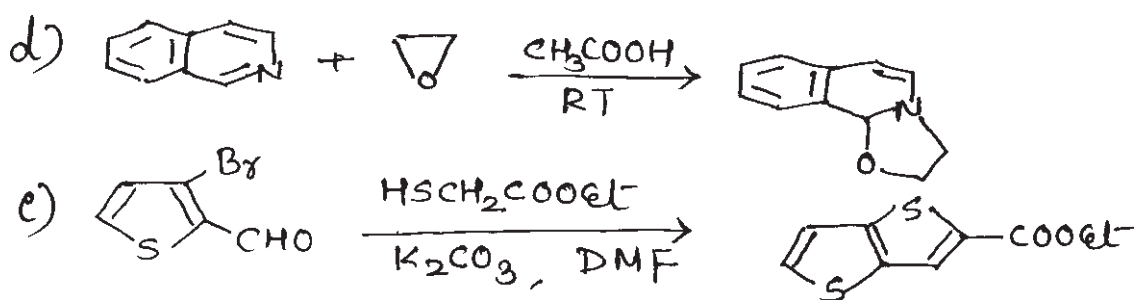
**Q3)** a) Give any one method with mechanism to synthesize following heterocycles (any two) : **[7]**

   i)   Ethyl furan tetracarboxylate.

   ii)  2,5 diphenyl imidazole.

   iii) 8-chloro, 7-hydroxy isoquinoline.

b) Explain the steps involved in the following synthesis giving suitable mechanism & reagents (any three) : **[9]**
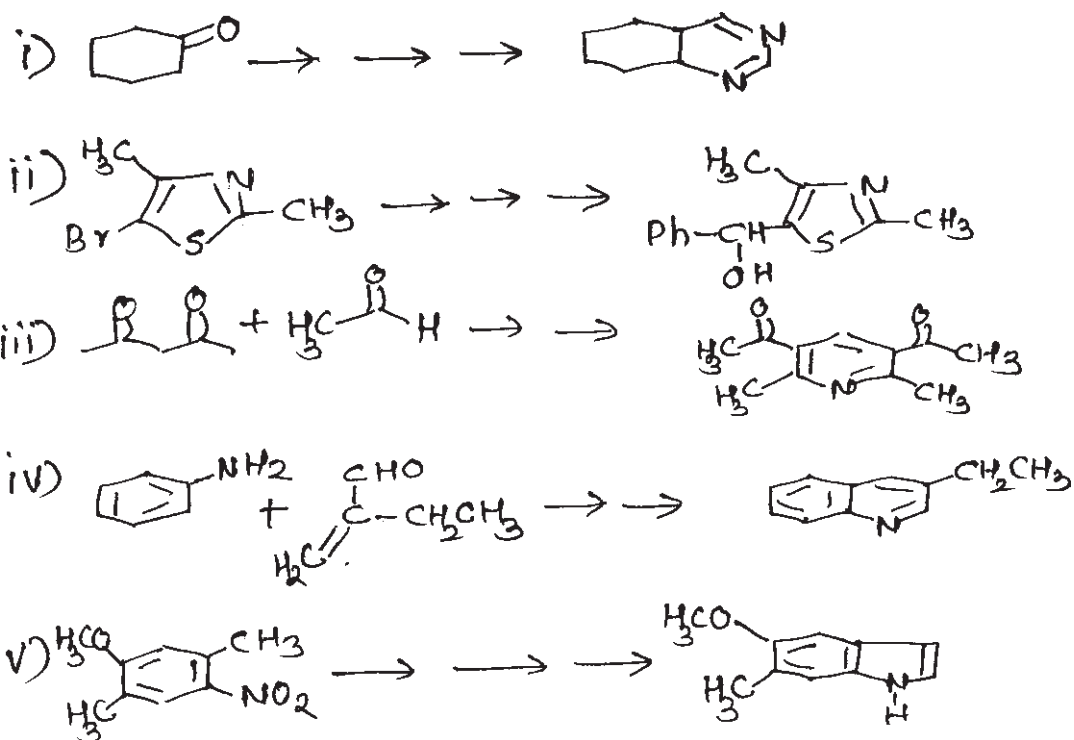


## SECTION - II

**Q4)** Describe the steps involved in the synthesis of following drug molecules or intermediates. Explain the mechanism (any four) : **[16]**

a)

b)

c)

d)

e)
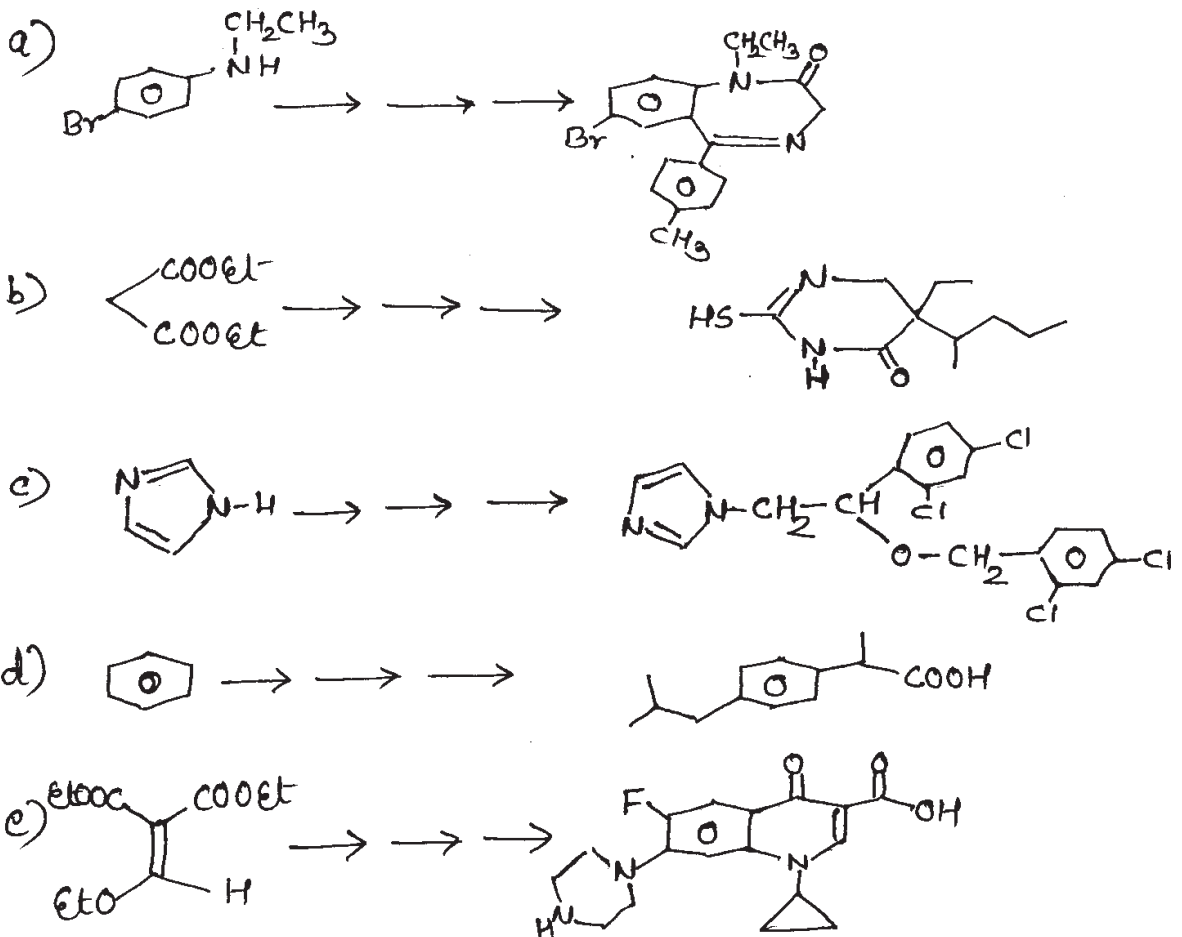
**Q5)** Discuss the synthesis of the following drugs comment on the reagents used and the mechanism involved (any three) : **[15]**

a)

b)

c)

d)



e)
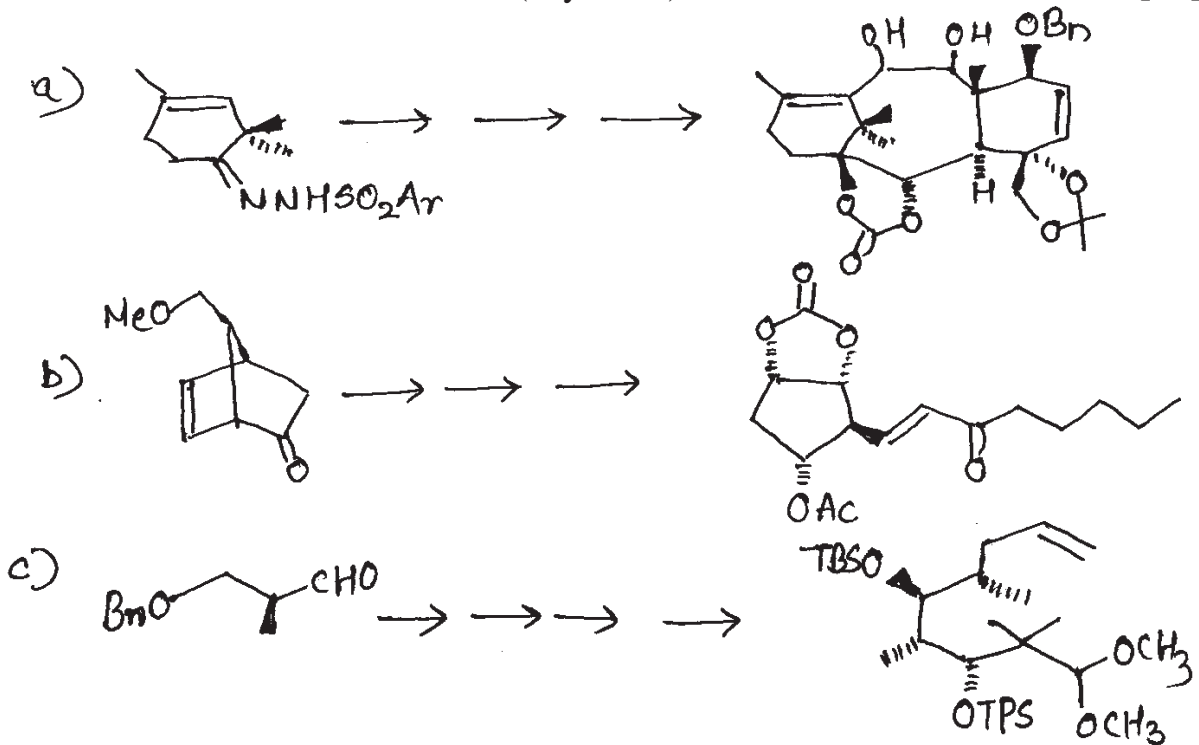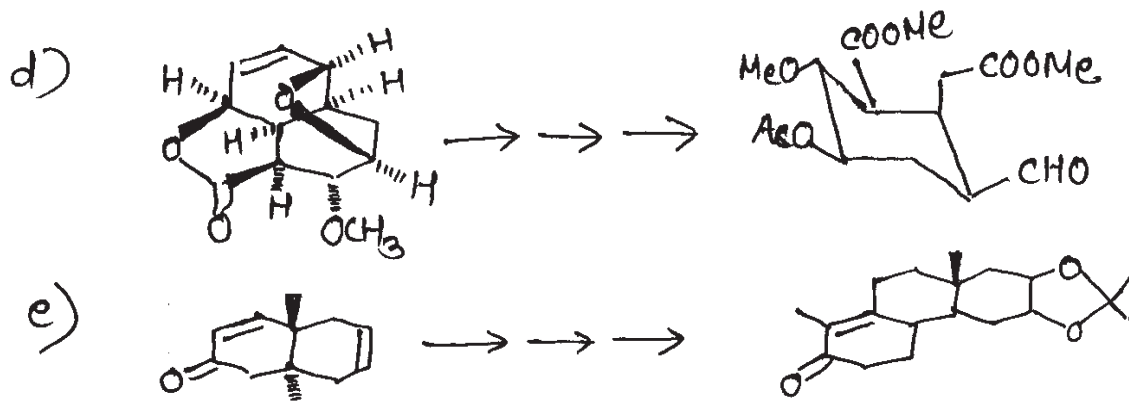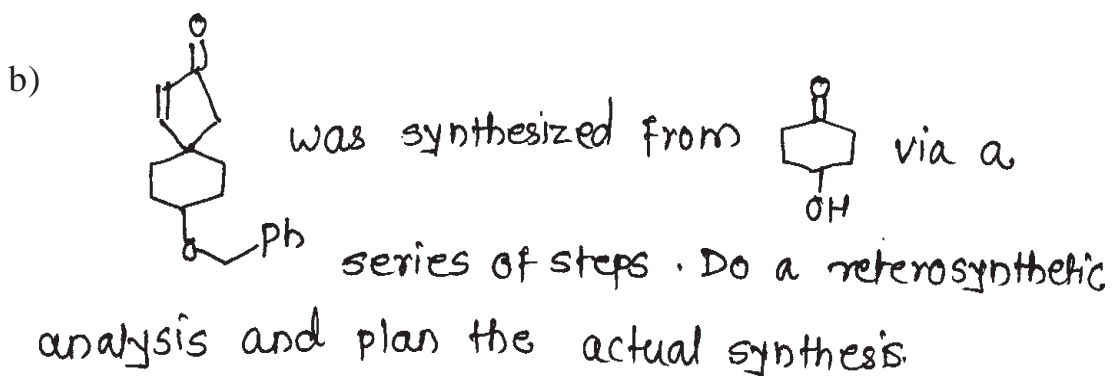


**Q6)** Answer any two of the following : [9]

a) Explain with examples following reactions (any two)

   i) Suzuki coupling.

   ii) Robinson annulation Reaction.

   iii) Role of protecting groups in drug synthesis.

b)



was synthesized from [structure] via a series of steps. Do a reterosynthetic analysis and plan the actual synthesis.

c) Discuss the reterosynthesis of Epothialone from the following intermediates. Explain the synthesis of atleast one of these intermediates A, B & C



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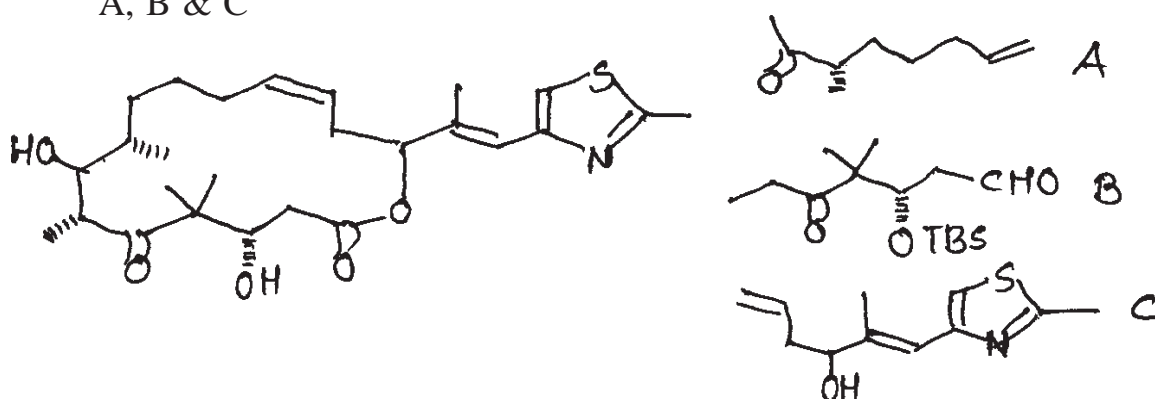
**P630**

**[3823] - 332**

# M.Sc.

## DRUG CHEMISTRY

## CH - 362 : Advanced Analytical Methods

## (2008 Pattern) (New)

*Time : 3 Hours]*        *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*    *All questions are compulsory.*

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

    *3)*    *Figures to the right side indicate full marks.*

## SECTION - I

*Q1)* Explain <u>any four</u> of the following :        **[12]**

    a)    Tetra substituted carbon atoms shows weak peaks in CMR.

    b)    In t-butyl cyclohexane, two signals for three methyl groups are observed at - 40°C in PMR.

    c)    Molecular ion peak is absent in MS of alcohols for EI technique.

    d)    DEPT Experiment is preferred over APT experiment.

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

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

    a)    Predict the structure from the spectral data given below.

        M.F.   :   $C_7H_{14}O_2$

        Mass   :   130, 115, 98, 73, 43

        CMR   :   208(s), 75(s), 54(t), 50(q), 33(q), 25(q,str.)

b) Deduce the structure of the compound

C : 60.95%; H : 8.11%

IR : 1745, 1190 cm$^{-1}$

CMR : 18.1(q), 27(d), 58(t), 61(t), 180(s)

PMR : 1.27(d, 7Hz, 3H); 2.55(m, 1H); 3.78(t, 8Hz, 1H)

3.84(d, 16Hz, 1H); 4.07(d, 16Hz, 1H)

4.49(dt, 8 & 7Hz, 1H)

c) Predict the structure

M.F. : $C_8H_9FO$

PMR : 1.38(d,7Hz, 3H); 3.2(s, exch., 1H)

4.75(q, 7Hz, 1H); 6.98(dd, 11 & 8Hz, 2H)

7.22(dd, 8 & 3Hz, 2H)

d) Deduce the structure from the following CMR data

M.F. : $C_{10}H_{15}N$

CMR : 10.2(q), 20.1(q), 29.6(t), 49.7(d),

113.1(d, str.), 116.6(d), 129.1(d, str.), 147.7(s)

e) On dehydration 3-hexanol affords a product mixture of four components whose CMR data is as follows. Assign the structure to the four products.

A : 12.3, 13.5, 23, 29.3, 123.7, 130.6

B : 13.5, 17.5, 23.1, 35.1, 124.7, 131.5
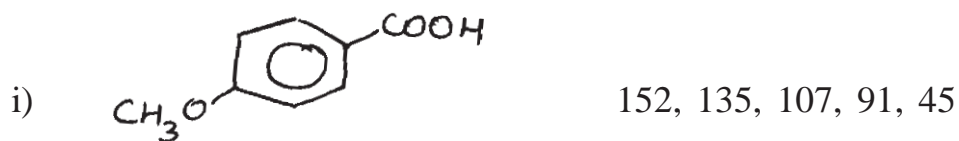
C : 14.3, 20.6, 131.0

D : 13.9, 25.8, 131.2

*Q3)* Write short notes on <u>any three</u> of the following : [12]

a) Lanthanide shift reagents.

b) Ion quadrupole mass filter analyzer in MS.

c) Off-resonance technique in CMR.

d) HETCOR.

**Q4)** a) Explain the genesis of the following ions (any three) : **[9]**

i)  152, 135, 107, 91, 45

ii)  102, 87, 73, 59, 57, 45, 31, 29

iii)  73, 72, 58, 44, 30

iv)  172, 130, 115, 57
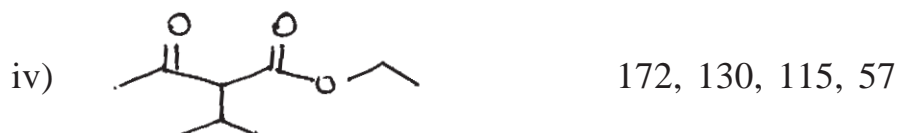
b) How could the progress of the claisen rearrangement of the ether shown below be followed by the mass spectral fragmentation patterns? **[3]**
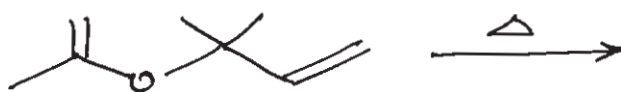


**Q5)** a) Assign the signals to the different protons of compound x. Use the decoupling experiment for assignments and justify your answer. **[8]**



X
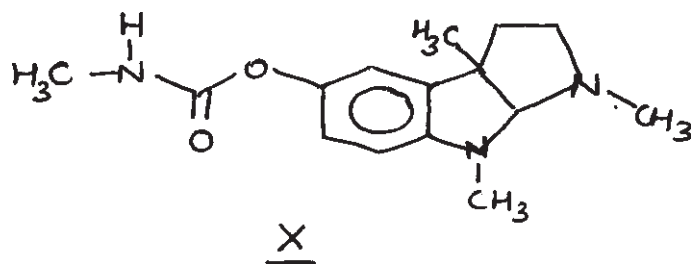
1.42(s, 3H); 1.95(t, 6Hz, 2H); 2.55(s, 3H); 2.7(t, 6Hz, 2H);

2.82(d, 6Hz, 3H); 2.92(s,3H); 4.12(s, 1H); 5.33(q, 6Hz, 1H);

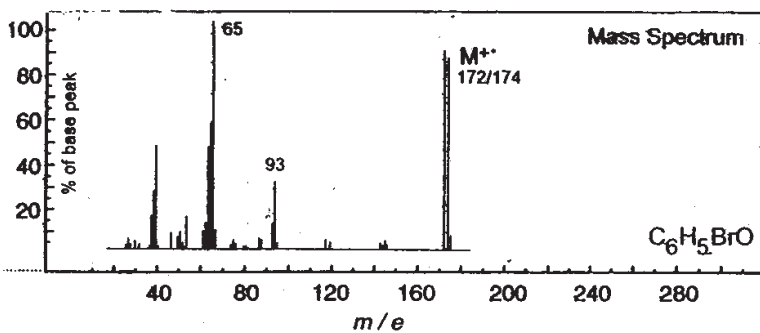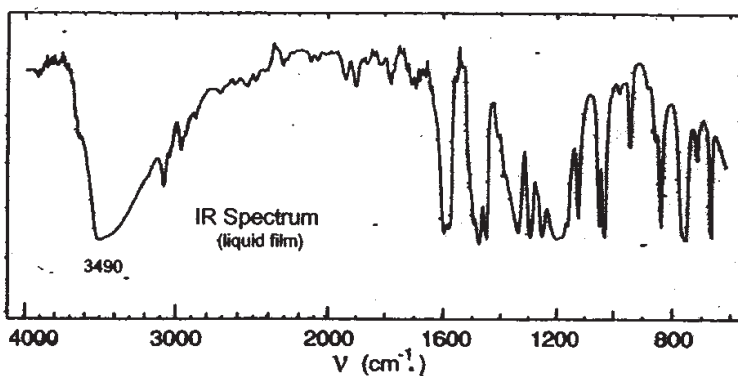6.37(d, 8Hz, 1H); 6.78(d, 2Hz, 1H); 6.87(dd, 8 & 2Hz, 1H)

Spin decoupling Expt : Irradiate at      Change at

1) 2.82 δ        5.33 (s)

2) 1.95 δ        2.70(s)

b) Answer <u>any two</u> of the following : [8]

    i) Discuss the various detectors used in GCMS.

    ii) Explain the theory and instrumentation of HPTLC.

    iii) Discuss the various columns used in HPLC.
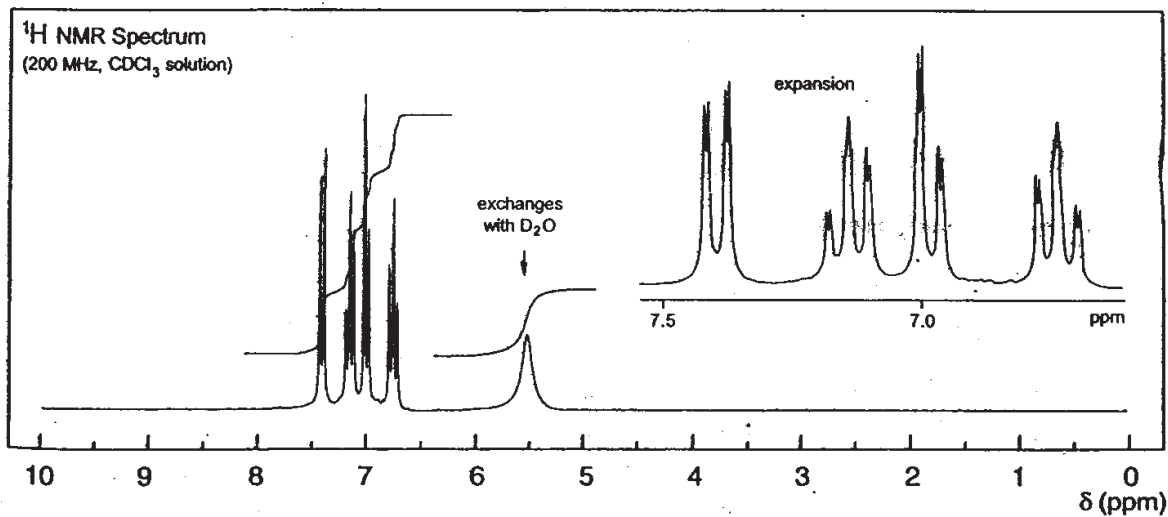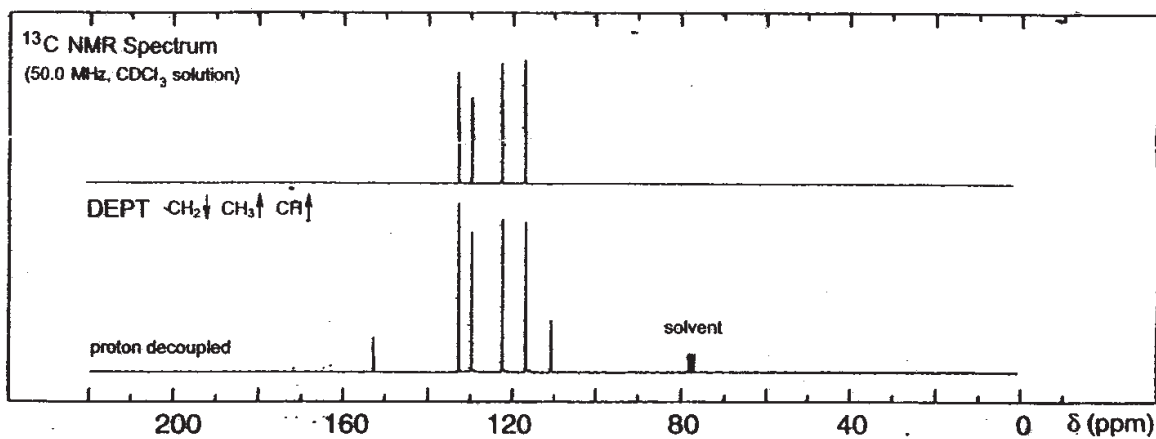
*Q6)* A compound exhibits the spectral properties shown on the attached sheet. Suggest the structure and explain the spectral data. [12]

IR Spectrum
(liquid film)

3490

4000   3000   2000   1600   1200   800

V (cm⁻¹.)

Mass Spectrum

65

M⁺·
172/174

93

C₆H₅BrO

40   80   120   160   200   240   280

m/e

UV Spectrum

λmax 277 nm (log₁₀ε 3.4)

solvent : methanol

¹³C NMR Spectrum
(50.0 MHz, CDCl₃ solution)

DEPT  -CH₂↓ CH₃↑ CH↑

proton decoupled

solvent

200   160   120   80   40   0   δ (ppm)

¹H NMR Spectrum
(200 MHz, CDCl₃ solution)

expansion

exchanges
with D₂O

7.5   7.0   ppm

10   9   8   7   6   5   4   3   2   1   0

δ (ppm)

❖ ❖ ❖ ❖

**P631**

[3823] - 333

**M.Sc.**

**DRUG CHEMISTRY**

**CH - 363 : Drug Development**

**(2008 Pattern) (New) (Sem. - III)**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

*1)* *All questions are compulsory.*

*2)* *Figures to the right -indicate maximum marks.*

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

**SECTION - I**

*Q1)* Answer <u>any three</u> of the following :                    **[15]**

a) Comment on physical, chemical and biological treatment of industrial waste? Why this treatment in necessary before disposal of waste?

b) Differentiate between diffusion and turbidometric microbial assays.

c) List different techniques used in strain improvement and explain any two in detail.

d) How microorganisms are classified on the basis of carbon and energy source?

e) With neat ray diagram show the steps of upstream and downstream processing in a typical fermentor.

*Q2)* Answer <u>any three</u> of the following :                    **[15]**

a) What is hypersensitivity? Explain any one type of hypersensitivity.

b) How ELISA test is carried out? What are its advantages.

c) What is innate immunity? Briefly describe the body components involved in innate response.

d) What is immunization? How vaccines are prepared?

e) How T-cells present antigens to activate the adaptive immune response?

*P.T.O.*

*Q3)* Answer <u>any two</u> of the following : **[10]**

a) What is a drug? Why do some drugs exhibit side effects? Discuss with examples.

b) Give a brief account of drugs obtained from plants & marine sources.

c) Explain the following terms

i) $IC_{50}$ & $ED_{50}$.

ii) Potency & Efficacy.

iii) Therapeutic Index & therapeutic window.

## SECTION - II

*Q4)* Answer <u>any three</u> of the following : **[18]**

a) Discuss in brief strategies involved in lead discovery. What is the new for lead development?

b) You are entrusted to discover a new anti AIDS drug. How will you proceed to achieve your target. Explain the steps involved.

c) What is the need for so many dosage forms of drugs? Justify with proper examples.

d) Define patent. Which inventions are not patentable? What is the process involved in the grant of a patent?

*Q5)* Answer <u>any two</u> of the following : **[12]**

a) Describe in brief the intentions & objectives of phase I, II & III of clinical trials? Explain in details how phase II is conducted.

b) Give a brief commentary on toxicological evaluation of NCE. Discuss the tests carried out for subacute & chronic toxicity studies.

c) Discuss <u>any two</u> of the following :

i) Strategies of lead development.

ii) Bioavailability & Bioequivalence.

iii) Phase I & Phase II metabolism.

*Q6)* Answer <u>any two</u> of the following : [10]

    a) Explain in brief the strategies involved in process development & scaling up of an process.

    b) Discuss in brief with proper examples how invivo & invitro assays are performed to check the biological activity of a new chemical entity.

    c) Discuss the role of the following with respect to a pharma industry

        i) QA & QC.

        ii) FDA.

        iii) Industrial Hygiene.

❖ ❖ ❖ ❖

**P632**

[3823] - 334

# M.Sc.

## DRUG CHEMISTRY

## CH - 364 : Stereochemical Principles and Applications

## (New) (2008 Pattern)

*Time : 3 Hours]*                                                      *[Max. Marks : 80*

***Instructions to the candidates:***

   *1)    All questions are compulsory.*

   *2)    Figures to the right indicate full marks.*

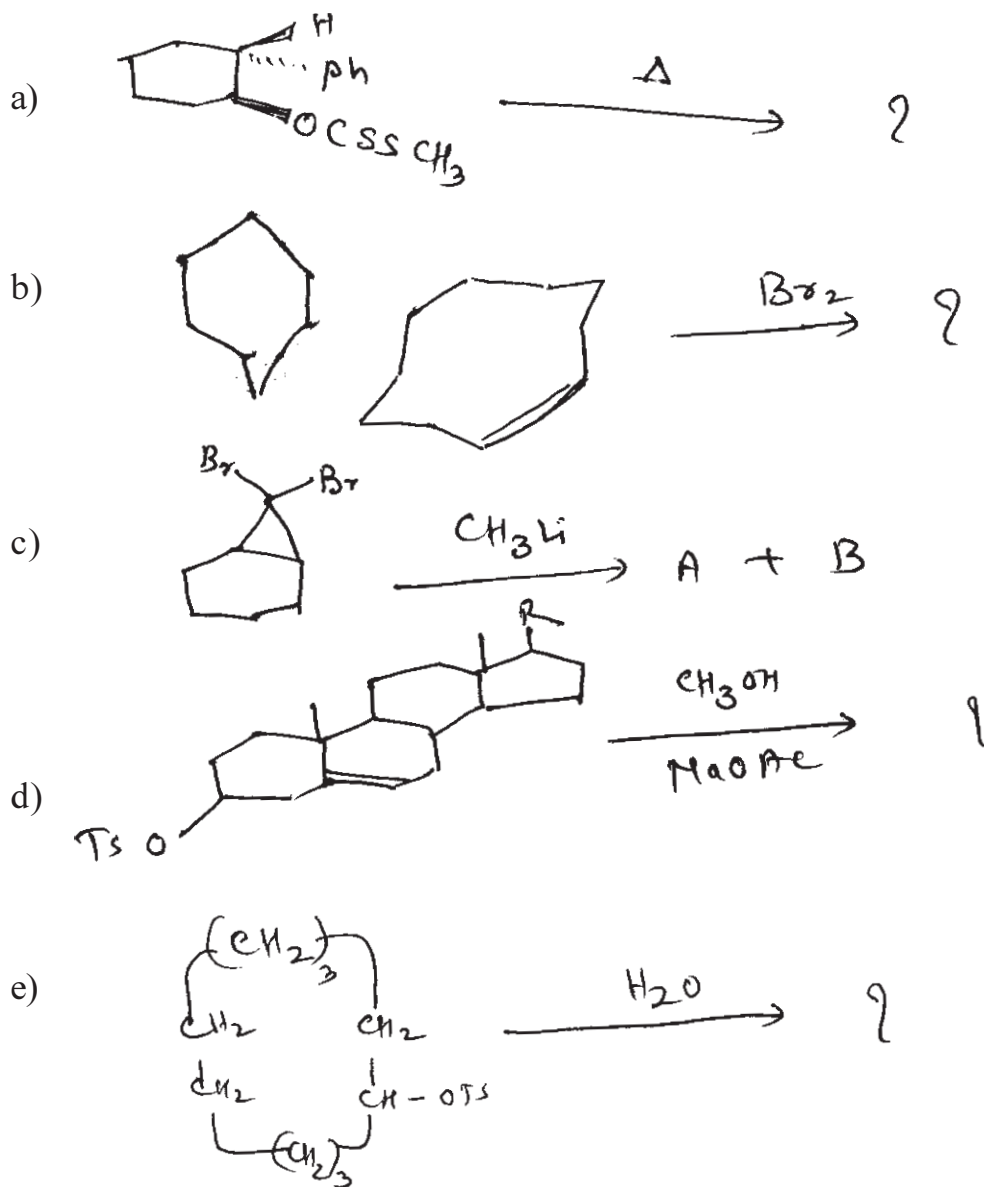   *3)    Answers to the two sections should be written in the separate answer books.*

## <u>SECTION - I</u>

*Q1)* Answer <u>any four</u> of the following :                          **[16]**

   a)   In 3 and 4 membered rings $SP^2$-$SP^3$ is facile process, where as in 5 membered rings $Sp^3$–$Sp^2$ is facile process. Explain.

   b)   Bromocamphour fails to undergo dehydrobromination an treatment with base. Explain.

   c)   Cis - 1, 2-cyclohexane diol is 22 times more reactive than trans 1, 2-cyclohexane diol, towards lead tetracetate oxidation. And cis 1,2-cyclopentane diol is 3000 times more reactive than its trans isomer towards lead tetracetate oxidation. Explain.

   d)   For cyclohexane 1, 2-dicarboxylic acid $pk_2$-$pk_1$ is higher than its trans isomer.

   e)   Trans 4-t butylcyclohexanol is more strongly adsorbed on aluminum than cis-isomer.

*Q2)* Write the mechanism of <u>any four</u> of the following. Explain the stereo chemical principles involved                                              **[12]**

*P.T.O.*

a) $\xrightarrow{\Delta}$ ?

H
ph
OCSS CH₃

b) $\xrightarrow{Br_2}$ ?

c) $\xrightarrow{CH_3Li}$ A + B

Br—Br

d) $\xrightarrow[NaOAc]{CH_3OH}$ ?

R

Ts O

e) $\xrightarrow{H_2O}$ ?

(CH₂)₃
CH₂    CH₂
CH₂    CH—OTs
(CH₂)₃

**Q3)** Solve <u>any three</u> of the following :                    **[12]**

a) Write short note on 'Van Auwer's Skita rule' give its limitations.

b) Draw the stereo structures of perhydro phenonthrocene write their nomenclature.

c) Relative rate of acetolysis for the following compounds are mentioned below. Explain.

OTs

TsO

OTs

$10^{11}$        $10^4$        1
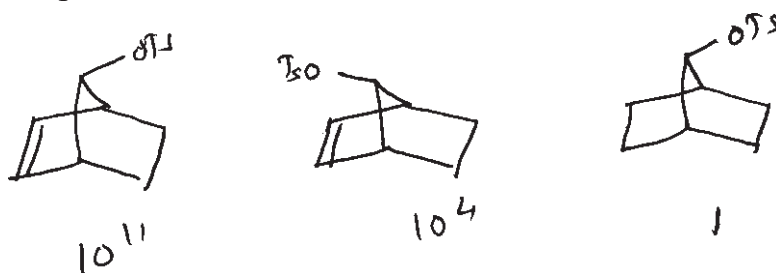
d) Bicyclo [2, 2, 2] octane-2, 6-dione (A) does not show acidic properties, while comphenic acid (B) does not readily undergo decarboxylation.
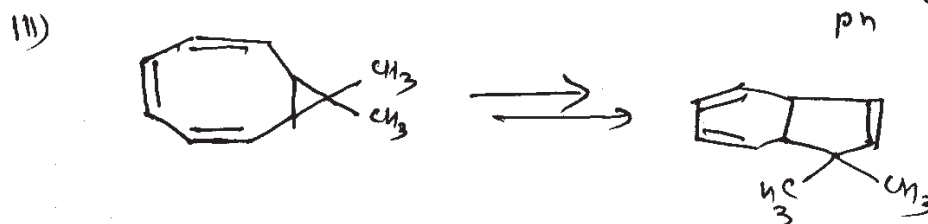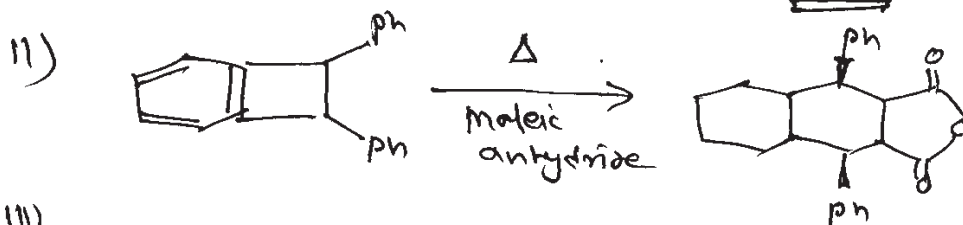


(A)

(B)

## SECTION - II

**Q4)** a) Draw co-relation diagram for cycloaddition between 1,3-butadiene and ethylene. Explain supra and antra focial reaction conditions. **[6]**

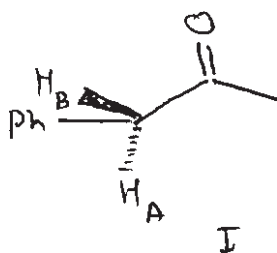b) Predict the product/s in the following reactions (any two) : **[5]**
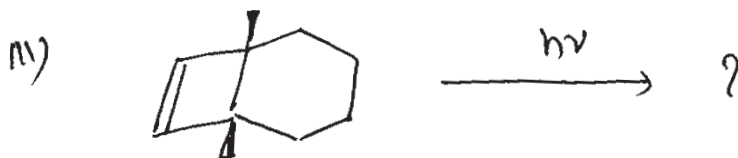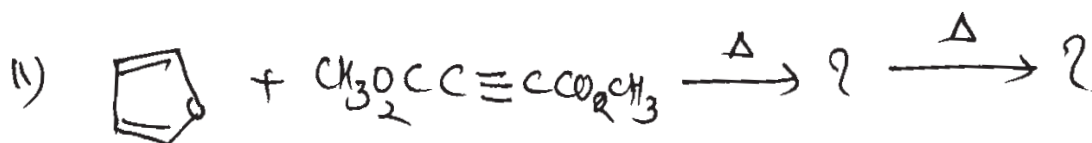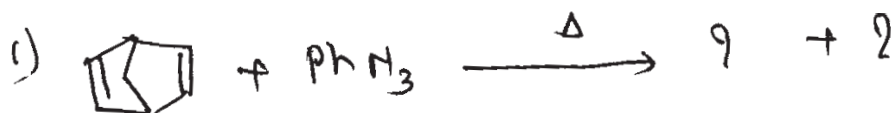


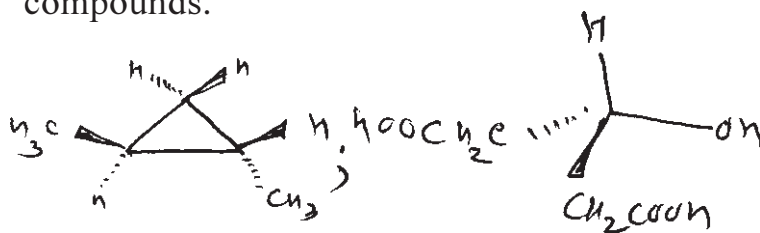c) Suggest mechanism for any two of the following : **[5]**

**Q5) a)** Attempt the followings (any two) : [6]

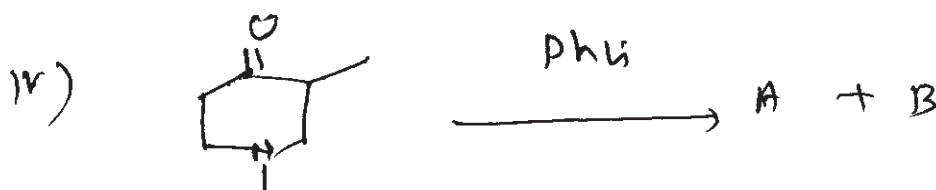i) Write pro-R / pro-S for $H_A$ & $H_B$ in compound I
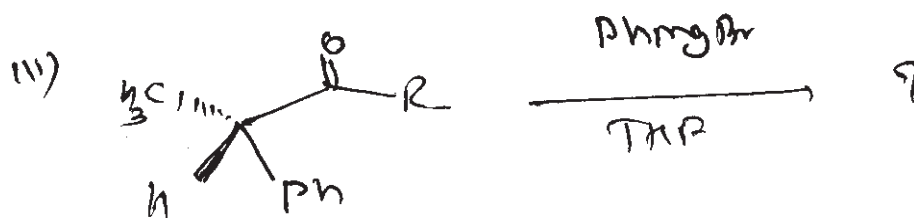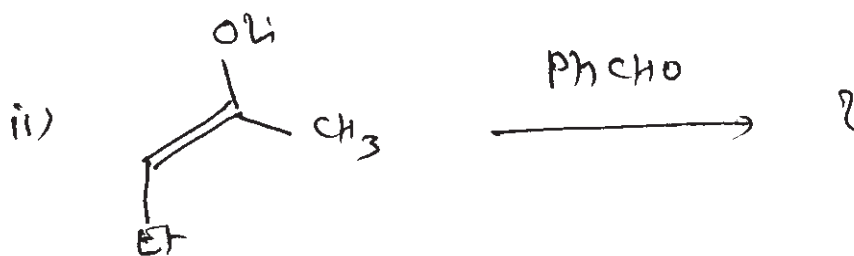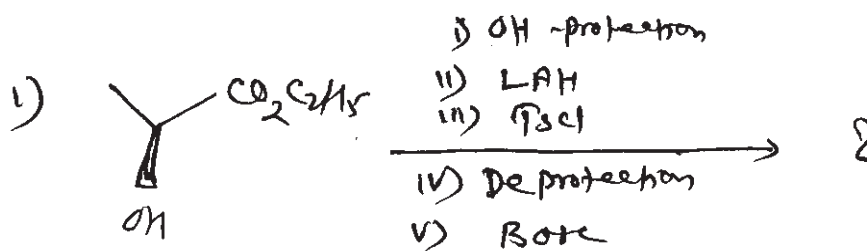


ii) Identify the homotopic or heterotopic groups/atoms in following compounds.



iii) Explain the Felkin's model and Cram's model with suitable example.

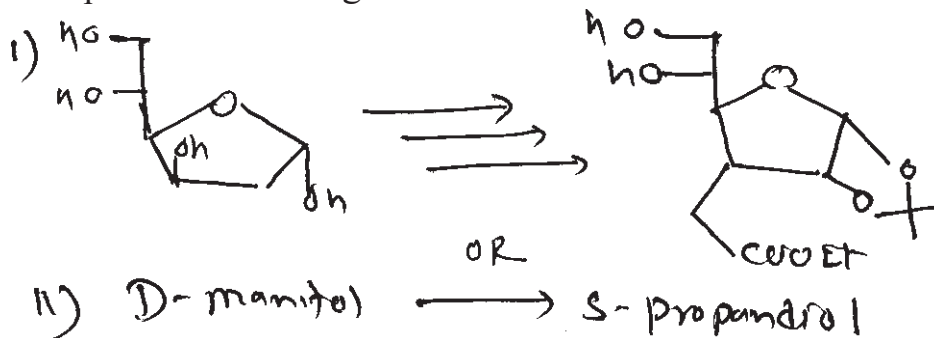b) Predict the product/s in the following reactions (any three) [6]

i)



   i) OH -protection
   ii) LAH
   iii) Tscl
   iv) De protection
   v) Bore

ii)



   PhCHO ⟶ ?

iii)



   PhmgBr / THF ⟶ ?

iv)



   PhLi ⟶ A + B

*Q6)* Attempt the following (any four) : **[12]**

a) Hexose 'C' on catalytic reduction give two hexahydric alcohol D, and E. Compound D can be obtained from D(+) glucose identify C, D, E.

b) Write short note on 'Anomeric effect'.

c) Complete the following reactions.



d) Give the product/s obtain when D-Glucose is reacted with

   i) PhMHNH$_2$     ii) Br$_2$ water     iii) CH$_3$OH | HCl

e) Write ring structure for (any one) :

   i) D-Glucose → D-Gluco furanose.

   ii) D-Glucose → D-Gluco pyranose.

f) Give the reagents for the following reaction products.



❖ ❖ ❖ ❖
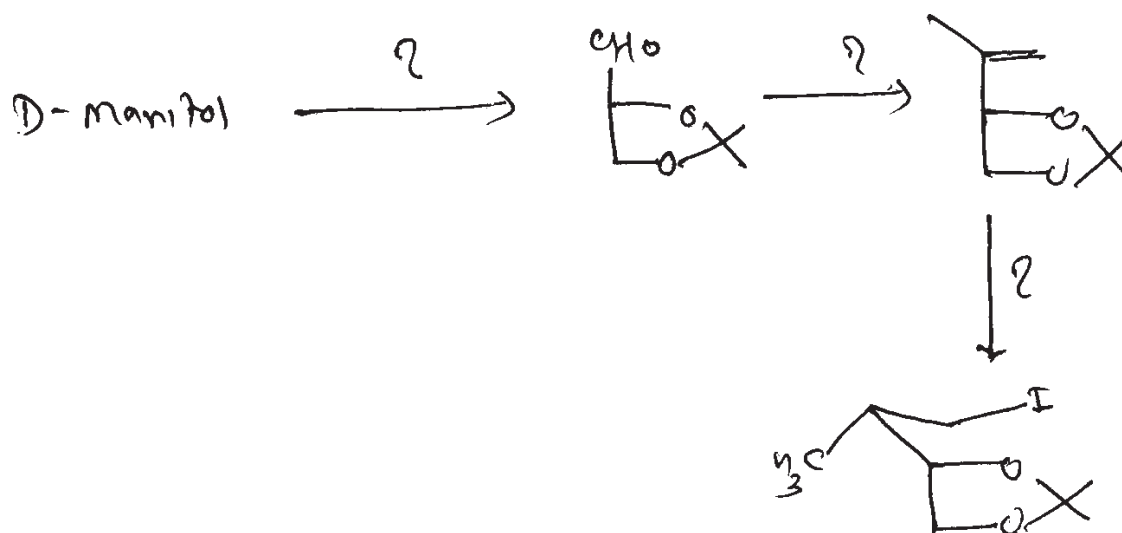
**P633**

**[3823] - 401**

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CH - 410 : Molecular Structure and Spectroscopy (New)**

*Time : 3 Hours]*                                              *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*    *Answers to the TWO sections should be written in separate answer books.*

    *2)*    *All questions are COMPULSORY.*

    *3)*    *Figures to the RIGHTSIDE indicate FULL marks.*

    *4)*    *Use of logarithmic tables/calculator is ALLOWED.*

    *5)*    *Neat diagrams must be drawn WHEREVER necessary.*
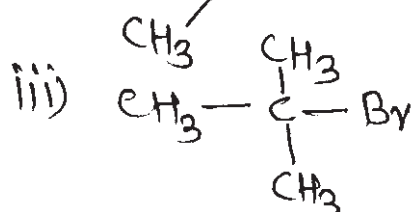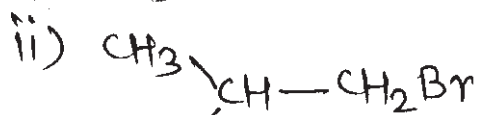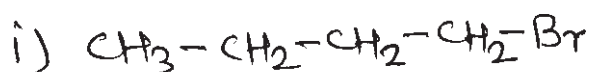
## Physico - Chemical Constants

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

*P.T.O.*

# SECTION - I

*Q1)* Attempt <u>any three</u> of the following : **[15]**

    a)   Explain the nature of AB and $A_2$ type of nmr spectra and deduce the situations when AB spectrum is reduced to $A_2$.

    b)   Explain the principle and mechanism of FT nmr.

    c)   Write a note on MRI?

    d)   Differentiate the following compounds on the basis of $^{13}C$ nmr data. Justify.

        i) $CH_3-CH_2-CH_2-CH_2-Br$

        ii) $\underset{CH_3}{\overset{CH_3}{\diagdown}}CH-CH_2Br$

        iii) $CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-Br$

    e)   What are limitations of NQR? Explain.
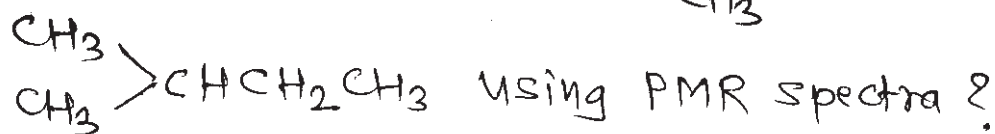
*Q2)* Attempt <u>any three</u> of the following : **[15]**

    a)   What is the experimental set up used in the electron spin resonance spectroscopy? Explain with a suitable diagram.

    b)   Discuss the concept of zero field splitting and Kramer's degeneracy.

    c)   Distinguish between nmr and esr spectroscopy.

    d)   What is the principle of photoacoustic spectroscopy (PAS)? How PAS is useful in the study of gases and condensed systems?

    e)   State and explain Mc Connell equation.

*Q3)* Solve <u>any two</u> of the following : **[10]**

    a)   Predict the intensity distribution in the hyperfine lines of the esr spectrum of the radicals $^{\cdot}CH_3$ and $^{\cdot}CD_3$.

b)  How will you distinguish among

$$CH_3CH_2CH_2CH_2CH_3, \quad CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3 \text{ and}$$

$$\underset{CH_3}{\overset{CH_3}{>}}CHCH_2CH_3 \text{ using PMR spectra ?}$$
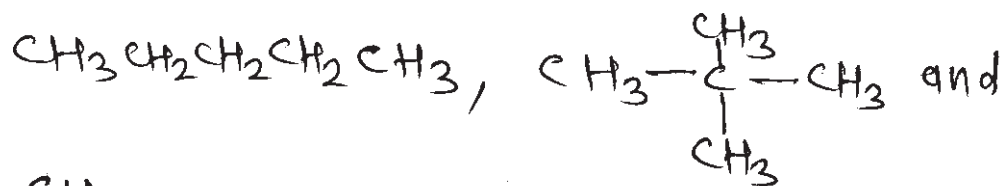
c)  Calculate the esr frequency of an unpaired electron in a magnetic field 3300 G. [Given : $g_e = 2$]

## SECTION - II

*Q4)* Attempt <u>any three</u> of the following :          [15]

a)  How are x-rays produced and detected?

b)  Define diffraction and give a brief account of any one method for investigating the structure of crystal.

c)  How can be unit cell identified from systematic absences in diffraction pattern.

d)  State the principle of electron diffraction. Enlist its applications.

e)  Discuss Wierl equation for electron diffraction.

*Q5)* Attempt <u>any three</u> of the following :          [15]

a)  Discuss some remarkable differences between x-ray diffraction and electron diffraction.

b)  Define and explain the terms :
    i)   Pole strength
    ii)  Magnetic field and
    iii) Intensity of magnetization.

c)  Explain the characteristic properties of diamagnetic, paramagnetic and ferromagnetic substances.

d)  Explain the principle and working of non-uniform field method. State its advantages and disadvantages.

e)  Derive Van Vleck's equation for susceptibility.

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

a)  Calculate the molar diamagnetic susceptibility of benzene using Pascal constants.

[Given : $\chi_A$ of c $=-6.0 \times 10^{-6}$, $\chi_A$ of H $=-2.93 \times 10^{-6}$, $\lambda$ for ring $=-0.24 \times 10^{-6}$]

b)  A powdered camera was used to determine the spacing in a powdered crystal. The radius of the camera was 57.296 mm and the incident radiation was the Cu $k_\alpha$ line. The distance 'S' on the developed film between the two opposite arcs of one of the diffracted cones of x-rays was 45.08 mm. Determine the internuclear spacing 'd' that caused the diffraction. ($\lambda = 0.154$ nm).

c)  A powder diffraction pattern of lead was obtained with Cu-$k_\alpha$ radiation ($\lambda = 1.539$ Å). Calculate the 'd' value of the interplanar distance which gives rise to a first order line at sin $\theta = 0.734$.

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**P634**

[3823] - 402

# M.Sc.

## PHYSICAL CHEMISTRY

## CH - 411 : Surface and Electrochemistry (New)

*Time : 3 Hours]*                                              *[Max. Marks : 80*

*Instructions to the candidates:*

1) *Answers to the TWO sections should be written in SEPARATE answer books.*
2) *ALL questions are COMPULSORY.*
3) *Figures to the RIGHTSIDE 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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| 1. | Avogadro Number | N | = | $6.022 \times 10^{23}$ mol$^{-1}$ |
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| 4. | Electronic Charge | e | = | $4.803 \times 10^{-10}$ esu |
| | | | = | $1.602 \times 10^{-19}$ C |
| 5. | 1 eV | | = | 23.06 k cal mol$^{-1}$ |
| | | | = | $1.602 \times 10^{-12}$ erg |
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| | | | = | 8065.5 cm$^{-1}$ |
| 6. | Gas Constant | R | = | $8.314 \times 10^{7}$ erg K$^{-1}$ mol$^{-1}$ |
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| 12. | Nuclear magneton | $\beta_n$ | = | $5.051 \times 10^{-27}$ J T$^{-1}$ |
| 13. | Mass of an electron | $m_e$ | = | $9.11 \times 10^{-31}$ kg |

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

    a)    What is surface excess? Give its determination by microtome method.

    b)    Explain the mechanism of detergent action.

    c)    Derive the general form of the Langmuir equation. State the condition at which it gets reduced to Freundlich's equation.

    d)    Discuss the mechanism of chemisorption with the help of localized bond approach.

    e)    Give the comparison between B.E.T. and H-J equations.

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

    a)    Discuss the Polanyi theory of multilayer adsorption.

    b)    Describe the 'mercury porosimeter method' for obtaining the pore size distribution.

    c)    Explain the catalysis with the help of chemical approach. Name any two industrial catalysts with reactions.

    d)    Define the terms :

        i)    Negative catalyst

        ii)    Turnover number

        iii)    Functionality

        iv)    Sites and

        v)    Catalyst selectivity.

    e)    Explain how are zeolites used as carriers of radioactive wastes.

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

    a)    A monomolecular film containing 0.82 mg protein per $m^2$ gave the surface tension lowering of 0.036 dyne per cm at 27°C. Calculate the molecular weight of the protein.

b) For a 0.05M solution of phenol in water at 20°C, $\dfrac{dr}{dc} = -165$ erg.cm$^{-2}$ mole$^{-1}$. $l$.

    i)    Determine how much phenol in moles per sq.cm is adsorbed.

    ii)   How many molecules are there per sq.cm?

    iii)  Per Å$^2$?

c) The adsorption of a gas is described by the Langmuir isotherm with K = 0.85 kPa$^{-1}$ at 25°C. Find the pressure at which the surface coverage is 30%.

## SECTION - II

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

a) Write Bernal-Fowler equation for heat of solution and explain the terms involved in it.

b) Explain the term activity coefficient. Write the Debye-Huckel equation for appreciable concentration and explain the terms involved in it.

c) Derive Nernst-Einstein relation between diffusion coefficient and equivalent conductance.

d) Describe potential theory of electrical double at electrode-solution interface.

e) Write the Butler-Volmer equation explaining the terms involved in it and explain the concept of exchange current density.

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

a) Discuss the various types of potentials existing at electrode-solution interface.

b) Describe the Wagner-Traud mechanism for corrosion of ultra-pure metals.

c) Explain with suitable example the primary cells.

d) What are fuel cells? Discuss various types of efficiencies used to evaluate performance of the cell.

e) Describe electrosynthetic method of preparing phenol from benzene and 2-propanol from acetone.

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

a)   Calculate the ionic strength of

   i)    0.1M $MgCl_2$

   ii)   0.01M NaI

   iii)  0.001M $FeSO_4$ solutions.

b)   The drift velocity of an univalent ion is $5 \times 10^{-8}$ cm s$^{-1}$, under potential gradient of 0.5 mV cm$^{-1}$. Calculate the absolute ionic mobility and conventional ionic mobility of ion.

c)   The exchange current density for the reaction $H^+ + e \rightarrow \dfrac{1}{2}H_2$ on tin at 25°C is $1 \times 10^{-5}$cm$^{-2}$. What current density would be necessary to attain an overpotential of 0.1V? (transfer coefficient is 0.5).

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**P635**

[3823] - 403

# M.Sc.
## PHYSICAL CHEMISTRY
## CH - 414 : Biophysical Chemistry & Related Techniques (New)

*Time : 3 Hours]*                                                    *[Max. Marks : 80*

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

### Physico - Chemical Constants

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*P.T.O.*

## SECTION - I

**Q1)** Attempt <u>any three</u> of the following : **[15]**

a) Discuss the dimensions of biopolymers relative to those of the atom, the molecule and cellular dimensions. Compare eukaryotes and prokaryotes.

b) Explain the strategy adopted to study the details of a biophysical macromolecule.

c) How is functionality regulated in macromolecules?

d) Discuss the classification of amino acids. Explain the colour tests of proteins.

e) Compare the RNA and DNA molecules.

**Q2)** Attempt <u>any three</u> of the following : **[15]**

a) Deduce the expression

$$\overline{R}_{mp} = \sqrt{\frac{2N}{3}} \times l$$

where the terms have the usual significance in polymer chains.

b) Write Henderson-Hassalbalch equation, explain the terms involved in it. Give its application.

c) Write a note on folding and unfolding of protein molecules.

d) Discuss the role of $Ca^{++}$ in muscle contraction.

e) Write a note on the role of ATP in cellular processes.

**Q3)** Solve <u>any two</u> of the following : **[10]**

a) Evaluate $R_{rms}$ for a randomly coiled polymer chain. The number of bonds is 4000 and the bond length is 154 pm.

b) Calculate the pH of a 4 L solution containing $10cm^3$, 5M $CH_3COOH$ and $10cm^3$, 1M $CH_3COONa$ [pKa = 4.7447].

c) The molecular weight of haemoglobin is 64500 daltons. Calculate the mass of a single haemoglobin molecule in kg.

## SECTION - II

**Q4)** Attempt <u>any four</u> of the following :                                    **[20]**

a)   Describe the lamellar models to explain the structure of cell membrane.

b)   Explain the role of channel proteins and carrier proteins in ion transport.

c)   Derive Henri, Michaelis and menten equation for enzyme catalysis.

d)   What is electrophoresis? How is the technique used to determine the molecular weight of proteins?

e)   Define the terms :

   i)    Specific viscosity

   ii)   Reduced viscosity and

   iii)  Intrinsic viscosity.

f)   What are micelles and bilayers? Draw their structures and explain the functions.

**Q5)** Attempt <u>any four</u> of the following :                                    **[20]**

a)   What is a nerve? State its types by giving typical examples.

b)   Write a note oscillatory reactions?

c)   Give the classification of biopolymer particles based on shapes. What are fibrous and globular proteins?

d)   Describe briefly the light scattering for determination molecular weight of a biopolymer.

e)   What is Donnan membrane equilibrium? State its applications.

f)   Discuss the theory of optical rotatory dispersion.

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**P636**

**[3823] - 404**

**M.Sc.**

**PHYSICAL CHEMISTRY**

**CH - 415 : Special Topics in Nuclear Radiation Chemistry (New)**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

*Instructions to the candidates:*

*1)   Answers to the TWO sections should be written in SEPARATE answer books.*

*2)   ALL questions are COMPULSORY.*

*3)   Figures to the RIGHT SIDE indicate FULL marks.*

*4)   Use of logarithmic table, calculator is ALLOWED.*

*5)   Neat diagrams must be drawn WHEREVER necessary.*

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

*P.T.O.*

**Q1)** Attempt <u>any three</u> of the following: **[15]**

    a)    Discuss the general principles for using radiopharmaceuticals in diagnosis and therapy.

    b)    What are the desirable properties for an indicator nuclide in radiopharmaceutical? Describe the preparation of $^{131}I$ isotope.

    c)    Which ionizing sources are used for food preservation and sterilization? Write the various doses given and their effects on food items.

    d)    Describe the method of separation for boron isotopes.

    e)    Which method is applied for the separation of heavy hydrogen? Describe the underlying principle for the method.

**Q2)** Attempt <u>any three</u> of the following : **[15]**

    a)    Describe the various categories of radiation waste. Which are the materials used for shielding of high level radiation?

    b)    Describe the method for waste disposal of radioactive gases.

    c)    Explain the terms Planck era, GUT era. What are their characteristics?

    d)    Write a note on $\gamma$ and p-processes.

    e)    Give an account of heavier element burning.

**Q3)** Attempt <u>any two</u> of the following: **[10]**

    a)    Write the reactions in helium burning.

    b)    Complete the following reactions

        i)     $^{12}C$ (p, $\vartheta$) ☐ (p, $\vartheta$) ☐

        ii)    $^{13}C$ (p, $\gamma$) ☐ (p, $\gamma$) ☐

    c)    Find out the activity of 99mTc which was extracted after loading 99Mo in the generator. (Given : Initial activity of 99Mo = 28000 cpm, time of decay = 16h, % extraction = 80, $t_{112}$ of 99Mo = 66h and of 99mTc = 6h).

## SECTION - II

**Q4)** Answer <u>any four</u> of the following : **[20]**

a) What are the various phase separation techniques used in precipitation radiometric titrations? Discuss any one of them in detail.

b) Give an account of radiometric titrations based on absorption of β-particles. What are its advantages?

c) Describe the radiometric titration curve for the titration of a mixture of three ions in which ions precipitating first and last are labelled.

d) Explain radiolysis of aromatic hydrocarbons.

e) Write the reactions occurring in the radiolysis of methanol.

f) State and explain the procedure for the determination of beam energy.

**Q5)** Answer <u>any four</u> of the following : **[20]**

a) Give an account of the choice of the counting equipment for activity measurement.

b) What are the differences between chemical separations of irradiated targets and ordinary analytical procedures.

c) Explain how kinetic equations can be applied to optical or conductometric methods to measure concentrations.

d) Define radical scavenging and explain it with a suitable example.

e) Write a note on molecular kinetics.

f) 15ml labelled NaI were titrated with 0.005M $AgNO_3$ radiometrically. Addition of 1 ml of $AgNO_3$ showed a reduction in initial activity from 18000 counts for 3 minutes to 5000 counts per minute. Find out the amount of NaI in the mixture if background counts are 50 for 5 minute.
(Given : Atomic weight of Na = 23, I = 127, Ag = 108, N = 14, O = 16).

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**P637**

[3823] - 405

## M.Sc. - II

## INORGANIC CHEMISTRY

## CH - 430 : Inorganic Polymers & Heterogeneous Catalysis

## (New)

*Time : 3 Hours]*　　　　　　　　　　　　　　　*[Max. Marks : 80*

*Instructions to the candidates:*

*1)　All questions are compulsory.*

*2)　Neat diagrams must be drawn wherever necessary.*

*3)　Figures to the right indicate full marks.*

*4)　Use of logarithmic table & calculator is allowed.*

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

　　a)　Give an account of phosphazenes with their structural aspects.

　　b)　Give the preparation, properties & structures of $S_4N_4^-$.

　　c)　What are different methods for synthesis of FAU zeolites?

　　d)　Give a brief account of silicones & Silicon rubber.

　　e)　Write in details allotropes of carbon.

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

　　a)　What are different methods that are used for characterisation of zeolite materials?

　　b)　Draw the structures of following compounds

　　　　(i)　$B_4H_{10}$　(ii) $B_5H_9$　(iii) $B_5H_{11}$

　　c)　Write a note on p-n compounds.

　　d)　Comment on selection of oxobridge condensed species in evolution of life processes.

　　e)　Explain what do you mean by LTA type of zeolite? Explain their properties & applications.

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

    a)    What are different types of reactors? Mention their merits & demerits.

    b)    Explain different factors that govern chemisorption of substrate on catalytic surface.

    c)    Explain the catalytic hydrogenation of alkenes using 'pd' as a catalyst.

    d)    What are molecular seives? Discuss their applications.

    e)    Write short note on SOD and ZSM-5 type of zeolites.

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

    a)    Complete the following reactions

        i)    $P_4O_{10} + H_2O \rightarrow$?

        ii)   $S_2Cl_2 + NH_3 \rightarrow$?

        iii)  $NaBH_4 + H_2IPO_3 \rightarrow$?

        iv)  $PCl_5 + NH_4Cl \rightarrow$?

        v)   $B_2O_3 + NH_3 \rightarrow$?

    b)    Explain the cossee-Arlman mechanism for catalytic polymerisation of ethene.

    c)    Describe the process of synthesis of polyaniline using MCM-41.

    d)    Discuss the synthesis of trimethyl silylation of silicate minerals.

    e)    Explain the mechanism of electro catalysis.

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**P638**

[3823] - 406
**M.Sc. - II**
**INORGANIC CHEMISTRY**
**CH - 431 : Material Science**
**(New)**

*Time : 3 Hours]*                                              *[Max. Marks : 80*
*Instructions to the candidates:*
   *1)   All questions are compulsory.*
   *2)   Neat diagrams must be drawn wherever necessary.*
   *3)   Figures to the right indicate full marks.*
   *4)   Use of log tables & calculators is allowed.*

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

   a)   Draw a (111) plane and a (222) plane in a unit cell of a cubic lattice
        with lattice parameter 'a'. Determine their distances from a parallel
        plane.

   b)   What are molecular magnets? Draw the first organic ferromagnet.

   c)   What are electro active ceramics? Explain with the help of suitable
        examples.

   d)   With the help of Hysterisis loops and magnetic anisotropy discuss the
        properties of hard and soft magnets.

   e)   How will you distinguish between Frenkel and Schottky defects. Derive
        an expression to calculate Schottky defect in alkali halides.

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

   a)   What is meant by (i) Magnetic domain (ii) Hysteresis loop (iii) Curie
        temperature (iv) Magnetic flux (v) Paramagnetism.

   b)   What are dielectric materials? Give an account of ferroelectric materials.

   c)   Write an account on Bioactive composites.

   d)   Explain the phenomenon of magnetic exchange in insulators.

   e)   Explain the phenomenon of super conductivity exhibited in pervoskites.

*P.T.O.*

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

a) Carbon, Silicon, Germanium and Tin all belong to group IV but exhibit different conductivity behaviour. Explain this behaviour with the help of Band Model.

b) What do you understand by "Junction Device"? Explain the functioning of any one in detail.

c) Give two examples of each :
   i) Piezo electric materials.
   ii) Natural composites.
   iii) Hard magnetic material.
   iv) Intrinsic semiconductor.
   v) Extrinsic semiconductor.

d) Write an account on the optical application of sol-gel derived materials.

e) Write a note on applications of superconductors.

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

a) Meisner effect.
b) BCS theory.
c) Imperfections in solids.
d) Bio solids.
e) Magnetic Recording Materials.

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**P639**

**[3823] - 407**

**M.Sc. - II**

**INORGANIC CHEMISTRY**

**CH - 445 : Inorganic Applications in Industry, Biotechnology and Environmental Chemistry**

**(New )**

*Time : 3 Hours]*                                    *[Max. Marks : 80*

***Instructions to the candidates:***

    *1)   Attempt any two sections from the following.*

    *2)   Both sections should be written in the same answer book.*

    *3)   All questions are compulsory.*

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

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

    *6)   Use of logarithmic table/calculator is allowed.*

**SECTION - I**

**Applications of Inorganic Materials**

*Q1)* Attempt <u>any three</u> of the following :                    **[15]**

    a)   What is meant by the term pigment? Explain the following properties of Inorganic pigment.

        i)     Colour

        ii)    Hiding Power

        iii)   Ease of wetting and dispersion

        iv)    Chemical resistance

    b)   Which type of isomerism are seen in chromium and cobalt complexes of tridentate AZO compounds? Explain any one type of isomerism.

    c)   Discuss the different processes available for electrodeposition of zinc.

    d)   Explain the production and properties of glass fibers for reinforcing plastic resin.

*P.T.O.*

*Q2)* Attempt <u>any three</u> of the following :  [15]

   a)    Explain the microstructure of hard Wood.

   b)    "Metal complex azo dyes finds extensive use as dyes". Give examples in support of this statement. Explain the nature of bonding by azo groups to metal in dyes.

   c)    Explain the methods for electroplating of precious metals.

   d)    Explain how complexes such as prussian blue and ferrocene modify the behaviour of electrodes in electroplating.

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

   a)    Blue pigment.

   b)    Phthalocyanins.

   c)    Luminous and Fluorescent pigments.

## SECTION - II
### Environmental Chemistry

*Q4)* Attempt <u>any three</u> of the following :  [15]

   a)    What are maximum contaminant level (MCL) of the safe Drinking water Act?

   b)    Will geothermal energy ever be a major source of energy world wide? Explain.

   c)    What are the broad categories of water pollutant? Discuss.

   d)    Draw a schematic diagram of a phosphoric acid fuel cell (PAFC)

       i)    What reaction is occurring at the cathode?

       ii)    What reaction is occurring at the anode?

       iii)   Shows the overall reaction.

       iv)   Why is methanol fed into the fuel cell with steam?

*Q5)* Attempt <u>any three</u> of the following :                                    **[15]**

a)   List the five provisions of the Clean Water Act. Which of these are considered the most important?

b)   The coliform bacteria count is used to taste water for what type of contamination? Do coliform bacteria cause disease? How do you treat water that contains pathogens?

c)   Name the instrumental methods for determination of metals such as Hg, cd, As, pb. Explain x-ray fluorescence (XRF) method for the determination of lead from polluted water.

d)   Determine pE for waste water that contains $5.0 \times 10^{-7}$M $cd^{+2}$. Does this waste water favours oxidation or reduction?

$cd^{+2} + 2e^- \rightarrow cd, pE° = -6.81$

*Q6)* Write short notes on <u>any two</u> :                                          **[10]**

a)   Primary and secondary sludge.

b)   Solar thermal power (STP).

c)   Reverse Osmosis.

## SECTION - III
## Biotechnology

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

a)   Explain the terms surface culture and submerged liquid culture with suitable examples.

b)   State the objections raised against biotechnologically developed varities of vegetables.

c)   Compare between agricultural and microbial food production.

d)   What are enzymes? How do they work? Give conditions for enzymes to be active.

*Q8)* Answer the following (any three) :                                    **[15]**

    a)   Outline the main stages in biotechnological purification of drinking water.

    b)   Comment on the work of Edward Jennar in vaccine production.

    c)   Explain the steps involved in cheese production.

    d)   How is biotechnology used to obtain more oil from oil-wells?


*Q9)* Write notes on (any two) :                                            **[10]**

    a)   Living cells as miniature factories.

    b)   Biomass as fuel.

    c)   Genetic Engineering.


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**P640**

**[3823] - 408**

**M.Sc.**

**ORGANIC CHEMISTRY**

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

**(New Course) (2008 Pattern)**

*Time : 3 Hours]*                                                    *[Max. Marks : 80*

*Instructions to the candidates:*

1) *All questions are compulsory.*

2) *Figures to the right indicate full marks.*

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

## SECTION - I

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

a)



b)



c)



d)

e)
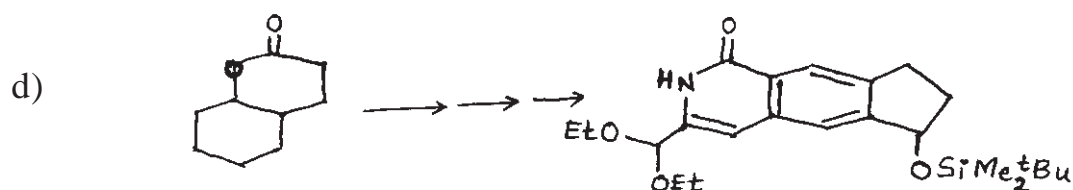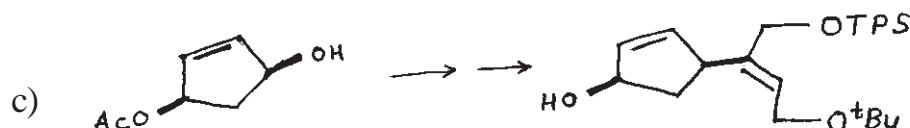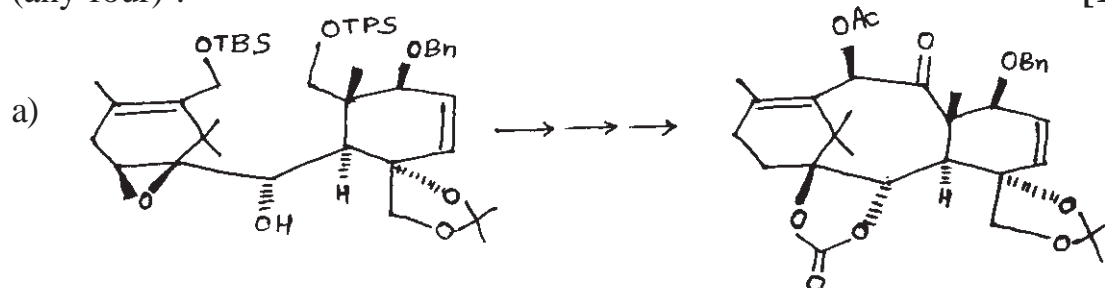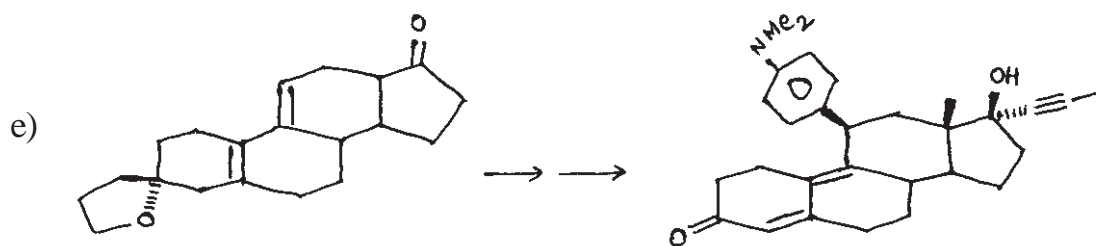


**Q2)** Answer <u>any three</u> of the following : **[12]**

a) Cesaldekarin <u>X</u> was assigned the structure shown
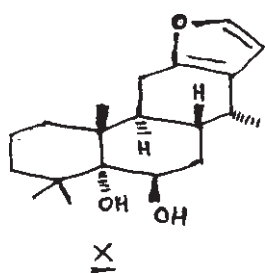


Draw its stereostructure and give evidences to establish the following in <u>X</u>

   i)   The nature of oxygen function.

   ii)  Presence of furan ring and its substitution pattern.

   iii) Presence of trans diol system.

b) Describe importance of spectral methods in structure determination of Hardwickiic acid.

c) Give the evidence to show the presence of pyrroloquinoline ring in hydroxycamptothecin.

d) How will you prove the presence of

   i)   Free alcoholic-OH group

   ii)  absence of phenolic-OH group.

   iii) ɤ-lactone in podophyllotoxin

**Q3)** a) 4'-Demethylpodophyllotoxin has the following structure **[6]**
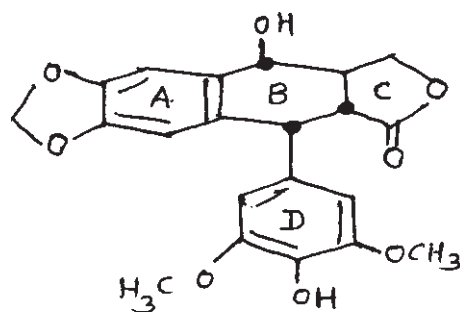


4'-Demethylpodophyllotoxin

i) How can you prove the trans B/C ring fusion.

ii) How can we distinguish between two methylene groups $H_2C\overset{O-}{\underset{O-}{\diagdown}}$

and $-CH_2\overset{O}{\diagdown}{\underset{C=O}{}}$ by $^1$H NMR

iii) How can we separate a mixture of podophyllotoxin and 4'-demethylpodophyllotoxin by chemical method.

b) Complete the following synthetic sequence. Give mechanism for all steps and structures of all intermediates involved. **[6]**



i) $CrO_3$, Pyridine

ii) $C_5H_{11}CO\overset{\ominus}{C}H-\overset{O}{\overset{\|}{P}}(OCH_3)_2$

?

i) $Zn(BH_4)_2$

ii) $K_2CO_3$, $NaOH$

iii)

?

i) $i$-$Bu_2AlH$

ii) $Ph_3\overset{+}{P}(CH_2)_4COOH$

?

?

$PGF_2\alpha$
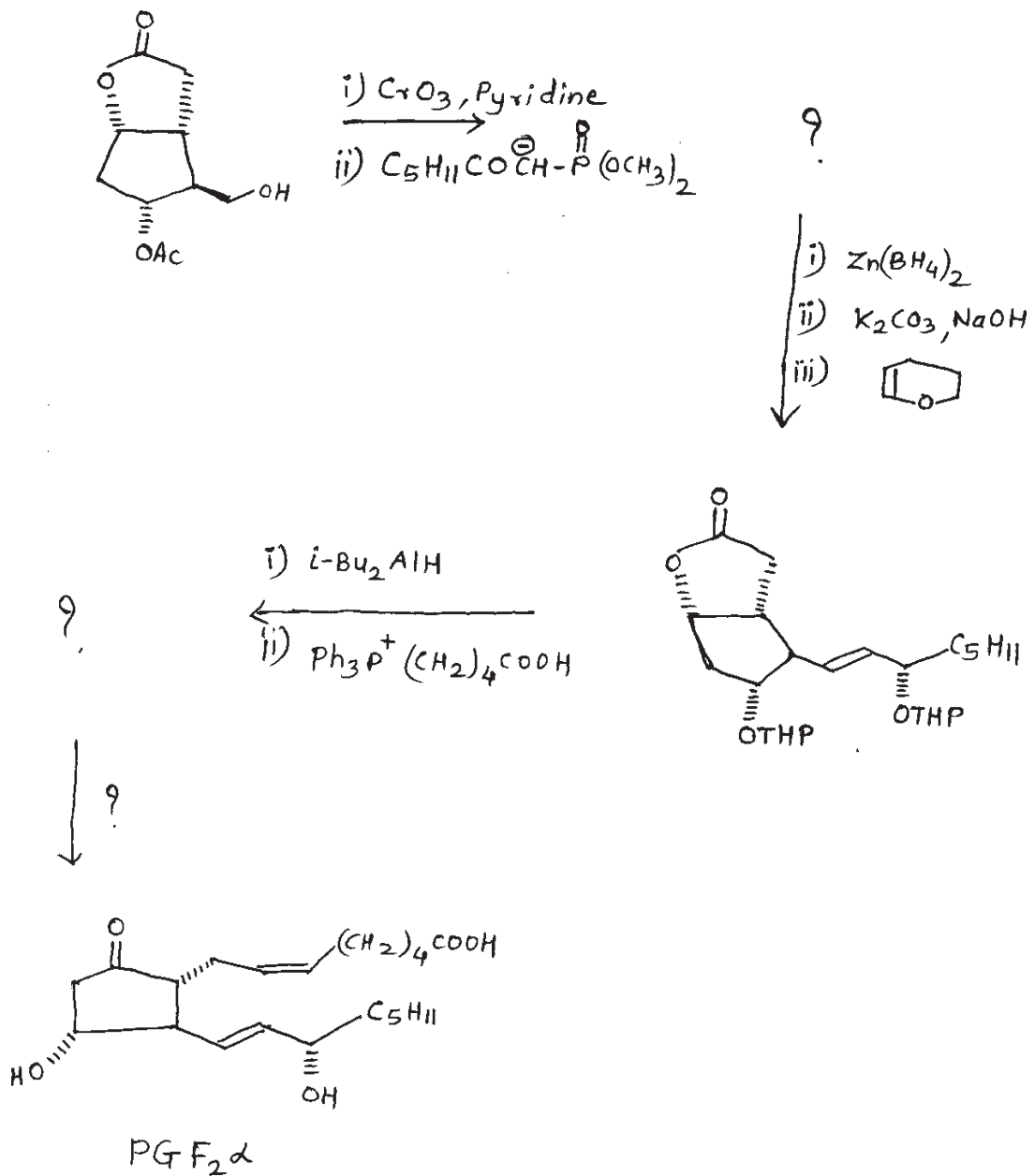
## SECTION - II

**Q4)** a) Discuss the mechanism of transamination reaction and the role of pyridoxal phosphate in this mechanism. **[4]**

b) Suggest biogenetic scheme for <u>any three</u> of the following conversions.

**[12]**

i) Phenylalanine ⟶ 

ii) Geranylgeranylpyrophosphate ⟶ 

iii) Squalene oxide ⟶ 

iv) 
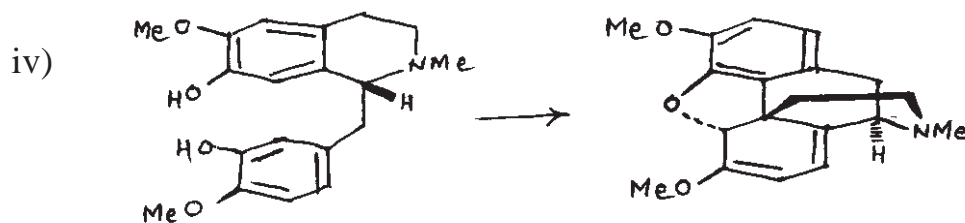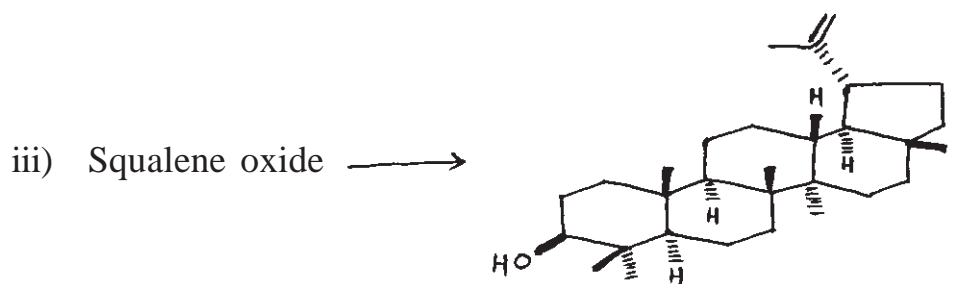
**Q5)** Write the steps involved in <u>any two</u> of the following biogenetic conversions.

**[12]**

a) 

b)

c)
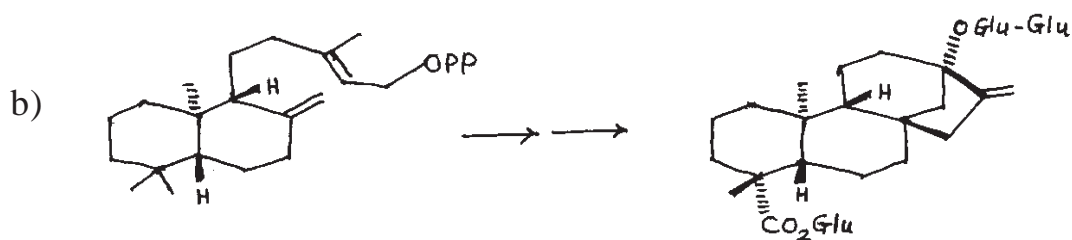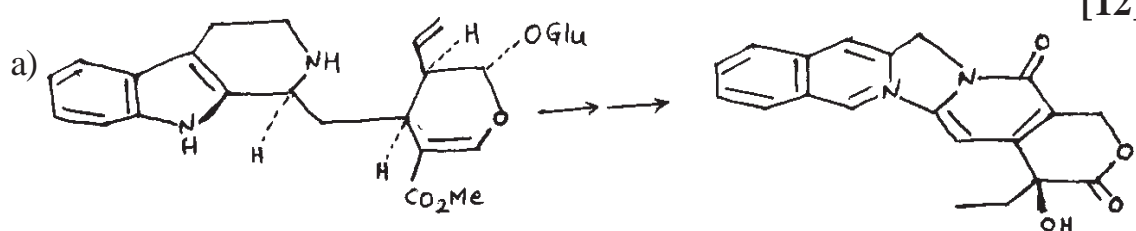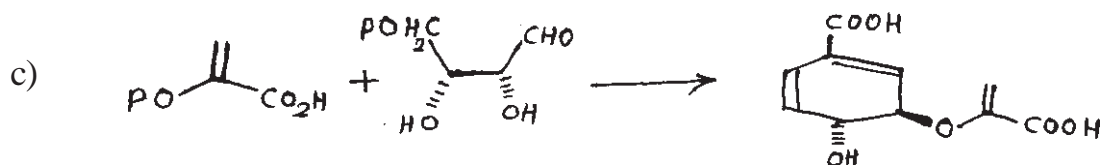


**Q6)** a) Write the steps involved in the following biogenetic conversion and indicate the position of label in each step and in the final product. **[2]**
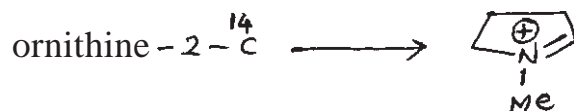
$$\text{ornithine} - 2 - \overset{14}{C} \longrightarrow \text{[structure with } \overset{\oplus}{N}\text{, Me]}$$

b) Outline the steps involved in <u>any one</u> of the following biogenetic conversions. **[5]**

i) $H_2N(CH_2)_4 \, CHNH_2COOH \rightarrow \rightarrow$ 

ii) 2Z, 6E-Farnesylpyrophosphate $\rightarrow$ 
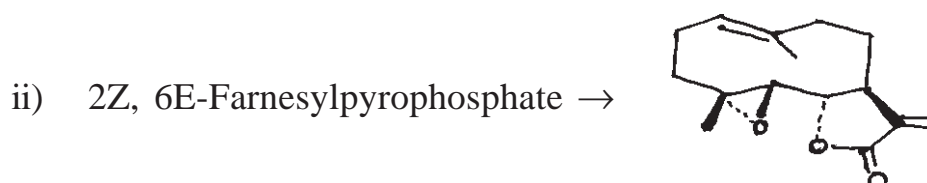
c) The conformation adopted by squalene or squalene oxide on the enzyme surface is crucial in deciding the stereochemistry of triterpenes and steroids. Explain this observation by giving at least three examples. **[5]**

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**P641**

**[3823] - 409**

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

*Time : 3 Hours]*　　　　　　　　　　　　　　　　　*[Max. Marks : 80*

***Instructions to the candidates:***

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

### SECTION - I

*Q1)* a)　Answer <u>any two</u> of the following:　　　　　　　**[6]**

　　i)　Explain the role of Pd(O) complex in Heck reaction.

　　ii)　Use of Grubb's catalyst in large ring formation.

　　iii)　Explain the role of Ni(O) complex in carbonylation reaction of acetylene in presence of alcohols.

　　b)　How will you effect the following conversions (any two) using organometals.　　　　　　**[6]**
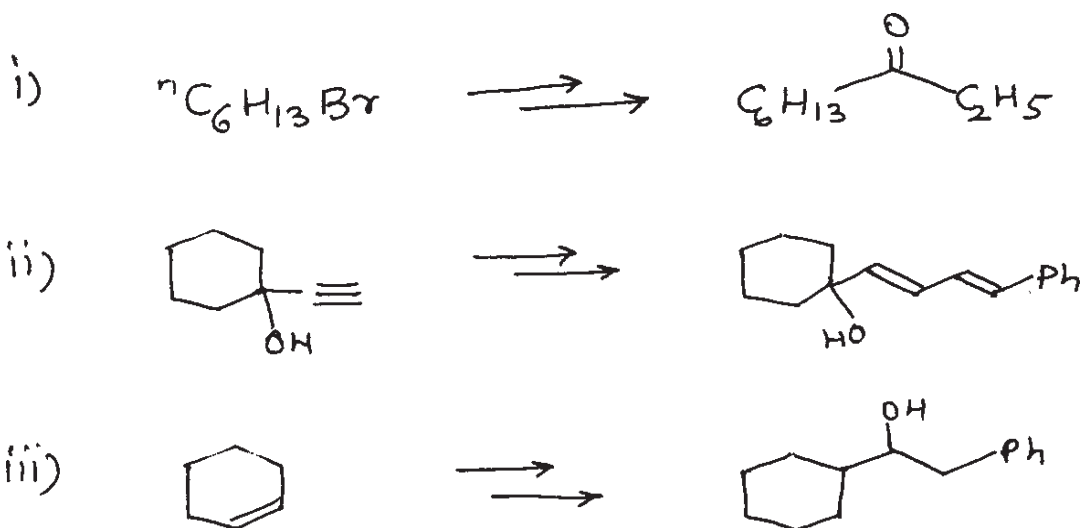
*Q2)* a)    Predict the product (any four) :                                    **[12]**

i)



2-methylcyclohexanone → LDA, Tf₂NPh → ?  → Pd(PPh₃)₄, LiCl, →Si~~~~Sn"Bu₃ → ?

ii)

EtO₂C~~~CO₂Et
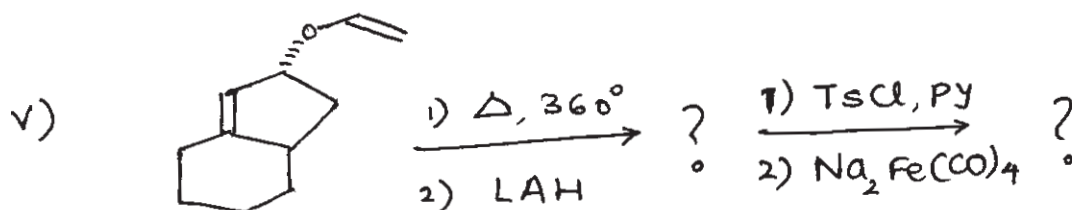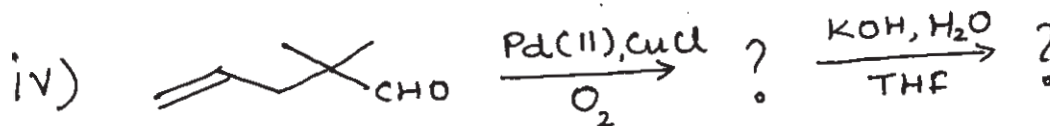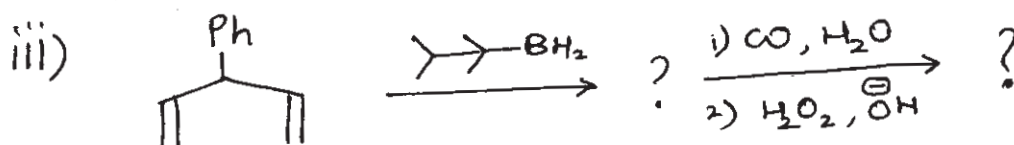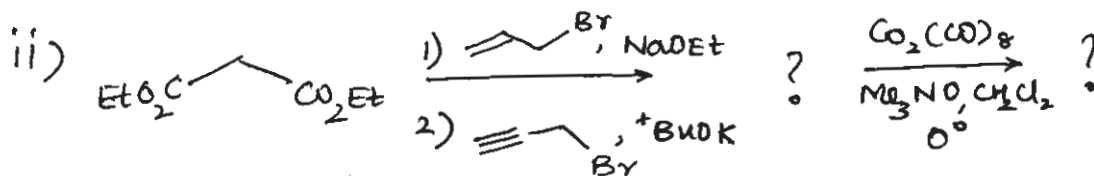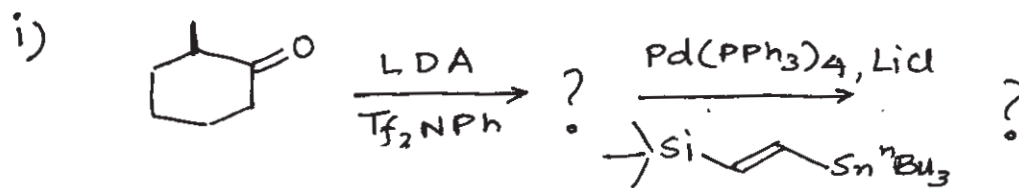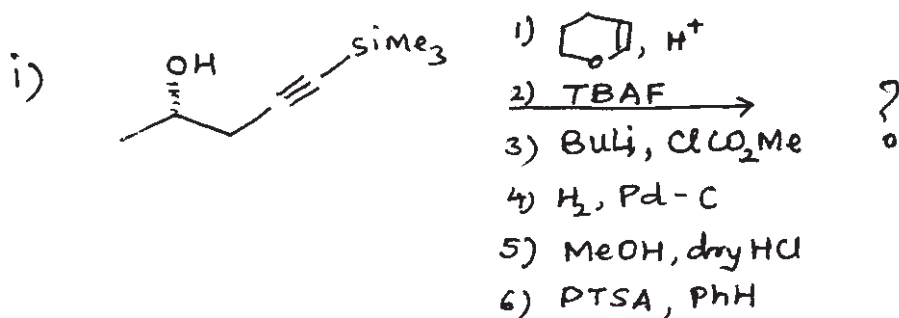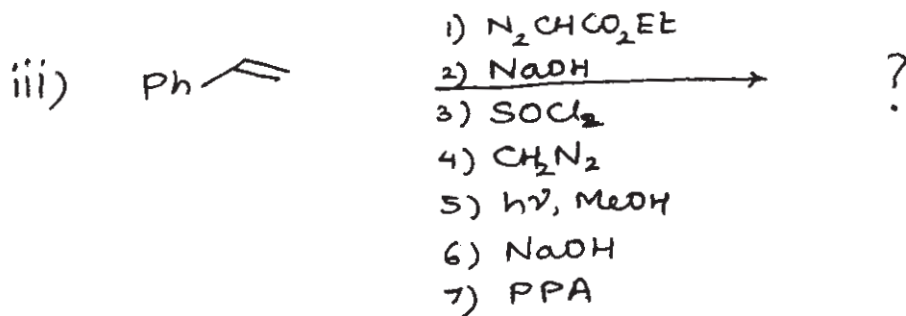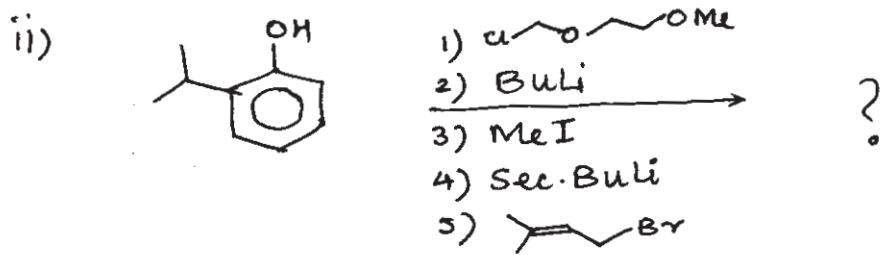
1) ~~~Br , NaOEt
2) ≡~~Br , ⁺BuOK
→ ? → Co₂(CO)₈, Me₃NO, CH₂Cl₂, 0° → ?

iii)

Ph substituted diene → >−BH₂ → ? → 1) CO, H₂O  2) H₂O₂, OH⁻ → ?

iv)

~~X−CHO → Pd(II), CuCl, O₂ → ? → KOH, H₂O, THF → ?

v)



1) Δ, 360°  2) LAH → ? → 1) TsCl, Py  2) Na₂Fe(CO)₄ → ?

b)    Complete the following conversion using organoborane chemistry
        (any two) :                                                            **[4]**

i)

  →   COOEt

ii)

  →  

iii)

  →   Ph

*Q3)* a) Write short note on <u>any three</u>: [9]

    i) Merrifield solid phase peptide synthesis.

    ii) Polymerization reaction using Zeigler-Natta catalyst.

    iii) Nickel tetracarbonyls in the synthesis of carbocyclic and heterocyclic compounds.

    iv) Use of organosilicon reagents in carbon-carbon double bond formation.

  b) 1, 4-dicarbonyl compounds can be synthesized by umpolung reaction. Explain. [3]

Suggest a method for the following conversion



## SECTION - II

*Q4)* a) Explain <u>any two</u> of the following : [6]

    i) Urethane protection is preferred over acyl protection of amino group during peptide synthesis.

    ii) Use of pericyclic reaction in the synthesis of four membered ring compounds.

    iii) Reconnection approach in the synthesis of 1, 2-dicarbonyl compounds.

  b) Predict the product/s in <u>any two</u> of the following : [6]

    i)

ii) 



1) cl~O~OMe
2) BuLi
3) MeI
4) Sec·BuLi
5) >=~Br

?

iii) Ph~

1) N$_2$CHCO$_2$Et
2) NaOH
3) SOCl$_2$
4) CH$_2$N$_2$
5) hν, MeOH
6) NaOH
7) PPA

?

**Q5)** a)  Carry out the following conversions using the reagents given below. Arrange the reagents in proper order to achieve the conversions. Write the structures of the intermediate products (any two) :          [6]

i)



TBDMSCl, imidazole ; $\overset{O}{\underset{}{\wedge}}$, ZnCl$_2$ ; $\overset{O}{\underset{}{\wedge}}$cl, pyridine ;

CuCl$_2$·2H$_2$0 ; LAH ; MOMCl ; DMSO, (COCl)$_2$ ; PPh$_3$=CHCOOEt;

TBAF

ii)



CH$_2$(COOH)$_2$, pyr ; $^i$PrMgCl, CuSPh ; Me$_2$SO$_4$, K$_2$CO$_3$ ;

PPA ; Me$_2$NCHO, POCl$_3$ ; MeOH, HCl aq.

iii)



Na, NH$_3$(l), $^+$BuOH ; mCPBA ; HO~OH, H$^+$ ;
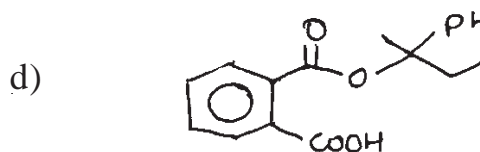
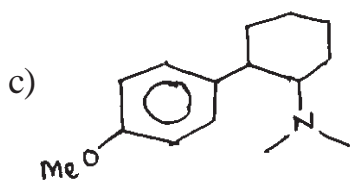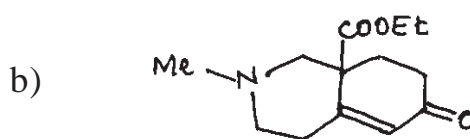EtBr, AlCl$_3$ ; H$_3$O$^+$ ; CH$_3$I, NaH
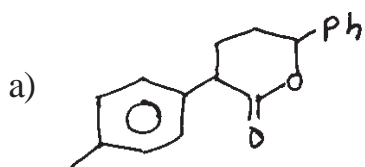
b) Discuss the uses of <u>any two</u> of the following reagents with one application. **[6]**

i) 9-BBN      ii) RuCl$_3$      iii) Pd(PPh$_3$)$_4$

*Q6)* Using retrosynthetic analysis suggest convenient route for the synthesis of <u>any four</u> of the following : **[16]**

a)       b) 

c)       d) 

e)       f) 

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**P642**

**[3823] - 410**

# M.Sc.

## ORGANIC CHEMISTRY

## CH - 452 : Heterocyclic Chemistry, Chiron Approach and Medicinal Chemistry

## (2008 Pattern) (New Course)

*Time : 3 Hours]*                                                    *[Max. Marks : 80*

*Instructions to the candidates:*

   *1)*   *All questions are compulsory.*

   *2)*   *Figures to the right indicate full marks.*

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

### SECTION - I

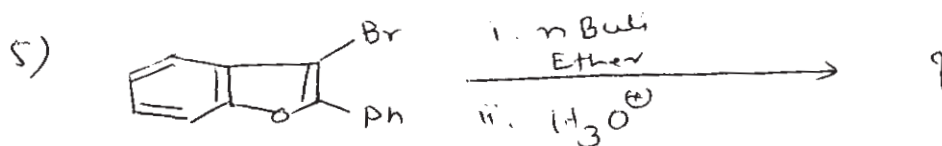*Q1)* a)   Explain the following (any three) :            **[6]**
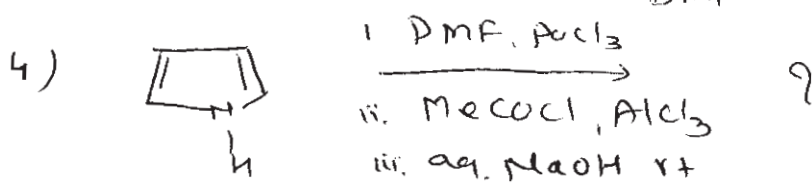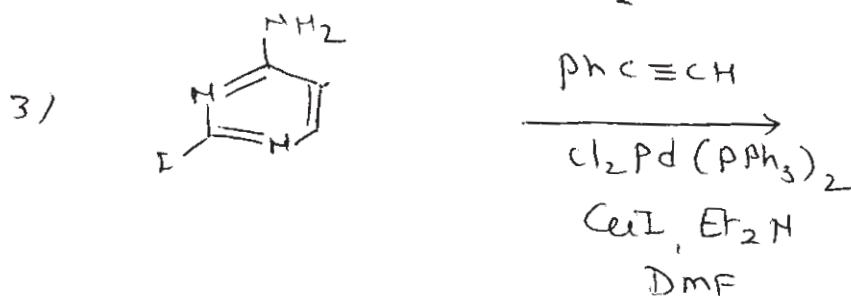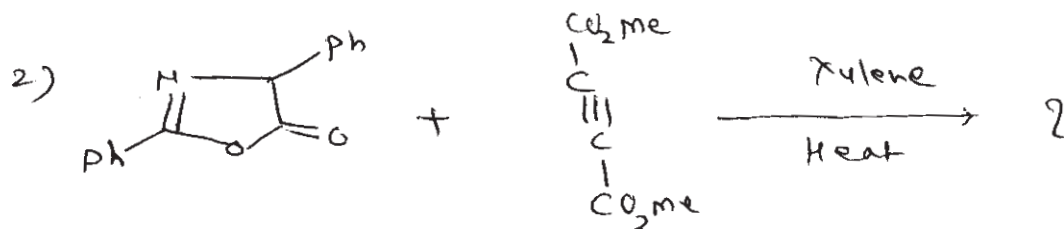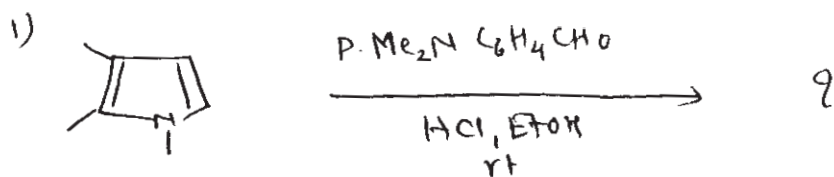
      i)   Purimidine is much less basic than pyridine.

      ii)   Indole undergoes fomulation reaction at 3-position but purrole mainly reacts at 2-position.

      iii)   Imidazole cation is stable than oxazole cation.

      iv)   Isoquinoline reacts with sodamide to give 1-amino isoquinoline, while 5-nitroisoquinoline on reaction with ammonia give 6-amino-5-nitroisoquinoline.

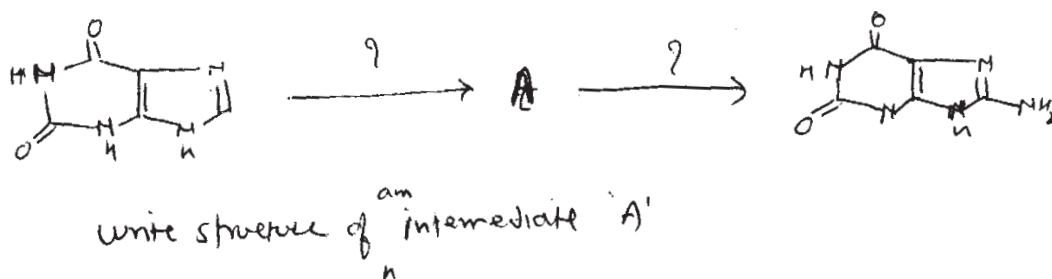   b)   Attempt any two of the following :            **[6]**

      i)   Give the synthesis of 2.5-diphenylthiophene using Lawessoris reagent.

      ii)   Write short note on applications of supromolecular chemistry in bio-chemical reactions.

      iii)   Write mechanism of Doebner quinoline synthesis for the formation of 2-phenyl quinoline.

*P.T.O.*

*Q2)* a)   Predict the product/s in any four of the following :                    [8]

1)



P. $Me_2N\ C_6H_4\ CHO$

HCl, EtOH
rt

?

2)


Ph

+

$CO_2me$
C
|||
C
|
$CO_2me$

Xylene

Heat

?

3)


$NH_2$
I

$PhC\equiv CH$

$Cl_2Pd(PPh_3)_2$

$CuI, Et_2N$

DMF

4)



i. DMF, POCl$_3$

ii. MeCOCl, AlCl$_3$

iii. aq. NaOH, rt

?

5)


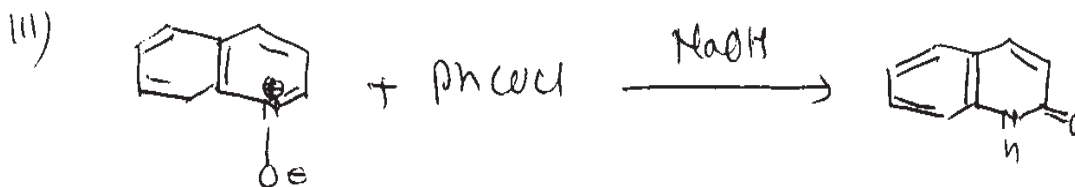Br

Ph

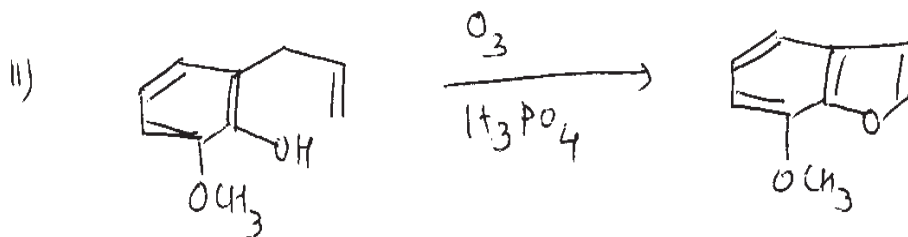i. n BuLi
Ether

ii. $H_3O^{\oplus}$

?

b)   Suggest reagents for following conversion                                      [3]

   ?  →  A  —?→  

write structure of intermediate 'A'
am
h

c)   Give the reaction sequence on thiophene with the following reagents. [3]

i)    $3Br_2$, 48%HBr, rt → 75°C

ii)   Zn/ACOH

iii)  n BuLi/THF, -70°C

iv)   $Me_2MCHO$

**Q3) a)** Suggest suitable mechanism for any two of the following : **[6]**

i)



ii)



iii)



**b)** Complete the following reaction sequence (any two) : **[4]**

i)



ii) $HCONH_2$ + ? $\xrightarrow[\Delta]{Piperidine\ acetate}$



iii) Aniline + $\begin{array}{c} COCl \\ | \\ COCl \end{array}$ $\longrightarrow$ A $\xrightarrow{AlCl_3}$ Isatin

**c)** Write the reactions involved in following synthesis (any two) : **[4]**
   i)   Fischer indole synthesis.
   ii)  Barton zard synthesis.
   iii) Hantzsch pyrrole synthesis.

## SECTION - II

*Q4)* Answer any four of the following :                    **[16]**

   a)   Osazones are converted by benzaldehyde to 1,2-dicarbonyl compounds called osones use this reaction to convert glucose into fructose.
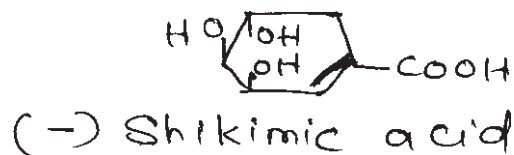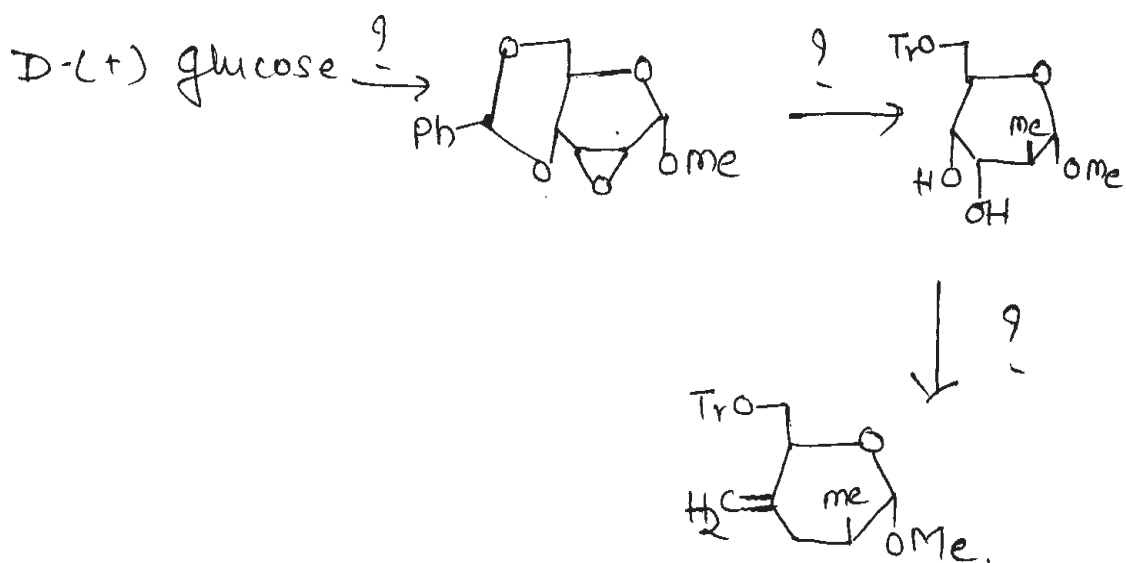
   b)   What are the products of reaction of

       i)   $HOCH_2(CHOH)_4CHO$ and

       ii)   $HOCH_2(CHOH)_3 CO\text{-}CH_2OH$ with

          1)   $Br_2 + H_2O$   2) $HIO_4$ ?

       iii)   For the given following elimination reaction calculate % atom economy.

$$H_3C - \underset{Br}{C}(CH_3)_2 + H_5C2ONa \longrightarrow H_2C=C(CH_3)_2 + H_5C2OH + NaBr.$$

       iv)   Describe the steps involved in conversion of aldohexose into aldoheptose by Killiani-Fischer synthesis.

       v)   Two isomeric compounds A and B with molecular formula $C_4H_8O_4$ give following reactions.

          1)   Both A and B form oxime.

          2)   Both A and B form triacetate.

          3)   On $HNO_3$ oxidation A gives optically active acid while B gives optically inactive acid. Deduce structure for A and B.

*Q5)* a)   Give the retrosynthetic analysis of (-) shikimic acid which is shown below :                    **[6]**



(-) Shikimic acid

How will you prove the presence of α, β-unsaturated acid in it by physical & chemical methods.

b) Write the appropriate reagents in the following course of reactions and rewrite the complete sequence of reactions. **[6]**



How will you determine the presence of exocyclic double bond qualitatively?

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

a) Write a note on "Drug transport".

b) Explain Bio availability. Discuss the factors affecting drug abscription.

c) How does drug design differ from drug discovery? What are the common methods used in drug design? Explain one of them.

d) Explain the importance of carbohydrates in synthesis using chiron approach.

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**P643**

**[3823] - 411**
**M.Sc. - II**
**ANALYTICAL CHEMISTRY**
**CH - 481 : Bioanalytical and Forensic Science**
**(Old & New)**

*Time : 3 Hours]*                                                           *[Max. Marks : 80*
*Instructions to the candidates:*
  *1) Answers to the two sections should be written in separate answer books.*
  *2) All questions are compulsory and carry equal marks.*
  *3) Neat diagrams must be drawn wherever necessary.*
  *4) Use of logarithmic table/non-programmable calculator is allowed.*

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following :                              **[20]**
  a) Outline the procedure for the estimation of residual $CO_2$ content in baking powder.
  b) Explain the procedure for estimation of tannin from tea sample.
  c) Write note on 'Food Preservatives'.
  d) Explain the analytical method used for estimation of starch from flour.
  e) The chicory content was estimated in sample of coffee. The percentage of water extract obtained from the sample was 36.3%. If the average value for percentage of water extract of chicory is 65.5 and pure coffee is 21.8% respectively. Calculate percentage of chicory in sample.

*Q2)* Attempt <u>any four</u> of the following :                              **[20]**
  a) Discuss chemistry of Thiamine with respect to structure, estimation and sources.
  b) Give suitable method for estimation of glucose.
  c) Explain the principle for determination of phosphatase. Give method for its estimation.
  d) How is theobromine estimated in Cocoa?
  e) 0.324 gm of sample containing nicotinamide was dissolved in 5.00 ml acetic acid and 5.00 ml acetic anhydride. It was titrated with 0.1N perchloric acid using crystal violet as an indicator. It gave burette reading 16.3 ml. Calculate percentage of nicotinamide in given sample. [Given molecular weight of nicotinamide = 122.12].

*P.T.O.*

*Q3)* Attempt <u>any four</u> of the following : **[20]**

   a) State and explain principle for isolation of amphetamine and metamphetamine from urine sample. How are these determined?

   b) Write note on LSD.

   c) Give the principle and explain detail procedure for extraction of caffeine from biological sample.

   d) How are duitable goods transferred from one warehouse to another bonded warehouse?

   e) Sample containing drugs was analyzed by thin layer chromatography using mixture of ethyl alcohol ammonium hydroxide as mobile phase. When distance travelled by solvent was 10.2 cm and morphine, amphetamine and cocain give Rf values 0.216, 0.559 and 0.912 respectively calculate distance travelled by morphine, amphetamine and cocain.

*Q4)* Attempt <u>any four</u> of the following : **[20]**

   a) Define the terms :

      i) Coca derivative.

      ii) Medicinal cannabis.

      iii) Duitable goods.

      iv) Opium derivatives.

   b) State the narcotic drug and psychotropic substances act 1985 related to manufacture, sale and export of opium.

   c) Explain the rules related to manufacture of manufactured drug.

   d) Give requirements of bonded laboratory.

   e) Write note on 'Illicit Traffic'.

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**P644**

**[3823] - 412**

**M.Sc. - II**

**ANALYTICAL CHEMISTRY**

**CH - 490 : Analytical Spectroscopy**

**(Old & New Course) (Sem. - IV)**

*Time : 3 Hours]*                                          *[Max. Marks : 80*

*Instructions to the candidates:*

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

## SECTION - I

*Q1)* Attempt <u>any four</u> of the following :                    **[20]**

a) With a neat diagram, describe the construction and working of a double beam spectrophotometer.

b) Enlist the electromagnetic spectral regions that are useful for chemical analysis. Explain the types of analysis with electron-agnetic radiation spectrum.

c) Explain the following terms used in instrumental analysis :

   i) Radient power.

   ii) Molar absorptivity.

   iii) Limiting law.

d) The absorbance of 250 ppm solution of substance gave percent transmittance 45 at 480 nm. Calculate the molar absorptivity of the solute in 1.00 cm cell.

   [Given : Molecular mass of substance = 250 g mole$^{-1}$]

e) Calculate the mass absorptive coefficient at 0.193 nm of homogeneous mixture that contains 28% $CaCl_2$, 58% $CuCl_2$ and 14% $ZnCl_2$. The mass absorptive coefficients at 0.193 nm of Ca, Cu, Zn and Cl are 306, 96.2, 910 and 198 cm$^2$/g respectively.

*Q2)* Attempt <u>any four</u> of the following : **[20]**

   a) What is electro chemiluminescence? Explain 'S' route and 'J' route mechanisms in electro chemiluminescence.

   b) Draw and explain the energy level diagram of an x-ray induced electron emission.

   c) Discuss the principle of electron spectroscopy for chemical analysis. Explain with block diagram, the essential components of an ESCA spectrometer.

   d) Calculate 1s electron binding energy of Nitrogen in tetra methyl ammonium ion from the incident x-ray photon that was used to create the inner-shell vacancy had a wavelength of 952.1 pm. The work function of spectrometer was 7.2 eV and the kinetic energy of measured electron was 889.4 eV.

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

   Velocity of light = $2.998 \times 10^8$ m/s]

   e) A crystals of lithium fluoride was exposed to $k_\alpha$ line of copper at 154.2 pm, diffracted at an angle of 22.5° relative to the crystalline surface for first order diffraction. Calculate the spacing between adjacent layers of nuclei in the lithium fluoride crystals.

## SECTION - II

*Q3)* Attempt <u>any four</u> of the following : **[20]**

   a) Distinguish between proton magnetic resonance spectra and non-protonic resonance spectra.

   b) Write a critical note on nuclear over hauser effect in NMR spectroscopy.

   c) What is meant by larmor precession? Explain the principle of NMR spectroscopy based on classical theory.

   d) Predict the splitting patterns and ratio of the peak area in each multiplet as well as between the multiplets in the PMR spectrum of $C_2H_5COCH_2CH_3$.

   e) The magnetic moment of $^{31}P$ is equal to 1.1305 nuclear magnetons. Calculate it's magnetogyric ratio, if the spin quantum number of $^{31}P$ is one half.

   [Given : $\beta_N = 5.05 \times 10^{-27}$ JT$^{-1}$]

*Q4)* Attempt <u>any four</u> of the following :                                    **[20]**

    a)    Explain the following terms of an EPR spectrum.

        i)    Position

        ii)   Intensity

        iii)  Band-width.

    b)    Explain general uses of ESR spectroscopy.

    c)    Mention the standard compounds used in ESR spectroscopy. Give the significance of standard compound for qualitative analysis.

    d)    Draw a schematic diagram of a scanning electron microscope, label it's component's. Explain how two pairs of coils are used for scanning with scanning electron microscope.

    e)    If an unpaired electron in a particular environment has a g-factor 2.015, calculate the magnetic flux density required to cause the electron to resonate at a frequency of 35 GHz.

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

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**P645**

## [3823] - 413
## M.Sc. - II
## ANALYTICAL CHEMISTRY
## CH - 491 : Polymer Technology
## (Old & New)

*Time : 3 Hours]*            *[Max. Marks : 80*

*Instructions to the candidates:*

   *1)*   *All questions are compulsory and carry equal marks.*

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

   *3)*   *Draw diagrams wherever necessary.*

### SECTION - I

*Q1)* Attempt <u>any four</u> of the following :            **[20]**

   a)   Give the salient features of solution condensation polymerisation.

   b)   Give the method of preparation and the uses of the following polymers:

       i)   Polyvinylchloride.

       ii)   Polybutadiene.

   c)   Explain the mechanism of Anionic polymerisation.

   d)   Write a short note on 'Cure Reaction'.

   e)   What are polymer degradation reactions? Explain oxidative degradation of polymers.

*Q2)* Answer <u>any four</u> of the following :            **[20]**

   a)   What are polymers? Explain the different methods of classification with suitable examples.

   b)   Explain the kinetics of cationic polymerisation.

   c)   Write short notes on :

       i)   Chain reaction.

       ii)   Silicone polymers.

   d)   Explain reactivity ratio and copolymerisation behaviour.

   e)   Explain the term Antioxidant? What is the role of antioxidant in the stability of polymer? Explain it with a suitable examples.

*P.T.O.*

# SECTION - II

**Q3)** Attempt <u>any four</u> of the following :                                    **[20]**

a)   Give an account of mechanical properties of polymeric materials.

b)   Write a short note on sol-gel and the aqueous chemistry of metal oxides.

c)   Explain in brief : Extrusion moulding process.

d)   Explain the terms :

   i)   Flammability            ii)  Gloss

   iii) Haze                    iv)  Resistivity

   v)   Vapour permeability.

e)   In a sample of a polymer mixture composed of five molecules of molar mass $1 kg mol^{-1}$, 5 molecules of molar mass $2 kg mol^{-1}$, 5 molecules of molar mass $3 kg mol^{-1}$ and 5 molecules of molar mass $4 kg mol^{-1}$. Calculate i) The number average molecular weight. and

   ii) Weight average molecular weight.


**Q4)** Answer <u>any four</u> of the following :                                    **[20]**

a)   Explain the role of thermal methods in structure elucidation of polymeric material with respect to TGA and DTA.

b)   Describe the cryoscopic method for molecular weight determination of a given polymer sample.

c)   What is fibre spinning? Describe in brief wet spinning process.

d)   Explain the term compounding. What are the ingradients used in compounding process? Give the role of each ingradient.

e)   The intrinsic viscosity of polystyrene polymer is 242.3 $cm^{3}/g$. Calculate the approximate concentration of polystyrene polymer with relative viscosity of 3.0126.


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**P646**

**[3823] - 431**

**M.Sc.**

**DRUG CHEMISTRY**

**CH - 461 : Synthetic Methods in Organic Chemistry**

**(Old & New Pattern)**

*Time : 3 Hours]*                                                      *[Max. Marks : 80*

*Instructions to the candidates:*

   *1)  All questions are compulsory.*

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

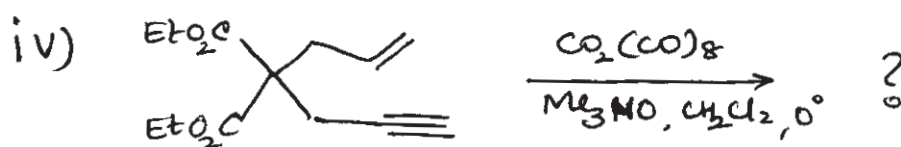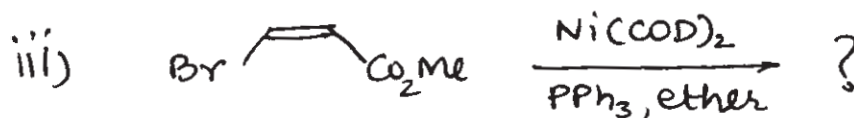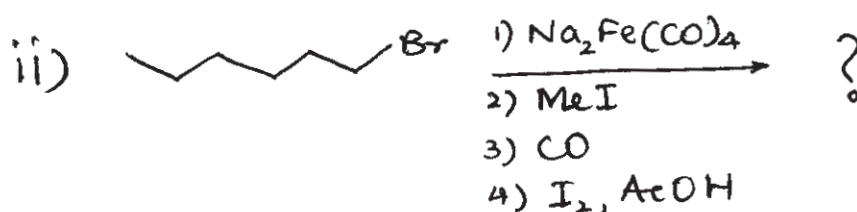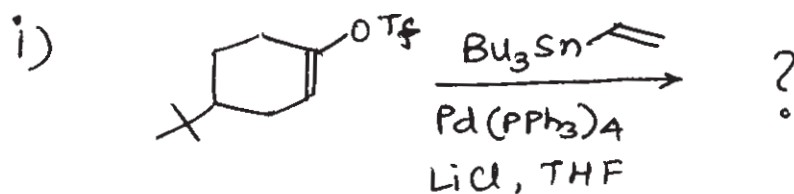   *3)  Figures to the right indicate full marks.*

**SECTION - I**

*Q1)* a)   Explain <u>any three</u> of the following with an example :    **[9]**

    i)   THP protection is stable under alkaline conditions but it can be cleaved under acidic conditions.

    ii)  Role of palladium complex in the Heck reaction catalytic cycle.

    iii) Benzyloxycarbonyl protection is preferred over benzoyl protection of amino group of amino acids in peptide synthesis.

    iv) Reconnection approach in the synthesis of 1, 6-dicarbonyl compounds.

  b)   Complete any two of the following transformations justify your answer.

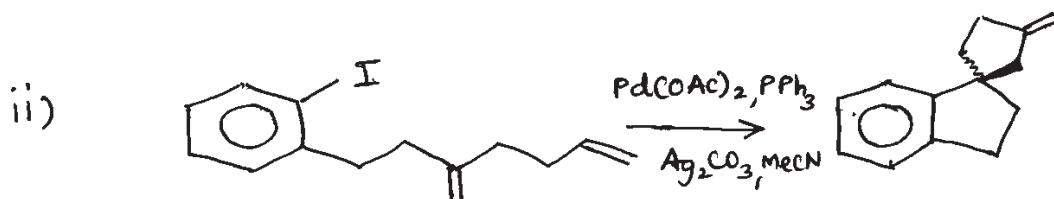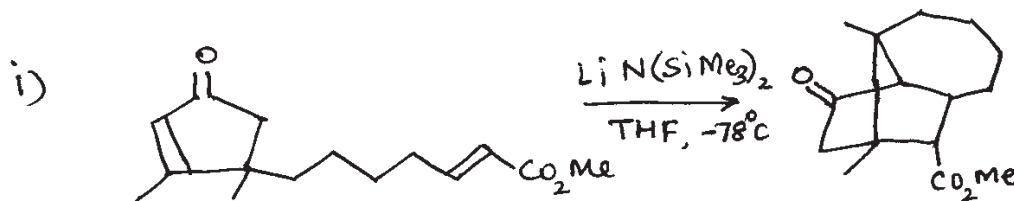                                                                                     **[6]**

**Q2)** a) Predict the product explaining the role of transition metal complex (any three) : **[9]**

i)



$Bu_3Sn$ ━━
━━━━━━━━→  ?
$Pd(PPh_3)_4$
$LiCl$, THF

ii)

$\diagdown\diagdown\diagdown\diagdown\diagdown$ Br
1) $Na_2Fe(CO)_4$
━━━━━━━━→ ?
2) MeI
3) CO
4) $I_2$, AcOH

iii)

Br $\diagdown$━━$\diagdown$ $CO_2Me$
$Ni(COD)_2$
━━━━━━━━→ ?
$PPh_3$, ether

iv)

$EtO_2C$ $\diagdown$ $\diagdown$
$\diagdown$
$EtO_2C$ ━━━
$Co_2(CO)_8$
━━━━━━━━→ ?
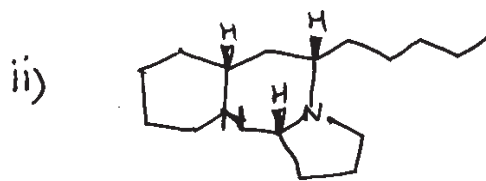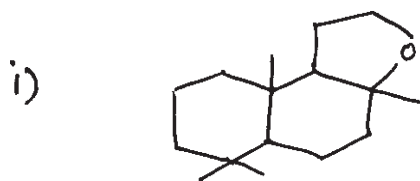$Me_3NO$, $CH_2Cl_2$, $0°$

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

i) Advantage of homogenous catalysis over heterogenous catalysis.

ii) Role of Grubb's catalyst in olefin metathesis.

iii) Role of chiral organoborane in preparation of optically active alcohols.

**Q3)** a) How domino reaction is different from stepwise reaction. Explain the steps involved in any one of the following domino reaction. **[5]**

i)



$Li\ N(SiMe_3)_2$
━━━━━━━━→
THF, $-78°C$

ii)



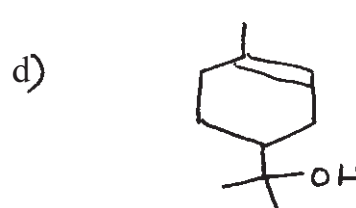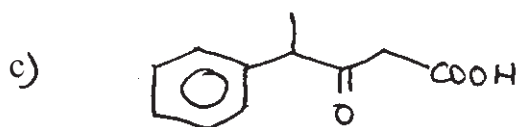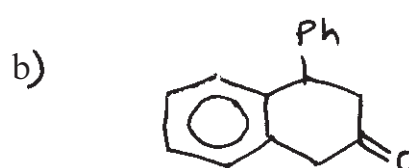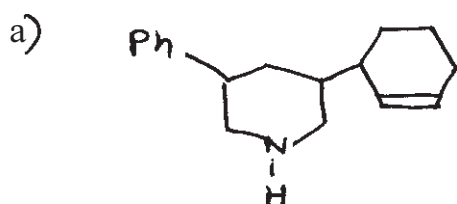$Pd(OAc)_2, PPh_3$
━━━━━━━━→
$Ag_2CO_3$, MeCN

b) Explain the biomimetic approach to the reterosynthesis of <u>any one</u> of the molecule : **[5]**

i)    ii) 

## SECTION - II

**Q4)** Using retrosynthetic analysis, suggest a suitable method to synthesize <u>any three</u> of the following : **[12]**

a) 

b) 

c) 

d) 

**Q5)** a) Give one reaction with reagent, for each synthon given below : **[6]**

i) $H-\overset{\oplus}{C}=O$     ii) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\oplus}{C}H_2$     iii) $CH_2=\overset{\ominus}{CH}$

b) Employing umpolung carry out the following transformations <u>any two</u> : **[6]**

i) 

ii) 

iii) $HC\equiv CH$

*Q6)* a) Give brief account of <u>any one</u> of the following : **[4]**

i) Principles of Green Chemistry.

ii) Ionic liquids in organic synthesis.

b) Answer any four of the following : **[12]**

i) Carry out the following conversion using organo borane chemistry



ii) Rearrange the reagents properly to carry out the following transformation.



Reagents : Ph₃P = CHCOOEt; (Me)₃CNH₂; Br $\diagup\!\!\!\!\!\diagup$ ; LDA; H⊕

iii) Discuss the steps involved in the synthesis of the following compound



iv) Carry out the following transformation by enamine approach.



v) Discuss three methods for the carbon-carbon double bond formation.

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**P647**

**[3823] - 432**

**M.Sc. - II**

**DRUG CHEMISTRY**

**CH - 462 : Chemotherapy**

**(Old & New Pattern)**

*Time : 3 Hours]*                                                   *[Max. Marks : 80*

*Instructions to the candidates:*

    *1)*   *All questions are compulsory.*

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

    *3)*   *Figures to right indicate maximum marks.*

## SECTION - I

*Q1)* Answer <u>any three</u> of the following :                    **[15]**

    a)   Give a brief account of Antibiotic resistance. Explain the mechanisms involved & strategies utilised to combat resistance.

    b)   What are antibiotics? How are they discovered? Give the classification of antibiotics with examples.

    c)   Discuss in brief protein synthesis inhibitors as antibiotics. Describe their various uses. Why are some of them broad spectrum & some narrow spectrum.

    d)   Describe in brief the discovery of carbapeneons. What makes them super antibiotics. Discuss their mode of action.

*Q2)* Answer <u>any two</u> of the following :                    **[16]**

    a)   What benefits chemotherapy has over other treatments of cancer. Why are Anticancer drugs with severe side effects? Discuss in brief the mechanism of action of cyclophosphamide & Nitrosourceas.

    b)   Explain in brief the role of the following in managing CNS disorder

        i)   Barbiturates              ii)   Benzodiasetrins

        iii)   Serotonin reuptake inhibition   iv)   Hydantoins

*P.T.O.*

c) Give a brief overview of Antimetabolites/Enzyme inhibition as drugs. Discuss their utility & mechanism of action. Comment why methotrexate & 5-Fluerocencil have 1000 times stronger affinity for DHFR & Thymidylate synthatase respectively.

*Q3)* Answer <u>any two</u> of the following : **[9]**
   a) Give an account of AIDS & current approaches to its therapy.
   b) Discuss in brief polyene & polypeptides as antimicrobials.
   c) Discuss the drugs of choice for Malaria & Leprosy-Justify your choice.

## SECTION - II

*Q4)* Answer <u>any three</u> of the following : **[18]**
   a) Explain in brief the common diseases associated with the cardiovascular system. Discuss the approaches to stroke & Arrythmia. Explain the mechanism of atleast one drug.
   b) Discuss in brief the organisation of the Endocrine system, also explain the positive & negative feedback mechanisms utilised in maintaining homeostasis with examples.
   c) Discuss <u>any two</u> of the following :
      i) Hyper tension.
      ii) Endocrine therapy of cancer.
      ii) Hormones of the pituitary glands.
   d) Explain the following & their current remedies
      i) Pain   ii) NIDDM   iii) Congestive Heart Failure

*Q5)* Answer <u>any two</u> of the following : **[10]**
   a) Give a short account of plant products used as drugs, wherever possible explain their mechanism also.
   b) Give a brief account of the strategies employed in the development of cephalosporins/Macrolides. Explain how these strategies helped achieve the improved drugs.

c)   Explain in brief Tuberculosis & Leprosy-discuss their symptoms & diagnosis. What is the difference between Mycobacteria & other bacterias. Discuss their first line therapies.

*Q6)* Discuss the mode of action & uses of <u>any four</u> :                         **[12]**
   a)   Amoxycillin
   b)   Chloroquine
   c)   Ketoconazole
   d)   Doxorubicin
   e)   Insulin
   f)   Trimethoprim.

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**P648**

**[3823] - 433**

**M.Sc.**

**DRUG CHEMISTRY**

**CH - 463 : Drug Design**

**(Old & New Pattern)**

*Time : 3 Hours]*                                               *[Max. Marks : 80*

*Instructions to the candidates:*

   *1)*   *Answers to the two sections should be written in separate books.*

   *2)*   *Figures to right indicate full marks.*

   *3)*   *All questions are compulsory.*

<u>**SECTION - I**</u>

*Q1)* Answer any two of the following :                          **[14]**

   a)   Name enzymes used in r-DNA preparation. Explain the role of any two of these enzymes in the process.

   b)   Discuss briefly any two of the following :

      i)   Subunit vaccines

      ii)   Differentiation of disease pattern using transcriptome database.

      iii)   Therapeutic enzymes production by RDT.

   c)   Why are knockout mice useful in investigation of human gene function?

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

   a)   Define arithmetic mean and standard deviation. Also compute the same for following data - 5, 8, 9, 3, 6, 1, 4, 7.

   b)   In USA, daily emergency admissions in hospitals due to heart problems follow a passion distribution with mean 4. On any given day, find the probability that (i) there is no admission (ii) exactly three admissions.

   c)   What is correlation? Find coefficient of correlation for the data of income X $\alpha$ expenditure Y in thousand Rs. of 8 families per month.

        X :  4.8  5.2  5.4  6.0  6.7  8.5  9.1  9.5

        Y :  3.9  5.0  5.1  5.9  6.5  8.4  9.0  9.4

*P.T.O.*

*Q3)* Answer <u>any two</u> of the following :                                    **[14]**
   a)  Give a short commentary on combinational chemistry & its importance in Pharmaceutical industry. Discuss the mixed & split approach & parallel synthesis.
   b)  Discuss the functions of membrane bound receptors & Ion channels-explain the mechanism.
   c)  With proper illustrations explain how prodrugs are constructed & discuss their eventual ADMET benefits this achieved.

## SECTION - II

*Q4)* Answer <u>any three</u> of the following :                                    **[18]**
   a)  Explain the molecular mechanics approach in drug designing. Discuss the components of a force field equation.
   b)  Explain i) Molecular Dynamics simulation ii) Ab initio methods
   c)  Discuss in brief the development of Hansch analysis as used in drug designing & explain with example.
   d)  ACE is an important target for Antihypertensive drugs. Its crystal structure is known. How will you design a novel antihypertensive from this information. Explain & justify your approach.

*Q5)* Answer <u>any two</u> of the following :                                    **[12]**
   a)  What are the benefits of topliss operational scheme over Hansch approach? Explain how a decision tree is made.
   b)  How are the following performed
       i)   COMFA & COMSIA   ii)   Free Wilson Analysis
   c)  Explain the following terms :
       i)   Equation of best fit.    ii)   Correlation coefficient
       iii)  Optimum log p.         iv)   Test series.

*Q6)* Discuss <u>any two</u> of the following in brief :                                    **[10]**
   a)  Virtual screening.
   b)  Receptor theories of drug action.
   c)  Approaches to drug designing when target structure is unknown.

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