[6063]-111
M.Sc. - I
PHYSICAL CHEMISTRY
CHP - 110 CCTP - 1 : Fundamentals of Physical Chemistry - I
(2019 Pattern) (Semester - I)

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

Instructions to the candidates:
  1) *All questions are compulsory.*
  2) *Figures to the right indicate full marks.*

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

P.T.O.

SECTION - I

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

     i) Define state function and path function.

     ii) State Henry's law and write its mathematical expression.

     iii) Define perfect black body and explain UV-catastrophe.

     iv) Draw the structures of PCl_3 and PCl_5 based on valence bond theory.

     v) What is Gibb's and Helmholtz function?

   b) Calculate the uncertainity in the position of an electron moving with an uncertainity in the velocity of $300 \, kms^{-1}$. **[3]**

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

     i) What is Osmotic pressure? Explain in detail.

     ii) Explain Clausius inequality.

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

     i) Explain the Molecular Orbital diagram of N_2 molecule. Calculate its bond order.

     ii) Calculate the degeneracy of a particle in a three dimensional box for $E = 51\dfrac{h^2}{8ma^2}$.

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

     i) Explain Hückel theory with suitable example.

     ii) What are colligative properties? Explain elevation in boiling point.

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

     i) What are the conditions for the well-behaved wave function?

     ii) What will be the depression in freezing point of benzene if 5g of hexane is added in 50g of benzene?

     [Given : Freezing point of benzene $5.5°C$ k_f for benzene $= 5.12 k.kg/mol$]

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

        i)   Explain the entropy change in ideal gas with temperature and pressure.

        ii)   Explain cummutative operator with suitable example.

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

        i)   Explain the hybridisation and geometry in BF_3 molecule.

        ii)   Calculate the de-Broglie wavelength in nm for a particle having momentum 3.5×10^{-24} kgms^{-1}.

SECTION - II

Q5) a)   Attempt any four: **[8]**

        i)   Write the difference between molecularity and order.

        ii)   For a chain reaction $R \xrightarrow{k_1} I \xrightarrow{k_2} P$, which rate of formation will be zero among $\dfrac{d[I]}{dt}$ and $\dfrac{d[P]}{dt}$? Justify your answer.

        iii)   What is the role of probability factor in the determination of rate constant by collision theory?

        iv)   What is the effect of temperature on the enzyme catalysed reactions?

        v)   What is Stirling approximation?

    b)   In a first order reaction, the graph of log C vs time has a slope of -3.7×10^2 min^{-1}. Calculate the rate constant and half life of the reaction.**[3]**

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

        i)   In a unimolecular reaction discuss how the order of the reaction changes with the pressure as per Lindemann mechanism.

        ii)   Derive an expression to calculate the translational partition function.

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

        i)   Explain the flash photolysis technique to study the kinetics of the fast reactions.

        ii)   Calculate the rotational partition function of H_2 molecule at 10°C if its moment of inertia is 4.59×10^{-41} g cm^2.

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

   i)   Discuss the kinetics of the following reaction.

   $A + B \rightarrow P_1$
   $A + C \rightarrow P_2$
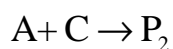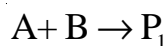
   ii) Explain the Line Weaver Bürk plot and Edie plot based on the Michaelis equation for the enzyme catalysis.

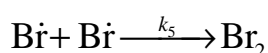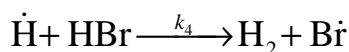 b) Solve the following: **[6]**
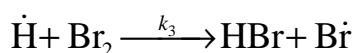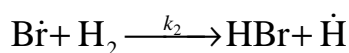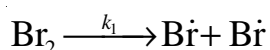
   i)   Derive an expression to determine the entropy from the partition function.

   ii) Calculate the activation energy for a reaction having pre exponential factor of 8.73×10^{11} s^{-1}. Rate constant is 17.46×10^3 s^{-1} at 303 k.

Q8) a) Answer the following: **[6]**

   i)   Compare the Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstine Statistics.

   ii) The reaction between H_2 and Br_2 has following mechanism.

   $Br_2 \xrightarrow{\ k_1\ } B\dot{r} + B\dot{r}$
   $B\dot{r} + H_2 \xrightarrow{\ k_2\ } HBr + \dot{H}$
   $\dot{H} + Br_2 \xrightarrow{\ k_3\ } HBr + B\dot{r}$
   $\dot{H} + HBr \xrightarrow{\ k_4\ } H_2 + B\dot{r}$
   $B\dot{r} + B\dot{r} \xrightarrow{\ k_5\ } Br_2$

   Find $\dfrac{d[B\dot{r}]}{dt}, \dfrac{d[\dot{H}]}{dt}$ and $\dfrac{d[HBr]}{dt}$.

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

   i)   Derive Erying equation.

   ii) What is the maximum velocity of an enzyme catalysed reaction if it has a velocity of 5×10^8 Ms^{-1} for substrate concept of 1μM $K_M = 0.6\mu$M.

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M.Sc. - I

INORGANIC CHEMISTRY

CHI-130 : Molecular Symmetry and Chemistry of P-Block Elements

(2019 Pattern) (Semester - I)

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

Instructions to the candidates:

   1)   *All questions are compulsory.*

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

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

   4)   *Use of logtables, character tables and calculator is allowed.*

SECTION - I

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

     i)   Identify and draw different types of planes in $NO_3^{\ominus}$ ion.

     ii)   Assign the appropriate point group for PCl_5 and benzene.

     iii)   List all symmetry elements of H_2O molecule. What is its point group?

     iv)   What is the multiplication of $\sigma^{xy} \times C_2^z$ using matrix multiplication method.

   B)   Explain with appropriate sketches different types of planes of symmetry in $[Ni(CN)_4]^{2-}$ (square planar) ion.   **[3]**

Q2) A)   Answer <u>ANY ONE</u> of the following :   **[6]**

     i)   Using great orthogonality theorem derive the character table for D_2 point group. The classes for D_2 point group are E_1 $C_2^{(x)}, C_2^{(y)}, C_2^{(z)}$.

P.T.O.

ii) Assign the point groups to the following molecules.

    a) Trans-planar H_2O_2

    b) C_2H_6 eclipsed configuration

    c) CO_2

B) Answer <u>ANY TWO</u> of the following : [6]

i) Explain with suitable examples the following symmetry elements.

    a) Principal axis and proper rotation

    b) Center of inversion

ii) Distinguish between C_4v and C_4h point groups using suitable example.

iii) What is similarity transformation? From the given group multiplication table find out the set of conjugate elements (classes).

C_2h	E	C_2^z	$\sigma_h^{(xy)}$	i
E	E	C_2^z	$\sigma_h^{(xy)}$	i
C_2^z	C_2^z	E	i	$\sigma_h^{(xy)}$
$\sigma_h^{(xy)}$	$\sigma_h^{(xy)}$	i	E	C_2^z
i	i	$\sigma_h^{(xy)}$	C_2^z	E

Q3) A) Answer <u>ANY ONE</u> of the following : [6]

i) Which irreducible representations of C_4v point group form the basis of following reducible representation?

C_4v	E	$2C_4$	C_2	$2\sigma v$	$2\sigma d$
T_{red}	1	−1	1	−1	1

Given : C_4v	E	$2C_4$	C_2	$2\sigma v$	$2\sigma d$
A_1	1	1	1	1	1
A_2	1	1	1	−1	−1
B_1	1	−1	1	1	−1
B_2	1	−1	1	−1	1
E	2	0	−2	0	0

ii) Find out normalized SALC using projection operators, B_1 operates on ϕ_1 orbital of NO_2^- ion.

C_2v	E	C_2^z	σ_v^{xz}	σ_v^{yz}
B_1	1	-1	1	-1

B) Answer <u>ANY TWO</u> of the following : [6]

i) What are the conditions of a mathematical group? Explain using H_2O molecule.

ii) Prove that $S_n^{2n} = E$ using suitable example.

iii) Classify the following into appropriate point groups.

   a) $POCl_3$

   b) $SOCl_2$

   c) SnF_4

SECTION - II

Q4) A) Answer the following : [8]

i) What are electron deficient hydrides? Explain with examples.

ii) BF_3 is weak acid as compared to BBr_3, explain.

iii) Give the principle for separation of alkali metals by using crown ethers.

iv) What are allotropes of carbon? Draw the structure of graphite.

B) What are oxoanions of phosphorous? Give any two examples. [3]

Q5) A) Answer <u>ANY ONE</u> of the following : [6]

i) Write a note on interhalogen compounds.

ii) Explain the structure and bonding in :

   a) B_2H_6 b) Boron nitride

B) Answer <u>ANY TWO</u> of the following : [6]

i) Give an account of PN compounds.

ii) Write a note on fullerenes.

iii) Give synthesis, reactions and properties of organosilicon compounds.

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

    i) Give an account of extended silicon-oxygen compounds.

    ii) Draw the structures of following.

        a) B_4H_{10} b) XeF_6

        c) $[Cl_2PN]_3$ d) $Si_3O_9^{6-}$

        e) N_2O_4 f) $AsPh_5$
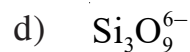
B) Answer <u>ANY TWO</u> of the following : **[6]**

    i) Write a note on metallic hydrides.

    ii) Give the synthesis, reactions and physical properties of borazine.

    iii) Classify the following compounds into closo/nido/arachno/hypho boranes.

        a) $B_{10}H_{14}$

        b) B_8H_{16}

        c) $(B_9H_{14})^-$

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M.Sc. (Part - I)
ORGANIC CHEMISTRY
CHO - 150 : Basic Organic Chemistry
(2019 Pattern) (Semester - I)

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

Instructions to the candidates:
1) *Q.1 and Q.5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from Q.2 to Q.4 and two from Q.6 to Q.8.*
3) *Answer to the two sections should be written in separate answer books.*
4) *Figures to right indicate full marks.*

SECTION - I

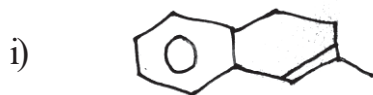**Q1) a)** Attempt the following :   **[9]**

     i)   Comment on current concept of Aromaticity.

     ii)   Comment on the conformational analysis of cyclic compounds.

     iii)   Define Enantiomer with example.

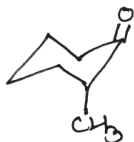**b)** Comment on optical activity in organic compounds.   **[2]**

Q2) Attempt the following (any four)   **[12]**

     a)   Give the synthesis of pyrrole using 1, 4 diketone

     b)   Draw all possible conformations of 1, 2 dimethyl cyclohexane.
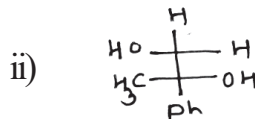
     c)   Assign E/Z designation to the following :

         i)

         ii)

d)   Assign R/S configuration to the following.

e)   Label the stereocentres and calculate number of stereoisomers.

i)

ii)

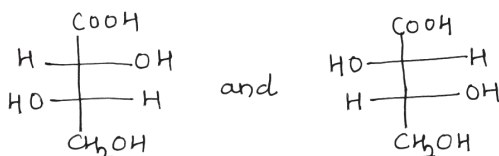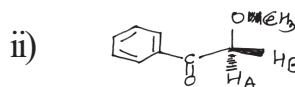**Q3)** Attempt the following. (any four)   **[12]**
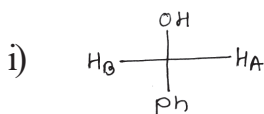
a)   Write a short note on Benzoid compounds.

b)   Pyridine is basic in nature explain.
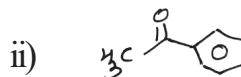
c)   Give the stereochemical relationship between follg.

d)   Assign Pro-R and Pro-S labels to H_A and H_B.

i)

ii)

e)   Assign Re and Si faces to the following.

i)

ii)
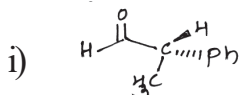
Q4) Answer the following (Any four)   **[12]**

a)   Write a note on Hantz Pyridine synthesis.

b)   Write a note on stereselective reactions.

c)   Give the sterochemical relationship between follg.

d)   Predict the product.

i)

ii)

e)   Comment on stability of following.

SECTION - II

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

    i) Explain the reaction of carboxylic acid with diazomethane.

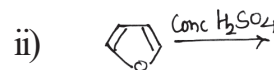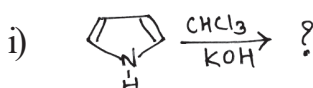   ii) Discuss the Dess Martin reagent.

    iii) Benzyl alcohol on oxidation with MnO_2 gives Ⓐ which on reduction with ⊗ again gives benzyl alcoho. Identify Ⓐ and ⊗.

    b) Give two applications of DDQ. **[2]**

Q6) Attempt any four of the following: **[12]**

    a) Comment on NGP by alkene

    b) Explain Beckmann Rearrangement

    c) Write a short note on Favorskii reaction

    d) Suggest the suitable mechanism.
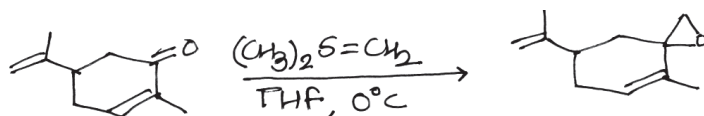
    e) Explain structure and stability of carbamion.

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

    a) Explain fries rearrangement.

    b) Write a note on wolff Kishner Reduction.

    c) Comment on stability of free radicals.

    d) Write a note on phosphorus ylides.

    e) Role of g-BBN in synthesis.

Q8) Predict the products (any four)   **[12]**

a) [Cl-substituted cyclohexene ring with CHO group and CH₃] + $Br\text{—}CH_2\text{—}C(=O)\text{—}OCH_3$ $\xrightarrow[\text{benzene}]{\text{PPh}_3,\ \text{NaOH}}$ Ⓐ $\xrightarrow{\text{Raney Ni}}$ Ⓑ

b) [bicyclic structure with OH] $\xrightarrow{\text{PCC}}$ Ⓐ $\xrightarrow[\text{HCl}]{\text{Zn-Hg}}$ Ⓑ

c) [cyclobutane with $CH_2\text{—}NH_2$] $\xrightarrow[\text{HCl}]{\text{HNO}_2}$ Ⓐ $\xrightarrow{\text{H}_2\text{O}/\text{H}^{\oplus}}$ Ⓑ

d) [cyclobutane with OH and vinyl group] $\xrightarrow{\text{H}_2\text{SO}_4}$ Ⓐ $\xrightarrow[\text{(CH}_3)_2\text{CHOH}]{\text{Al(OCHMe}_2)_3}$ Ⓑ

e) [two cyclobutane rings linked with two OH groups] $\xrightarrow{\text{H}_2\text{SO}_4}$ Ⓐ

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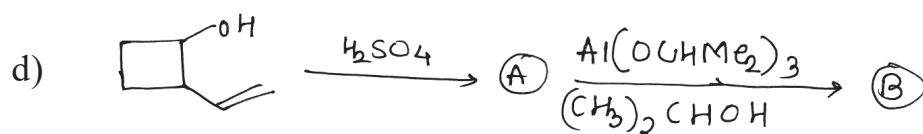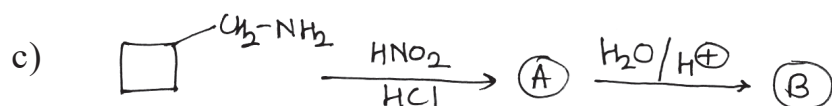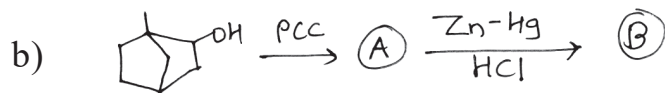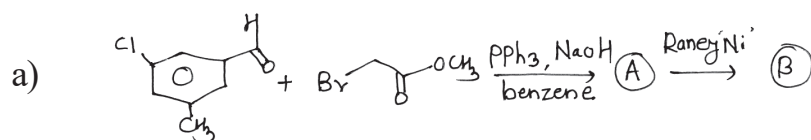
[6063]-114

M.Sc. - I (Analytical Chemistry)
GENERAL CHEMISTRY - I
CHG - 190, CBOP - 1 : Introduction to Solid of State Matter
(2019 Pattern) (Semester - I) (2 Credits) (Option A)

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

Instructions to the candidates:

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

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

     i)   Distinguish conductor, semiconductor and insulator on the basis of band diagram.

     ii)   Why solids show conductivity?

     iii)   Give two important applications of super conductor.

     iv)   Explain synthesis of ZnO.

     v)   What is extrinsic defect?

   b)   Write a note on Sol-Gel synthesis.   **[3]**

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

     i)   Synthesis of solids using combustion method.

     ii)   Fast ion conductors : Sodium ion conductors.

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

     i)   Explain semi - conducting behaviour of transition metal oxides.

     ii)   Discuss photo conductivity in solids.

P.T.O.

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

What is meant by defect in solid? Give classification of defects and explain each defect with suitable example.

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

i) Write a note on sensors.

ii) Explain magnetic properties of superconductors.

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

i) Discuss electronic conductivity in solids.

ii) Justify; Semiconducting behaviour in tetrahedral crystal structure on the basis of band theory.

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

i) Give the synthesis of cds nanoparticles.

ii) Discuss non - stoichiometry in wustite.

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M.Sc. - I

GENERAL CHEMISTRY

CHG - 190 : Mathematics for Chemists

(2019 Pattern) (Semester - I) (2 Credits) (Elective Option B)

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

Instructions to the candidates:

   1)   *Question 1 is compulsory.*

   2)   *Solve any two questions from Q.2 to Q.4.*

   3)   *Questions 2 to 4 carry equal marks.*

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

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

    i)   Write the derivative of

       1) $\cos x$

       2) x^n

    ii)   Define the following.

       1)   Node

       2)   Determinant

    iii) Give the quotient rule of derivatives

    iv) Find the maximum and minimum values of $2x^3 - 15x^2 + 36x + 10$

    v)   Find the value of 7A if $A = \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix}$

  b)   Write the three rules of partial differentiation.   **[3]**

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

    i)   Differentiate the following w.r.t.x $(x+1)(x+5)(x-1)(x-5)$

    ii)   Integrate the following $\int (x^2-3)^3 dx$

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

If $A = \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix} B = \begin{bmatrix} 3 & 7 \\ 4 & 8 \end{bmatrix} C = \begin{bmatrix} -1 & 1 \\ 0 & 0 \end{bmatrix}$ then find

    i) $A - 5B$

    ii) $4A + 3C$

    iii) $-3B$

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

    i)   Solve the following differentiation $(5x+4x^2)^5$

    ii)   Evaluate the following integral by substitution method

    $\int (ax+b)^{12} dx$

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

    i)   Find the cofactors of the third raw elements of the given matrix

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 2 & 0 & 4 \\ 0 & 1 & -1 \end{bmatrix}$$

    ii)   Integrate the following wrt independant variable $\int (x^5+3x+b)dx$.**[6]**

Q4) a) Solve the following.

    i)   If $y = \log(\log x)$ find dy/dx

    ii)   Evaluate following integral by parts

    $\int xe^x dx$

b) Find the adjoint of the matrix **[6]**

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & -1 \\ 2 & 0 & 4 \end{bmatrix}$$

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M.Sc. - I

GENERAL CHEMISTRY

CHG - 190 CBOP - 1 : Introduction to Chemical Biology - I
(2019 Pattern) (Semester - I) (2 Credits) (Elective Option C)

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

Instructions to the candidates:

1) *Question 1 is compulsory.*
2) *Solve any two questions from Q.2 to Q.4.*
3) *Questions 2 to 4 carry equal marks.*
4) *Figures to the right indicate full marks.*
5) *Draw neat and lebelled diagram wherever necessary*

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

     i) Name non - reducing sugar, draw the structure and explain why it is not reducing sugar.

     ii) Define and name the essential fatty acids.

     iii) Comment on mitochondrion: power house of the cell.

     iv) What is peptide bond? How it is formed.

     v) Draw structures of acidic amino acids. Mention three letter code and one letter code.

   b) Explain Uniport, symport and antiport transport system.   **[3]**

Q2) Attempt the following questions.

   a) Define and classify carbohydrates with suitable examples.   **[6]**

   b) i) What are the three main differences between acture and passive transport. Give example of each.   **[3]**

     ii) Explain significance of saponification number and acid number in lipid analysis.   **[3]**

Q3) Solve the following questions.

a) Comment in brief three major types of proteomics. **[6]**

b) i) Describe in detail fluid mosaic model of plasma membrane. **[3]**

ii) What are essential amino acid? Draw structures of any five essential amino acids. **[3]**

Q4) Answer the following questions.

a) Discuss in detail structure and function of different organelles of prokaryotic cell. **[6]**

b) i) Describe the tertiary structure of protein. **[3]**

ii) Why are liposomes important for drug delivery? Comment on the main component of liposomes. **[3]**

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P-2435

[6063]-211

F.Y. M.Sc.

PHYSICAL CHEMISTRY

CHP-210 : Molecular Spectroscopy and Nuclear Chemistry

(2019 Pattern) (Semester - II)

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

Instructions to the candidates:

1) *Q1 and Q5 compulsory.*

2) *Attempt any two Questions from each section.*

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

4) *Symbols have their usual meaning.*

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^4 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		$= 23.06$ kcal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6.	Gas Constant	R	$= 8.314 \times 10^7$ erg K^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mor1^{-1}
7.	Faraday Constant	F	$= 96487$ C equiv^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^8$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^7$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-24}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

SECTION - I

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

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

BCl_3, OCS, NH_3 & HCl

ii) Write down Born. Oppenheimer approximation

iii) State mutual exclusion principle.

iv) What is Franck - condon principle?

v) Which of the following molecules has the highest fundamental frequency of vibration?

H_2, HO

b) The bond length of NO is 1.151×10^{-10} m. Calculate the frequencies in cm^{-1} for the pure rotational lines in the spectrum of NO corresponding to the following changes in the rotational quantum, $0 \rightarrow 1$. [3]

[Mass no. N = 14, O = 16]

Q2) a) Answer the following. [6]

i) If the rotational constants for $^{14}N^{16}O$ & $^{15}N^{16}O$ respectively are B and B', then predict the relation between B & B'.

I) B = B'

II) B < B'

III) B > B'

ii) What are symmetric and asymmetric vibration? Explain with the example of H_2O molecule.

b) Solve the following. [6]

i) If HCl is irradiated with 435.8 nm Hg line. Calculate position of first stokes line in cm^{-1} fundamental vibrational frequency of HCl is 8.667×10^{13} s^{-1}.

ii) Explain the principle of Mössbauer spectroscopy & give its one application.

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

    i) Discuss the Birge-Sponer method for the determination of dissociation energy of a diatomic molecule.

    ii) Calculate the relative populations of two non-degenerate energy levels separated at 298K by an energy corresponding to a wave number of 5 cm^{-1}.

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

    i) Explain the order of Isomeric shift in Mössbauer spectroscopy of Sn^{2+}, Sn^{4+} and Sn (sp^3 hybridised)

    ii) Explain the pure rotational Raman spectrum for linear molecules and sketch the Raman spectra.

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

    i) The force constant for $^1H^{19}F$ molecule is 9.7×10^2 Nm^{-1}. Calculate the frequency of radiation to excite the molecule from $0 \rightarrow 1$ in cm^{-1}.

    ii) Explain the principle of photo electron spectroscopy.

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

    i) Write a note on Fortrat diagram.

    ii) Explain the classical theory of Raman effect

SECTION - II

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

    i) How does Geiger-Nuttall's law explain the relationship between half life of a radioactive substance and the energy of the emitted particles.

    ii) A sample of radioactive material has an activity of 1 microcurie. What is its activity in becquerels?

    iii) What is fission energy?

    iv) What do you mean by Newtron activation analysis?

    v) Write the equation for the preparation of ^{35}S.

  b) Find the thickness of lead required to reduce the level of radiation due to ^{60}Co source at a point from 0.1 Gy/min to 3.1 mGy/h.

    [Given : eµ = 0.211 b/electron, density of Pb = 11.29 g/cc Pb, Z = 82, A = 207] **[3]**

Q6) a) Answer the following.   [6]

   i)   How does the process of nuclear fission occur and what are the steps involved?

   ii) What is photoelectric effect? Discuss in detail.

   b) Solve the following.   [6]

   i)   A sample of radioactive material has a half life of 10 days. If its activity is 1000 decays per sec. initially, what will its activity be after 20 days?

   ii) Explain the radiometric titration with suitable example.

Q7) a) Answer the following.   [6]

   i)   What is spallation in nuclear fission and how does it differ from neutron evaporation?

   ii) What is a Fricke dosimeter and how does it work?

   b) Solve the following.   [6]

   i)   Explain the isotopic dilution method with suitable example.

   ii) 0.1 g of a medicinal plant extract containing Mn was irradiated in neutron flux of 10^{12}n cm^{-2}s^{-1} for 5 minutes. The activity counted after 10 h of cooling period was 2500 cpm with a detector with detection efficiency 20%. Determine the percentage of Mn in the extract.

   [Given : σ = 13.3 b; ty_z = 2.58 h for ^{56}Mn, isotopic abundance = 100%]

Q8) a) Answer the following.   [6]

   i)   What are spurs and δ-rays?

   ii) Explain the determination of mechanism of Friedel craft reaction using radioactive tracers.

   b) Solve the following.   [6]

   i)   For the radioactive isotope ^{131}I, the time required for the 50% disintegration in 8 days. What is time required for the 99.9% disintegration fo 5.5 g of ^{131}I in days?

   ii) Define the following terms : The Sievert, The REM & the Röntgen.

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[6063]-212

M.Sc.-I
CHEMISTRY
CHI-230 : Coordination and BioInoragnic Chemistry
(2019 Pattern) (Semester-II) (New 4-Credits)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:

  1)   *All questions are compulsory.*

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

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

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

SECTION-I

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

    a)   Why an aqueous solution of $[CO(H_2O)_6]^{2+}$ complex is pink in colour while $[COCl_4]^{2-}$ is blue in colour.

    b)   Arrange the following terms in increasing energy order and justify your answer.
^1G ^3I ^4F ^6D ^2P ^6H

    c)   Explain : Hole formalism.

    d)   Determine the full spectroscopic term symbol for the following free ions
      i) Ni^{2+} (Z=28)
      ii) Pm^{3+} (Z=61)

  B) Ni^{2+} (oh) complex shows 18% increase in its observed magnetic moment value. Calculate spin coupling constant λ for Ni^{2+} ion using following data : $D_9 = 850 Cm^{-1}$ **[3]**

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

    a)   Prepare a table of microstates and obtain R.S term symbols for the d^2 configuration.

    b)   Classify the following transitions in octahedral complex as orbitally allowed, vibronically allowed and forbidden transitions justify your answer.
      i) $Eg \rightarrow Eg$
      ii) $A_{2u} \rightarrow T_{2g}$
      iii) $A_{2g} \rightarrow T_{2g}$

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

a) Give splitting of 4H term in weak cubic ligand field using character for pure rotational point group (o)

b) How would you account the magnetic moment listed against the following complex. $[Ni(NH_3)_6]SO_4$ (Z=28)

c) Classify the following configurations as A, E (or) T in complex having on symmetry.

i) $(t_{2g})^3(e_g)^2$

ii) $(t_{2g})^3(e_g)^0$

iii) $(t_{2g})^4(e_g)^2$

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

a) Determine the spin multiplicities of states arising from $(t_{2g})^2$ configuration when infinitely strong octahedral field is relaxed to strong filed using Bethe's method of descending symmetry, correlation table and direct product table.

b) Hexa aquo Ni^{2+} complex shows absorption bands at 356.8nm, 571.2nm and 891.2nm. Calculation the spectrochemical parameter D9 and Nephelauxetic parameter B and β with the help of following data. comment on the nature of M-L bonding, Given

i) $B_0 = 1030 Cm^{-1}$

ii) $B = \dfrac{2V_1^2 + V_2^2 + 3V_1 V_2}{15 V_1 - 27 D_1}$

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

a) Explain which of the following complex's show orbital contribution to magnetic moment. Justify your answer.

i) $[Cr(H_2O)6]^{3+}$ (Z=24)

ii) $[Cucl4]^{2-}$ (Z=29)

b) For $[Cr(ox)3]^{3-}$ complex μeff is 3.79BM. $\underline{V}_1$ transition is observed at 17,000cm^{-1}, calculate spin orbit coupling constant.

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

i) $P^1 d^1$

ii) ^3I

iii) $^3B_{2g}$

SECTION-II

Q4) a) Answer the following: [8]

    i)   Explain the role of manganse in biological system.

    ii)   What are the groups attached to zinc in carbonic anhydrase?

    iii) What are the oxidation state of cobalt and zinc found in biological system?

    iv) Why metal chelate are more stable than metal complex?

  b) Explain the dioxygen transport by hemoglobin. [3]

Q5) a) Answer any one of the following: [6]

    i)   What is model complex? explain the concept of spontaneous self-assembly.

    ii)   Explain the electron transfer reactions in metal complexes.

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

    i)   Discuss the role of cobalt in vitamin B_{12}.

    ii)   Explain the interactions of metal ions and nucleic acid.

    iii) Explain the effect of substitutent on doner atom over the redoy potential of metal.

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

    i)   Draw and discuss the structures of iron-sulfur clusters.

    ii)   What is transferrin and ferritin? Discuss the structural features of transferrin and ferritin.

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

    i)   Explain administration and invivo chemistry of cis-platin.

    ii)   Explain the binding preferences of ligand to metal as per hard-soft acid base concept.

    iii) Explain the four electron transfer by metalloprotein.

Direct Product

1. **Group of the form $G \times i$ or $G \times \sigma h$**

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

   $g \times g = u \times u = g$, $g \times u = u$, 'x' = "x"=

2. **Product of the form $A \times A$, $B \times B$, $A \times B$**

   For all groups:

   Letter Symbol: $A \times A = A$, $B \times B = A$, $A \times B = B$

   Subscript: $1 \times 1 = 1$, $2 \times 2 = 1$, $1 \times 2 = 2$

   Except for the B representations of D_2 and D_2 where

   $B \times B = B$, and $1 \times 2 = 3$, $2 \times 3 = 1$, $3 \times 1 = 2$

3. **Products of the forms: $A \times E$, $B \times E$:**

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

   (b) For all groups except D_4h, D_4d, S_8:

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

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

   (c) For D_4h:

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

   Irrespective of the suffix on B:

   (d) For D_4d, S_8:

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

   Irrespective of the suffix on B:

4. **Products of the form $E \times E$:**

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

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

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

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

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

   (c) For D_6d:

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

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

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

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

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

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

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

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

   $E_1 \times E_2 = E_1 + E_2$

   (e) For D_4d, S_8

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

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

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

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

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

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

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

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

6. **To Complete result for O are**

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

Character Table for O rotational group

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

Correlation table for group Oh

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

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[6063]-213
M.Sc. (Part - I) (Chemistry)
CCTP-6 : ORGANIC CHEMISTRY - II
CHO-250 : Photochemistry, Pericyclic and Organic Spectroscopy
(2019 Pattern) (Semester - II)

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

Instructions to the candidates:

1) *Q1 and Q5 are compulsory questions and carry 11 marks.*

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

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

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

SECTION - I

Q1) a) Predict the products with exact stereochemistry. Justify your answer. **[8]**
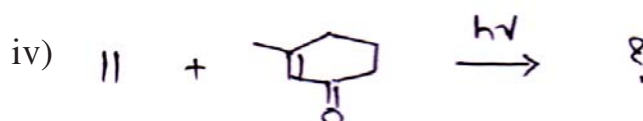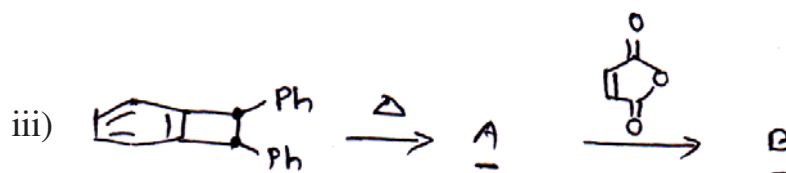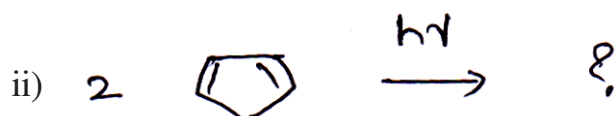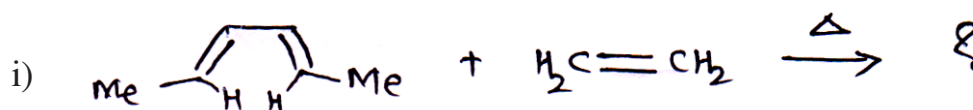
b) Write a note on Diels - Alder reaction. **[3]**

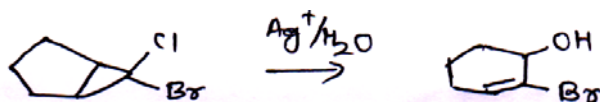*Q2)* a) Attempt any three of the following : [9]

i) Write a note on 'Norrish type - I' reaction.

ii) Explain Jablonski diagram in detail.

iii) Explain photo-fries rearrangement.

iv) Write a note on 'Ene reaction'.

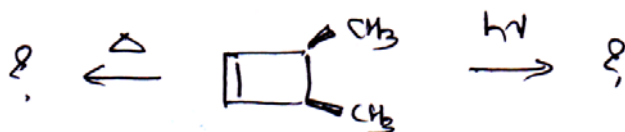b) Predict products in following reaction. [3]

Q3) a) Attempt any three of the following : [9]

i) Write a note on 'Photo sensitization'.
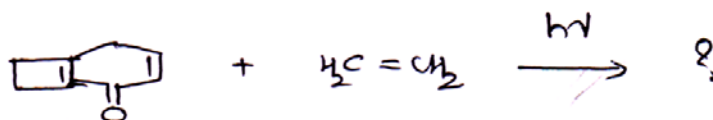
ii) Explain following reaction

iii) What are pericyclic reactions? Explain with suitable examples.

iv) Write a note on 1, 3-dipolar reaction.

b) Predict the products in following reaction justify your answer. [3]

Q4) a) Attempt any three of the following : [9]

i) Draw a correlation diagram for butadiene for electrocyclic ring formation.

ii) Predict products in following reaction.

iii) Write a note on cheletropic reactions.

iv) Explain Patemo Buchi reaction with suitable examples.

b) Suggest the mechanism for following reaction. [3]

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SECTION - II

**Q5) a)** Attempt the following : **[8]**

    i)   Why there is no C-C coupling observed in ^{13}C. NMR spectrum?

    ii)   What is Hooke's law? How it is useful in IR spectroscopy?

    iii) Isomers of stilbene shows UV absorptions (λmax) at 294nm and 278nm. Explain

   iv) Calculate λmax for following compounds
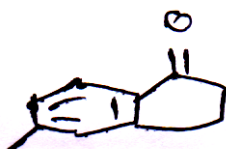
    b) Explain methods of fragmentation in mass spectrometry. **[3]**

Q6) a) Attempt any three of the following : **[9]**

    i)   Distinguish following isomers on the basis of PMR Explain coupling constants.
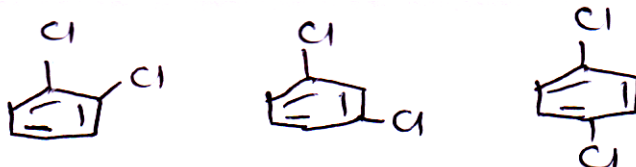
    ii)   A proton has resonance 90 Hz downfield from AMS when the field strength is 60 MHz. What will be it's chemical shift in ppm(δ)?

    iii) Write a note on coupling constant.

    iv) How will you follow the following reaction using IR spectroscopy?
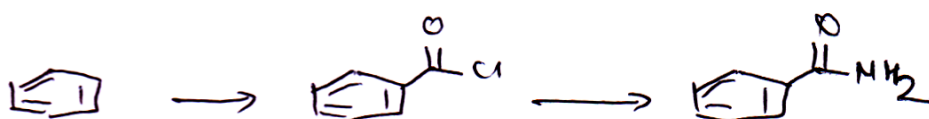
    b) $COCl_3$ appears as a triplet at 77.8 ppm in CMR while it appears a singlet at 7.26 ppm in PMR. Explain : **[3]**

Q7) a) Attempt any three of the following : **[9]**

    i)   Explain electron Ionization in mass spectrometry.

    ii)   Explain why IR frequency of isobutonol changes on dilution?

    iii) What is diamagnetic anisotropy? Explain

    iv) Draw and explain PMR spectrum of n-propyl amine.

b) A compound with MF $C_6H_4N_2O_4$ shows IR at 1530, 1360 and 1600 cm^{-1}. PMR at 8.2(5, 4H). Deduce the structure. **[3]**

Q8) a) Attempt any three of the following : **[9]**

Deduce the Structure of the following :

i) MF - $C_{10}H_{12}O_2$
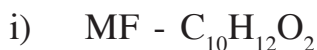
IR - 1500, 1600, 1620, 1740 cm^{-1}

PMR(δ, ppm) - 2.1(s, 3H); 2.8(t, J = 7.2 Hz, 2H); 4.3(t, J = 7.2Hz, 2H); 7.2–7.4(m, 5H)

ii) M.F. = C_9H_{12}

IR = 1503, 1610, 1621 cm^{-1}

PMR - 2.1(s, 9H)

7.3(s, 3H)

iii) M.F = $C_4H_6O_2$
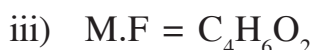
PMR = 1.9(d, J = 6Hz, 3H)

5.7(d, J = 18Hz, 1H)

7.2(dq, J = 18, 6Hz, 1H)

12.20(bs, exchangeable with D_2O, 1H)

iv) M.F. = $C_{15}H_{14}O$
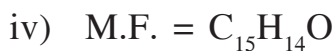
IR = 1650 cm^{-1}

PMR = 2.4(s, 6H)

7.2(d, J = 8Hz, 4H)

7.7(d, J = 8Hz, 4H)

CMR = 21, 129, 133, 136, 141, 190.

b) Explain base peak and molecular ion peak in mass spectrometry. **[3]**

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[6063]-214

M.Sc. - I (Analytical Chemistry)
GENERAL CHEMISTRY
GHG-290-CBOP-2 PART A : Material Characterization Technique
(2019 Pattern) (Semester - II) (Elective-Option-A) (2 Credits)

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

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

*Q1)* A) Answer the following. (Any four) **[8]**

  a) What is reciprocal lattice in XRD?

  b) Enlist the operational variables in SEM.

  c) What is fluorescent yield? How it changes with atomic number?

  d) What is prethinning in TEM?

  e) Give the selection rules for electron transition between two shells in X-ray generation.

  B) Bragg's diffraction of the second order was observed at 23.5° for parallel planes of the crystal under examination. If the Wavelength of X-rays used in 1.54 Å. Calculate the interplanar spacing for planes in the crystal. **[3]**

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

  Describe various applications of X-ray diffractometer.

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

  a) Explain topographic contrast in SEM.

  b) Discuss analyzing crystal in wavelength dispersive spectroscopy.

P.T.O.

Q3) A) Answer the following: [6]

    a)   Discuss field emission gun in TEM.

    b)   Describe electron-Specimen interaction in SEM.

   B) Answer the following: [6]

    a)   Describe X-ray generation with suitable diagram.

    b)   Explain Energy dispersive spectroscopy (EDS) in brief.

Q4) A) Answer the following: [6]

    a)   Discuss mass density contrast in TEM.

    b)   Explain absorption filter in XRD.

   B) Write a note on : [6]

    a)   Scanning modes in EDS.

    b)   Applications of XRF.

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P2438

[6063]-214
M.Sc. - I (Chemistry)
GENERAL CHEMISTRY
GHG-290-CBOP-2 : Organometallic And Inorganic Reaction Mechanism
(2019 Pattern) (Semester - II) (Elective Option-B) (2 Credits)

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

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

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

     a) High spin d^4, $[Cr(H_2O)_6]^{2+}$ complex is labile while d^4 low spin, $[Cr(CN)_6]^{4-}$ complex is inert. Explain.

     b) What is oxidative addition reaction in organo metallic compounds?

     c) Between two compounds which do not obey $18\bar{e}$ rule.

         i) $Fe(CO)_5$ and   ii) $[Ni(CN)_4]^{2-}$

     d) What is the product of -
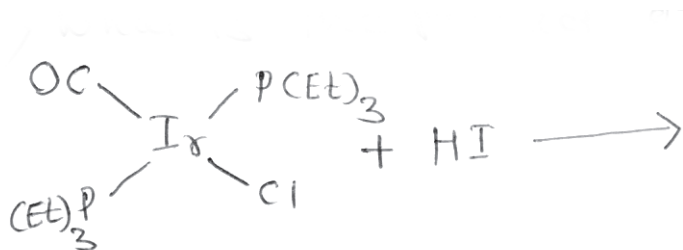
     e) What is hydride elimination reaction?

   B) Draw the structure of the following complexes   **[3]**

     a) $Cr(CO)_6$

     b) $Fe_3(CO)_{12}$

     c) $CO_2(CO)_8$

Q2) A) Explain in detail hydroformylation reaction by HCO $(CO)_4$ catalyst. **[6]**

B) Explain the following: **[6]**

   a) Steriochemistry of the substitution reaction. in trans $[M(L–L)_2Bx]$ complexes.

   b) $18\bar{e}$ rule with suitable example.

Q3) A) Write notes on **[6]**

   a) Kinetic chelate effect.

   b) Trans effect in pt complexes.

B) Explain synthesis of binary carbonyl complexes by **[6]**

   a) Direct reaction

   b) Reductive carbonylation

   c) Thermal or photochemical reaction.

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

   a) How IR spectroscopy is used to explain

      i) Bonding modes of CO

      ii) Structure identification in binary carboyal complexes.

   b) What is nucleophilic displacement reaction? Explain with suitable example.

B) What is dissociative ligand substitution reaction? Give evidence basis of LFAF and electronic effects. **[6]**

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P2438

[6063]-214
M.Sc. - I (Chemistry)
GENERAL CHEMISTRY
CHG-290 : Introduction to Chemical Biology-II
(2019 Pattern) (Semester - II) (Elective Option-C) (2 Credits)

Time : 2 Hours] *[Max. Marks : 35*
Instructions to the candidates:
1) *Q. 1 is compulsory.*
2) *Solve any two questions from Q.2 to Q.4.*
3) *Draw neat and labelled daigtam wherever necessary.*
4) *Figures to the right indicate fulll marks.*

Q1) A) Solve any Four of the following. **[8]**

a) Write the complementary sequence for one strand of DNA having the sequence.

AGTCTTGACCA

b) What are allosteric enzymes? why are allosteric enzymes important?

c) Explain decarboxylation reaction of amino acid.

d) what is the purpose of dialyzing a protein.

e) Comment on Gene therapy.

B) Discuss the principle and application of affinity chromatography. **[3]**

Q2) Attempt the following questions:

a) Explain Elongation and termination stage of transcription process. **[6]**

b) i) What is meant by enzyme specificity? Discuss its types with suitable example. **[3]**

ii) Comment on preparatory phase of Glycolysis. **[3]**

P.T.O.

Q3) Answer the following questions:

a) What are the different types of enzyme inhibition? Discuss in detail on any one type of enzyme inhibition with suitable example. **[6]**

b) i) What is the principle of gel permeation and Ion exchange chromatography? Give some example of cation and anion exchanger. **[3]**

ii) Describe β-oxidation of palmitic acid. **[3]**

Q4) Solve the following questions:

a) Explain the principle and procedure of SDS-PAGE. Add a not on its applications. **[6]**

b) i) Discuss the reactions of citric acid cycle. **[3]**

ii) Give the applications of biotechnology. **[3]**

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[6063]-311
M.Sc.-II
PHYSICAL CHEMISTRY
CCPT-7 CHP-310: Quantum and Solid State Chemistry
(2019 Pattern) (Semester-III) (Credit-4)

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

Instructions to the candidates:

1) *Answer the two sections should be written in Separate answer book.*
2) *Question 1and 5 are compulsory.*
3) *Answer any 2 questions out of Q2. Q3 and Q4 and any 2 questions out of Q6. Q7 and Q.8.*
4) *Figures to the right indicate full marks.*
5) *Use of logarithmic table, calculator is Allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

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

SECTION-I

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

    i) State whether following operators are linear or non-linear

       1) $(\ )^2$

       2) exp

    ii) What is the principle of variation method?

    iii) Define eigen function and eigen value.

    iv) State Pauli's exclusion principle.

    v) Explain the properties of quantum mechanical operators

  b) State the condition for an operator to be Hermitian. Give one example.

    [3]

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

    i) Formulate the Hamiltonian operator for

       1) Be^{+2} ion

       2) H_2 molecule

    ii) Write the Schrodinger time-independent equation and give the significance of the terms in it.

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

    i) Give the steps involve in the application of the variation method.

    ii) Define Symmetric and antisymmetric wave function.

Q3) a) What is slater determinant? Explain properties of slater determinant. **[6]**

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

    i) State the Russel-saunder's rules to determine ground state of an atom.

    ii) Show that linear momentum operator $\left(\hat{P}_x\right)$ is a Hermition operator.

Q4) a) Write a note on Hartree-Fock SCF method for multi-electron system.

    [6]

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

    i) If $\hat{A}$ and $\hat{B}$ commute then show that they have same set of eigen function.

    ii) Explain the regular and inverted multiplet.

SECTION-II

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

   i) What is a lattice imperfection? Give its classification.

   ii) State the conditions to grow crystal from melts.

   iii) Give the factors affecting rates of solid-solid reactions.

   iv) State Kirkendall effect.

   v) Explain the formation of F and V colour centres.

   b) Write the various methods of electric breakdown in insulators. **[3]**

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

   i) What is lattice imperfection? Give its classification?

   ii) Discuss Czochralski method to grow crystal from melts.

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

   i) Explain the parabolic rate law used to explain the mechanism of gas-solid reactions.

   ii) Discuss any one method for the growth of crystal from vapour phase.

Q7) a) Derive the equation $E_0 = \frac{1}{2}[E_v + E_c]$ **[6]**

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

   i) Explain photovoltaic effect.

   ii) Calculate the number of Schottky defects in $1cm^3$ NaCl single crystal if energy required to remove a pair of oppositely charged ions in 2eV. [Given: $\zeta = 2.165\,gcm^{-3}$, M = 58.5]

Q8) a) Derive an expression for number of Frenkel defects present in a crystal at a given temperature. **[6]**

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

   i) Explain the mechanism of the following solid-solid reaction:

   $Cu_{(s)} + AgCl_{(s)} \rightarrow CuCl_{(s)} + Ag_{(s)}$

   ii) Describe flux method for crystal growth.

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SEAT No. :

[6063]-312
M.Sc. - II
PHYSICAL CHEMISTRY
CHP-311:CCTP-8 : Nuclear, Radiation and Polymer Chemistry
(2019 Pattern) (Semester - III) (4 Credits)

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

Instructions to the candidates:

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

   2)   *Questions 1 and 5 are compulsory.*

   3)   *Answer any 2 questions out of Q2, Q3 and Q4 and any 2 questions out of Q6, Q7 and Q8.*

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

   5)   *Use of logarithmic table, calculator is allowed.*

   6)   *Neat diagram must be drawn wherever necessary.*

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.023 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-16}$ erg s
			$= 6.626 \times 10^{-34}$ J/s
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ k cal mol^{-1}
			$= 1.602 \times 10^{-12}$ erg
			$= 1.602 \times 10^{-19}$ J
			$= 8065.5$ cm^{-1}
6.	Gas Constant	R	$= 8.314 \times 10^{7}$ erg K^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7.	Faraday Constant	F	$= 96487$ C equivalent^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.187 \times 10^{3}$ erg
			$= 4.187$ J
10.	1 amu		$= 1.673 \times 10^{-22}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

SECTION - I

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

      i) Define the term exotic nuclei.

      ii) Write the functon of shielding in reactor design.

      iii) State liquid drop model.

      iv) Give any two applications of PIXE technique.

      v) Draw basic structure of oxide layer detector.

   b) Explain conservation of energy in nuclear reaction. **[3]**

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

      i) Distinguish between thermal and biological shield.

      ii) Explain projectile acceleration and target preparation in PIXE.

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

      i) Explain inorganic scintillator with the help of suitable example.

      ii) Describe principle of PIXE technique.

Q3) a) Derive the Breit - Wigner formula for yield of nuclear reaction. **[6]**

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

      i) Explain classification of reactors on the basis of neutron energy.

      ii) Discuss ionization and X-ray emission in PIXE.

Q4) a) What is research reactor? Explain different types of reasearch reactor. **[6]**

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

      i) Find spin and parity of ^{39}K.

      ii) Find excitation energy of a compound nucleus formed by bombarding ^{20}Ne by 8 MeV deuterons.

        [Given : A of ^{20}Ne = 19.99244 u

                 d = 2.01402 u

                ^{22}Na = 21.9447726u

SECTION - II

(Polymer Chemistry)

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

    i) Define Branched chain polymer.

    ii) State the principle of viscometry technique.

    iii) What is meant by degree of polymerization.

    iv) Define the term copolymerization.

    v) State the assumptions of Flory - Krigbaum theory.

  b) The degree of polymerization of polyproylene is 5000. Find out molecular weight of polyproylene. **[3]**

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

    i) Explain sedimentation velocity method.

    ii) Distinguish between homochain and heterochain polymer.

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

    i) Describe end group analysis for addition polymer.

    ii) Discuss the entropy of mixing of polymer solutions.

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

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

    i) Give the classification of polymer with an example.

    ii) Write characterization of polymers.

Q8) a) Explain light scattering method for molecular weight determination of polymer solution. **[6]**

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

    i) Write a note on Flory-Krigbaum theory.

    ii) Three moles of vinyle acetate combines with one mole of vinyl chloride. Find the polymer composition.

    [monomer reactivity ratios : 0.23 and 1.68 respectively]

    At. wt. : C = 12, H = 1, C1 = 35.5, O = 16

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[6063]-313

S.Y. M.Sc.

PHYSICAL CHEMISTRY

CCPT-9 CHP-312: Physicochemical Methods of Analysis

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

1) *Answer the two sections should be written in Separate answer book.*
2) *Question 1and 5 are compulsory.*
3) *Answer any 2 questions out of Q2. Q3 and Q4 and any 2 questions out of Q6. Q7 and Q.8.*
4) *Figures to the right Side indicate Full marks.*
5) *Use of logarithmic table, calculator is Allowed.*
6) *Neat diagrams must be drawn wheever 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	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

P.T.O.

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

    i) Give two applications of X-raw absorption.

    ii) Define the terms short - wavelength cut-off and Brems strahlung.

    iii) Draw a neat labeled diagram of an ESCA spectrometer.

    iv) Define the terms Fermi energy and binding energy.

    v) Explain the term thermal analysis

  b) Discuss the analysis of solid, liquid and gaseous samples by X - ray fluorescence method. [3]

Q2) a) Attempt the following: [6]

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

    ii) Find the short-wavelength cutoff in X -ray tube having a potential difference 1250 V between the filament and target.

  b) Attempt the following: [6]

    i) Describe cylindrical mirror analyzer used in ESCA.

    ii) Write the applications of DTA technique.

Q3) a) Describe electrostatic field analyzers used in ESCA. [6]

  b) Attempt the following: [6]

    i) Explain spectral splitting observed in ESCA technique.

    ii) Discusss in brief electron shake up and shake of processes with example observed in ESCA.

Q4) a) State the principle of thermometric titrations. Explain thermometric titration curve for exothermic and endothermic reaction. [6]

  b) Attempt the following: [6]

    i) Show glass titration temperature, crystallization melting and oxidation on a typical DTA curve.

    ii) TGA of plaster of paris showed mass loss of about 6.2% of original sample mass for complete dehydration of plaster of paris at about100 °C. Determin the number of water molecules present in plaster of paris.

    [At. Wt. of Ca = 40, S = 32, O = 16 and H = 1]

SECTION-II

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

    i) Write the advantages of amperometric titraction.

    ii) Define the term potentiostant.

    iii) What is plasma? State its types.

    iv) Explain the effect of temperature on photoluminescent intensity.

    v) State the advantage of constant current coulometry.

  b) Explain S route mechanism for electrochemiluminescence. **[3]**

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

    i) What are the applications of amperometric titrations?

    ii) Define singlet, doublet and triplet states.

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

    i) Discuss briefly the technique of pulse voltammetry.

    ii) Explain how radical anions and radical cations are formed in electrochemiluminescence.

Q7) a) Explain the sample introduction in ICP spectrometer. **[6]**

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

    i) What are the different techniques of amperometric titration.

    ii) At what value should the cathod potential be controlled if it is desired to separate silver from 0.005 M Solution of Cu^{2+} ions?

    [Given : E^o_{oxi} Cu^{2+} $= -0.337$ V]

Q8) a) Discuss the gas-phase titrations performed in chemilumenescence. **[6]**

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

    i) Discuss the applications of cyclic voltametry.

    ii) A sample of Ni are weighing 3.18g is dissolve in acid and the Ni is electrolysed using constant current of 2.5 µA for 10 minutes. Calculate the precentage of Ni in the ore.

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[6063]-314

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-313(A) CBOP-3 : Photochemistry and Techniques in Polymer Chemistry

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

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

Instructions to the candidates:

1) *Answer to the two sections should be written in separate answer book.*
2) *Question 1 and 5 compulsory.*
3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
4) *Figures to right side indicate full marks.*
5) *Use of logarithmic table, calculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

<u>**Physico - Chemical Constants**</u>

1)	Avogadro Number	N	$= 6.022 \times 10^{23}$ 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	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12)	Nuclear magneton	β_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

(Photochemistry and Techniques in Polymer Chemistry)

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

  i) State Grotthus - Draper's law.

  ii) Define effective light of photochemical change.

  iii) Explain the term stimulated emission and spontaneous emission.

  iv) What are primary and secondary photochemical processes?

  v) State the principle of photochemical activation.

  b) Explain mechanism of delayed fluorescence. **[3]**

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

  i) What are the types of electronic transition in organic molecule.

  ii) Write a note on depth profiling technique.

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

  i) Explain the Jablonski diagram depecting photophysical process.

  ii) Discuss the working of photomultimeter tube.

Q3) a) Derive the stern-volmer equation for the kinetics of collisional quenching. **[6]**

  b) Answer the following:

  i) Explain the working of Ruby and Nd : YAG Laser. **[3]**

  ii) Discuss the working of linear accelarator. **[3]**

Q4) a) Discuss nanosecond and picosecond laser flash photolysis. **[6]**

  b) Answer the following:

  i) Discuss the theory of fluorescence. **[3]**

  ii) Define actinometry. Enlist the various type of chemical actinometers. **[3]**

SECTION - II

(Photochemistry and Techniques in Polymer Chemistry)

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

      i) Define the term degree of Polymerization.

      ii) What is meant by thermosetting polymer.

      iii) Define conducting polymer with example.

      iv) What is glass transition temperature?

      v) What is vulcanization?

  b) Explain the effect of radiation in polymer. **[3]**

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

      i) Explain block co-polymerization.

      ii) Write a note on step polymerization.

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

      i) Derive copolymer equation.

      ii) Give an account of extrusion molding.

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

      i) How IR spectra useful in polymer analysis.

      ii) Describe the principle of membrane osmometry.

  b) What are the techniques used for reinforced plastics. Explain any one techniques with neat diagram. **[6]**

Q8) a) Write a note on X-ray diffraction in analysis of Polymer. **[6]**

  b) Answer the following:

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

      ii) Explain the term polymer utilization. **[3]**

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P2442

[6063]-314
M.Sc. - II
PHYSICAL CHEMISTRY
CHP-313(B) CBOP-3 : Special Topics in Physical Chemistry
(2019 Pattern) (Semester - III) (Elective) (Option - A)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
1) *Answer to the two sections should be written in separate answer book.*
2) *Question 1 and 5 compulsory.*
3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
4) *Figures to right side indicate full marks.*
5) *Use of logarithmic table, calculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

<u>**Physico - Chemical Constants**</u>

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

SECTION - I

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

    i) What are gross errors?

    ii) Write the difference between turbidimetry and colorimetry.

    iii) What are instrumental errors?

    iv) State combination? Give its formula.

    v) Define the term significant figure. Find significant figure of 0.023.

  b) Explain the difference between nephelometry and turbidimetry. **[3]**

Q2) a) Calculate the pH and concentration of all species for 0.01M CH_3COONa. [Given : $K_a = 1.8 \times 10^5$] **[6]**

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

    i) Write mass balance and charge balance for 0.1 M H_3PO_4.

    ii) What is proton condition for 0.1 M Na_3PO_4?

Q3) a) The pH of a soft drink is 8.29. Calculate the fractions of carbonic acid existing as H_2CO_3, HCO_3 and CO_3^{2-} in the solution. **[6]**

$$\left[Given; K_{a_1} = 4.47 \times 10^{-7}, K_{a_2} = 5.62 \times 10^{-11} \right]$$

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

    i) Turbidimetry was used to examine a sample. The transmittance of the sample was 0.368, the cell pathlength was 1.00 cm and the concentration was 112mg/L. Determine the turbidity coefficient of sample.

    ii) Discuss applications of turbidimetry and nephelometry.

Q4) a) Explain the methods of expressing accuracy and precision. **[6]**

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

    i) Write the formula of correlation coefficient (r) and explain the terms involved in it.

    ii) Take four alphabets K, L, M, N. How many combinations and permtations are possible? All 2 at a time.

SECTION - II

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

    i) What are nano aerogel? Give examples.

    ii) What do you mean by smart material?

    iii) Give two examples of size dependent properties of nanoparticles.

    iv) What is electrochemical adsorption of hydrogen storage?

    v) What is the influence of temperature and pressure on storage of hydrogen?

  b) Explain the storage of hydrogen in carbon nanotubes. **[3]**

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

    i) Explain hydrogen storage of bucky balls.

    ii) Write note on semiconductor nanoparticles.

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

    i) What are shape memory alloys? Give examples.

    ii) What are the different methods of preparation of nanoparticles.

Q7) a) Explain in detail the applications of nanoparticles with examples. **[6]**

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

    i) Write short notes on smart polymers.

    ii) Explain adsorption energy in detail.

Q8) a) Explain the role of physisorption in the storage of hydrogen. **[6]**

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

    i) Give electrical properties of metal nanoparticles.

    ii) What are the uses of smart windows and smart glasses?

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[6063]-315

M.Sc.-II

INORGANIC CHEMISTRY

CHI - 330 : Organometallic and Homogeneous Catalysis

(2019 Pattern) (CBCS) (Semester-III)

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

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Write each section on separate answer book.*
4) *Neat diagram must be clean wherever necessary.*

SECTION-I

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

     i)   What is Mond's process?

     ii)   Explain the term π acid ligand?

     iii)   What are metal carbyne complexes? Give example.

     iv)   What is heptacity? Explain with example.

   b)   Give an account of transition metal atom clusters   **[3]**

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

     i)   Explain the Dewar Chatt Dunconson model for bonding in metal olefin complexes.

     ii)   Describe properties of organometallic compounds and give industrial applications of organometallic compounds.

   b)   Answer Any two of the following   **[6]**

     i)   Explain synthesis and bonding properties of cyclobutadiene metal complexes

     ii)   Which of the following complexes obeys 18 electron rules?

        1) $[TiCpCl_2]$

        2) $(\eta^5\text{-}C_5H_5)_2$ Fe

        3) $[\eta^5\text{-}CpMo(CO)_2]_2$

     iii)   What is the significance of 18 electronrule in organometallic compounds

Q3) a) Answer Any One of the following [6]
  i) Give an account of organometallic compounds which acts as a activating agent and protecting agents.
  ii) Give Synthesis, bonding, properties and applications of phosphine compounds.

  b) Answer Any Two of the following. [6]
  i) Explain bonding in metallic carbonyls.
  ii) What are the difference between Fischer carbene and schrock carbene?
  iii) Give classification of sigma complexes.

SECTION-II

Q4) a) Answer the following [8]
  i) Define chemoselectivity with suitable example.
  ii) What is β-hydride elimination reaction?
  iii) What is Fenton reagent? Mention its advanstage?
  iv) What are the advanstages of cativa process over the monsanto process?

  b) Differentiate between homogenous catalyst vs heterogenous catalyst. [3]

Q5) a) Answer Any one of the following. [6]
  i) List out various C-C bond forming reactions Discuss the mechanism of Negishi coupling with the help of catalystic cycle.
  ii) What is biphasic catalysis? What are its advanstages? explain in detail aqueous biphasic catalysis

  b) Answer any two of the following [6]
  i) How 16 electron; 18 electron rule is important in homogenous catalytic cycle.
  ii) Give the basic steps involved in polymerisation reaction.
  iii) How IR-Spectroscopy is used for studying homogenous reaction?

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

     i)   Discuss the mechanism of epoxidation reaction using catalytic cycle.

     ii)   Give an account of use of homogenous catalyst for synthesis of high value chemicals.

   b) Answer Any two of the following **[6]**

     i)   Write short note on oxidative addition reaction.

     ii)   Discuss ring closing metathesis reaction with suitable example.

     iii) What is Heck reaction? Give its application in organic synthesis.

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[6063]-316
M.Sc. (Part - II)
INORGANIC CHEMISTRY
CHI - 331 : Inorganic Reaction Mechanism
(2019 Pattern) (CBCS) (Semester - III)

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

Instructions to the candidates:

1) All questions are compulsory.

2) Neat diagrams must be drawn wherever necessary.

3) Figures to the right side indicate full marks.

4) Use of logarithmic table and calculator is allowed.

5) Answer to the two sections should be written in separate answer sheets.

SECTION - I

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

    i) List out the parameters which determines thermodynamic stability of complexes.

    ii) Complete the following reaction sequence

       $[PtCl_4]^{2-} \xrightarrow{NH_3} ? \xrightarrow{PPh_3} ?$

    iii) Four coordinated tetrahedral or square planar complexes reacts faster than octahedral complexes. Why?

    iv) What do you mean by atom or group transfer reaction? Explain with suitable example.

   b) List out characteristics of outer sphere electron transfer reactions. **[3]**

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

    i) Discuss relationship between d electron configuration of the metal and Lability of metal complexes with the help of VBT.

    ii) Substitution reaction in square planar complexes takes place with retension of configuration. Explain.

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

i) What do you mean by associative and dissociative type mechanism? Explain with suitable example.

ii) Discuss the effect of nature of leaving group in octahedral substitution.

iii) Discuss factors affecting on stability constant.

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

i) What is SN1CB mechanism? Explain with suitable example.

ii) Discuss the mechanism of inner sphere electron transfer reaction with suitable example.

b) Write a note on (Any two) : **[6]**

i) Complementary and Non-complementary reactions.

ii) Racemization in trischelate complexes.

iii) Polarisation theory of trans effect.

SECTION - II

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

i) Describe the mechanism for halogenation of coordinated nitrogen atom with example.

ii) What do you mean by reductive elimination reaction? give example.

iii) Compare thermal and photochemical reactions.

iv) What is photochemical reaction? Where do it occurs?

b) Describe the phenomenon of phosphorescence with the help of Jablonski diagram. **[3]**

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

i) Explain the electrophilic behaviour of the coordinated ligand.

ii) Give an account of Insertion reactions.

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

i) What do you mean by one electron oxidative addition? Explain with suitable example.

ii) State laws of photochemistry. How are they significant?

iii) Explain in brief the kinetic template effect involving reaction between two donor atoms.

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

     i) Discuss in detail alkylation of coordinated sulphur and nitrogen atom.

     ii) Give an account of photochemical reactions of Cr (III) complexes.

   b) Write a note on (any two) : **[6]**

     i) Photo isomerization reactions.

     ii) Methyl migration reactions.

     iii) Solvolysis of coordinated phosphorous atom.

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[6063]-317

M.Sc. - II

INORGANIC CHEMISTRY

CCTP-9-CHI - 332 : Bioinorganic and Medicinal Inorganic Chemistry

(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

1) All questions are compulsory.

2) Figures to the right indicates full marks.

3) Draw neat diagram wherever necessary.

4) Answer to the two section should be written in separate anwser book.

SECTION - I

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

  i) Differentiate between blue and non blue copper protein.

  ii) What is the function of oxygen evolving complex?

  iii) What is the biological role of vanadium? Which areits stable oxidation states.

  iv) Define with example

    1) Anticancer

    2) Antiviral.

  b) What are the classification of Cu-enzyme depending on ligand environment.   **[3]**

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

  i) Explain in detail the antagonism of Cu and Mo.

  ii) Discuss the any two model compounds of copper.

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

  i) Explain the active site, structure and function of enzyme urase.

  ii) Write a detailed account on transition metal complexes as spectroscopic and conformational probes.

  iii) Discuss the structure and functions of enzymes of zinc.

Q3) a) Answer <u>any One</u> of the following. **[6]**
   i) Discuss in brief Mo, Cu, and Zn coutaining enzymes and mention their functions.
   ii) Which metal is present in carboxy peptidase - A? Draw the coordination sphere of the metal in its active site and explain the action of this enzyme?

   b) Write note on any Two. **[6]**
   i) Functions of copper in living system.
   ii) Oxygen evolving complex.
   iii) Metal ions in medicine.

SECTION - II

Q4) a) Attempt the following. **[8]**
   i) What is chelation?
   ii) Cis-platin and its analogs reacts with DNA at which base?
   iii) What is chrysotherapy? Give the examples.

   B) Explain chemistry of Lithium **[3]**

Q5) a) Answer <u>any One</u> of the following. **[6]**
   i) Explain Neurotoxicity and Nephrotoxicity, occurs due to Cis-platin.
   ii) Draw the structure of $^{99m}T_C$ Mebrofenin. Write the uses of $^{99m}T_C$ mebrofenin.

   b) Answer <u>any Two</u> of the following. **[6]**
   i) Explain in detail mechanism of action and tumour resistance to cis-platin.
   ii) Explain the role of dopamine β-mono oxygenase in the biological phenylamine.
   iii) Explain in brief anti-HIV drug. and their mechanism of action

Q6) a) Answer <u>any One</u> of the following. **[6]**
   i) Discuss the role of distribution of lithium in the body and in cells.
   ii) Give FDA approved durgs names and their inhibition activity as a anit - HIV.

   b) Write note on <u>any two</u> **[6]**
   i) Rheumatoid arthritis.
   ii) Helicobactor pylori
   iii) Metal based chemotherapeutic drugs.

[6063]-318

M.Sc. (Part - II)

INORGANIC CHEMISTRY

CHI-333A : Modern Instrumental Methods in Inorganic Chemistry

(2019 Pattern) (Semester - III)

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

Instructions to the candidates:
1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Write each section in separate answer book.*

SECTION - I

(Inorganic Thermal and Spectroscopic methods of Characterization)

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

   i)   What is principle of XRD?

   ii)   What is TGA?

   iii)   Why KBr is inactive in IR analysis?

   iv)   What is TPD?

   b)   Explain Auger effect? Draw neat labelled diagram.   **[3]**

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

   i)   Explain instrumentation and working of DSC with diagram. Explain its types and different parts.

   ii)   Write difference between :

      1)   TGA and DTA

      2)   DTA and DSC

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

   i)   Explain Fluorescence with examples.

   ii)   Explain ESR spectrum of benzene and methyl radical

   iii)   Derive Bragg's equation

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

i) What is principle of TPD? Explain construction, working with diagram.

ii) What is principle of NMR? Explain block diagram with its different parts.

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

i) Explain parts of IR spectroscopy

ii) Write the difference between ESR and NMR

iii) What are the advantages and dis-advantages of AES?

SECTION - II
(Imaging and Analytical Techniques)

Q4) a) Answer the following : [8]

i) Write the wavelength range of UV-Spectroscopy.

ii) Why three electrode are used in cyclic voltammetry.

iii) Which metal has more magnetic susceptibility.

iv) What are the advantages of UHV condition in X PS.

b) Explain the difference between SEM and TEM. [3]

Q5) a) Answer any one of the following : [6]

i) Explain the principle and working of flune photometry.

ii) What is photodegradation explain the factor's affecting on photodegradation of dye.

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

i) What is magnetic susptibility? Write the formula for calculation of magnetic susptibility.

ii) Give the application of X PS.

iii) Explain the chemical state and chemical shift.

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

i) Explain the typical cyclic voltammogram.

ii) What is soft magnet? Write the application of soft magnet.

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

i) Explain positive and negative deviation in UV-spectroscopy.

ii) Write the advantages STEM over TEM.

iii) Explain the cyclic voltammogram of thyronine.

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[6063]-318

M.Sc. (Part - II)
INORGANIC CHEMISTRY
CHI-333B : Inorganic Magneto and Polymer Chemistry
(2019 Pattern) (Semester - III)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
- *1)*   *All questions are compulsory.*
- *2)*   *Neat diagrams must be drawn wherever necessary.*
- *3)*   *Use of calculators is allowed.*

SECTION - I
(Magneto - Chemistry)

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

- i)   Find out the R-S term symbol for Fe^{3+} ion and CO^{2+} ion.
- ii)   Define the terms ferromagnetism and antiferromagnetism.
- iii)   Explain solute-solute magnetic interactions.
- iv)   What is mean by curie temperature and neel temperature? Explain.

b)   What is mean by anomalous behaviour of magnetic moment? Explain with one example.   **[3]**

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

- i)   Write a short note on quenching of orbital angular momentum and magnetism.
- ii)   Why Mn_2CO_{10} is diamagnetic? Explain.

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

- i)   Explain the anomalous magnetic moment in the following.

      μ_{exp} of C_O^{2+} is 4.91 B.M.
- ii)   Explain curie law and curie-weiss law.
- iii)   Distinguish between the ferromagnetism and antiferromagnetism.

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

   i) Predict the type of magnetic exchange which occurs via 90° exchange pathway in the systems d^1-d^1, d^2-d^2, d^3-d^3, d^8-d^8 and d^9-d^9.

   ii) Explain in detail Van-vleck's equation.

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

   i) Explain with examples super exchange interactions.

   ii) Give a comparison of the magnetic properties of actinide ions and the lanthanide ions.

   iii) Write a note on equillibrium between two spin states and solute - solvent interactions.

SECTION - II
(Inorganic Polymers)

Q4) a) Answer the following : [8]

   i) Write a note on Inorganic benzene.

   ii) Mention four advantages of synthetic rubber over natural rubber.

   iii) Give a brief account of silicones.

   iv) Complete the following reactions.
   1) $P_4O_{10} + H_2O \rightarrow$?   2) $B_2O_3 + NH_3 \rightarrow$?

b) Draw the structure of $(NPCl_2)_3$, $(NpF_2)_3$ and explain its bonding. [3]

Q5) a) Answer any one of the following : [6]

   i) Write a note on S-N compounds. Give its applications.

   ii) Draw the structures and explain bonding in following compounds.
   1) B_4H_{10} 2) B_5Hg 3) B_5H_{11}

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

   i) Write in detail about allotropes of carbon.

   ii) Give an account of phosphazenes with their structural aspects.

   iii) Explain in details about chrysotile, keolinite and tale.

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

   i) Explain in detail the structures of S_4N_4, S_2N_2 and $(SN)_x$ compounds.

   ii) Write in detail about applications of inorganic polymers.

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

   i) Write a note on homopolymer of sulpher?

   ii) Give a brief account of silicon rubber.

   iii) Write a note on Aluminimum nitride.

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[6063]-319

M.Sc.-II

ORGANIC CHEMISTRY

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

(2019 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

1) *Q1 and Q5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from Q2 and Q4 and two questions from Q6 to Q8.*
3) *Answer to the two sections should be written in separate anawer book.*
4) *Figures to the right indicate full marks.*

SECTION-I

Q1) Attempt the following:

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

i)

ii) $CH_3-CH=CH_2$ $\xrightarrow[\text{H}_2\text{O}_2]{\text{HBr}}$ $CH_3-CH_2-CH_2-Br$
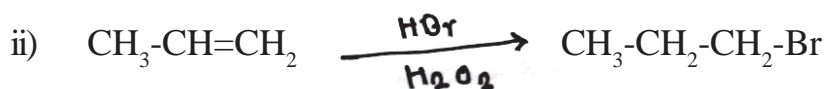
b) Suggest the reagents for the following conversions and explain the mechanism. **[6]**

i) $CH_2=CH-Et$ $\xrightarrow{?}$ O_2N-CH_2CH-Et with Br substituent

ii)
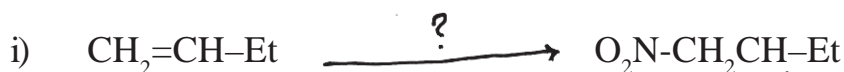
Q2) Write a short notes on any three of the following: **[12]**

a) Hammett equation.

b) Hunsdiecker Reaction.

c) Autoxidation.

d) Cross-over experiment.

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

a) Explain the Mc Murry coupling reaction with suitable example.

b) Predict the sign of Hammett σ (sigma) constant for following substituents:

   i)   P-CF$_3$

   ii) m-COOH

   iii) P-CH$_3$

c) Write a note on trapping of intermediate to determine reaction mechanism.

d) Explain 'non linear-Hammett Plot' with suitable example.

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

$$\xrightarrow{HNO_3 + H_2SO_4}$$
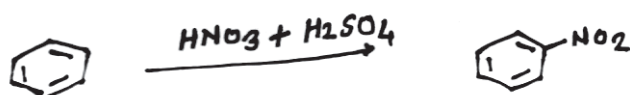
Q4) Attempt any four of the following. [12]

a) Derive the Taft equation.

b) Give applications of Bu$_3$SnH (Tributyltin hydride).

c) How Isotopic Labeling helps to decide the reaction mechanism.

d) The $_pKa$ p-methoxybenzoic acid is 4.49 and benzoic acid is 4.19. Calculate σ (Sigma) for p-ome (methoxy).

e) Predict the product with mechanism.

$$\xrightarrow[Et_2O]{Na} \ ?$$

f) Predict the product with mechanism.

$$\xrightarrow[CCl_3 Br]{h\vartheta} \ ?$$
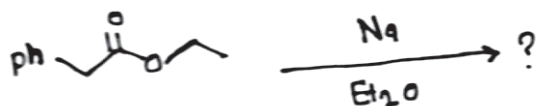
Q5) Attempt the following:

a) Suggest the biogenetic steps. [5]

i) GPP

ii)
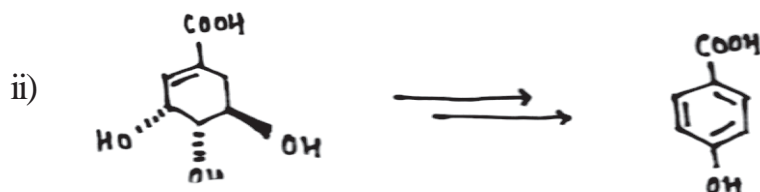
b) Com plete the given biosynthnetic steps. [6]

i)

ii) L-ornithine

Q6) Write short note on any three of the following: [12]
   a) Classification of Terpenoids.
   b) Irregular monoterpenes.
   c) Biogenesis of shikimic acid.
   d) Wagner-meerwein Rearrangment.

Q7) Complete the biogenesis of any four of the following. [12]

a)

b) FPP

c) L-Lysine
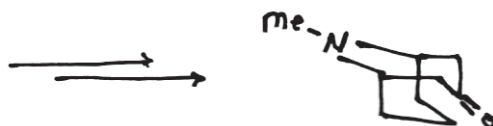
d) DMAPP

e) Cinnamic acid

Q8) Attempt any four of the following: [12]

a) Indicate the position of label in each step and in the Final Product.
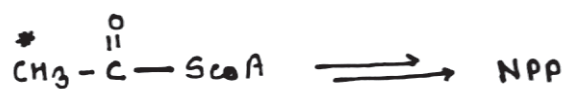
b) Outline the steps involved in the given biogenesis.

c) Complete the given biogenesis.

squalene $\longrightarrow$
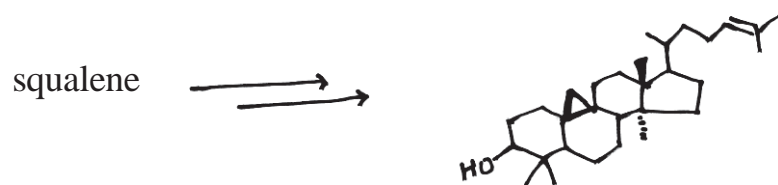
d) Complete the Following.

Anthranilic Acid $\longrightarrow$
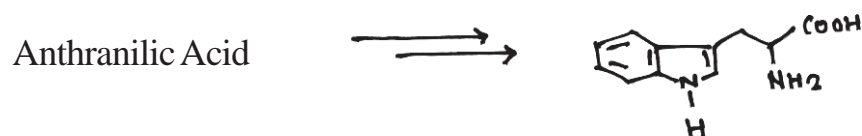
e) Complete the following biogenesis.

4-hydroxycinnamoyl-coA $\longrightarrow$

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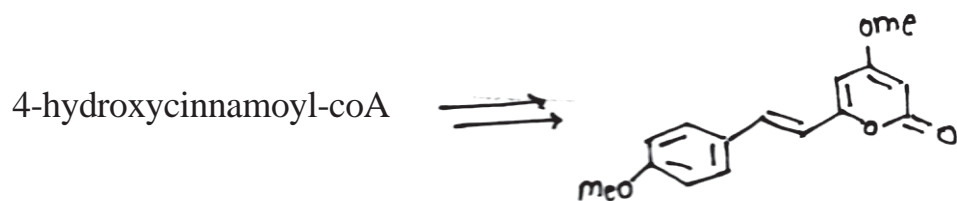
[6063]-320

M.Sc. (Part - II)
ORGANIC CHEMISTRY
CCTP-8 : CHO-351 : Structure Determination of Organic Compounds by Spectroscopic Methods
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

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

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

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

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

SECTION - I

Q1) a)   Cyclohexane displays itself in PMR as a singlet at room temperature however at $-100°C$ the spectrum becomes complicated. Explain. **[3]**

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

        i)   M.F. : $C_9H_9ClO_3$ (After D_2O exchange)

           PMR (δ) : 1.8 (d, J = 7Hz, 3H), 4.78 (9, J = 7Hz, 1H)

                    6.78 (dt, J = 8, 2Hz, 1H), 6.9 (t, J = 8Hz, 1H)

                    6.97 (dt, J = 8, 2Hz, 1H), 7.2 (t, J = 8Hz, 1H)

        ii)   M.F. : $C_5H_{10}O_3$

           IR :   1728 cm^{-1}

           ^{1}H NMR (δ) : 2.1 (S, 3H), 3.35 (S, 6H), 4.6 (S, 1H)

           CMR: 25, 55, 104, 204

           DEPT 90 :   25, 55, 204, No peak

                          104 up

           DEPT 135 : 204 No peak

                          25, 55,

                          104 up

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

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

   b)   Role of shift reagents in NMR spectroscopy.

   c)   Splitting pattern in vinyl system of styrene.

   d)   Importance of DEPT in CMR spectroscopy.

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

   a) $^{13}C - {}^{13}C$ coupling is not observed in CMR spectrum. Explain.

   b)   NMR can be used as a tool to distinguish between primary, secondary and tertiary alcohols. Explain.

   c)   Arrange the following compounds in decreasing order of vicinal coupling constant. Justify your answer.
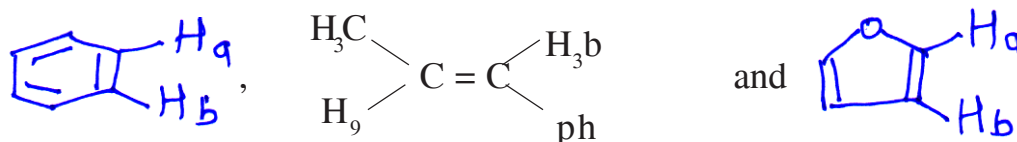
   d)   Deduce the structure from following spectral data

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

   IR : 1200, 1180 cm^{-1}

   Mass : 132 (M$^+$), 131, 117, 89, 87, 45 (base peak), 43, 29

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

   ^{13}C NMR (δ) :   20, 98

   e) $C_7H_{14}O$ has two isomeric ketones whose PMR and CMR signals are shown below. Assign the structures to each of the ketones from data provided.

   i)   PMR (δ) :   1.2 (d, 12 mm), 2.8 (septet, 2mm)

        CMR (δ) :   18 (str), 38 (m), 214(w)

   ii)   PMR (δ) :   1.0 (s, 9 mm), 2.2 (5, 3mm), 2.31 (s, 2mm)

        CMR (δ) :   30 (str), 32(w), 34(w), 56(m), 210(w)

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

a) How will you differentiate the following pair of compounds by ^{1}H NMR spectroscopy.

 and
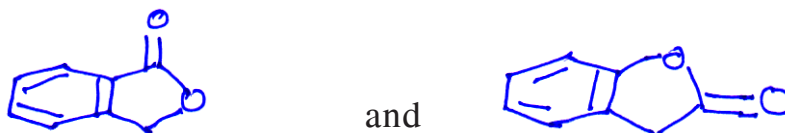
b) How will you differentiate the following compounds by ^{13}C NMR spectroscopy?

 and
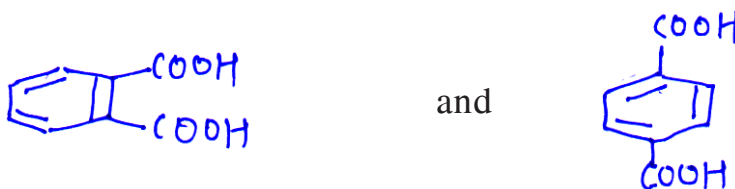
c) A compound having molar mass of 150 shows following spectral data. Deduce its structure.

IR : 1690 cm^{-1}

^{1}H NMR (δ) :   2.5 (S, 3H)

3.8 (S, 3H)

6.9 (d, J = 8Hz, 2H)

7.8 (d, J = 8Hz, 2H)

^{13}C NMR (δ) :   198, 165, 130, 129, 114, 56, 26

d) Comment on role of deuterated solvents in ^{1}H NMR spectroscopy.

SECTION - II

Q5) The spectra of an unknown compound are shown on adjacent page. Analyse the spectral data and by using this data arrive at a correct structure of the unknown compound. Justify your assignments. **[11]**

Molecular formula $C_{10}H_{12}O_3$.
IR: 1720cm^{-1}

^{1}H NMR Spectrum
(CDCl$_3$, 500 MHz)

TMS

8   7   6   5   4   3   2   1   ppm
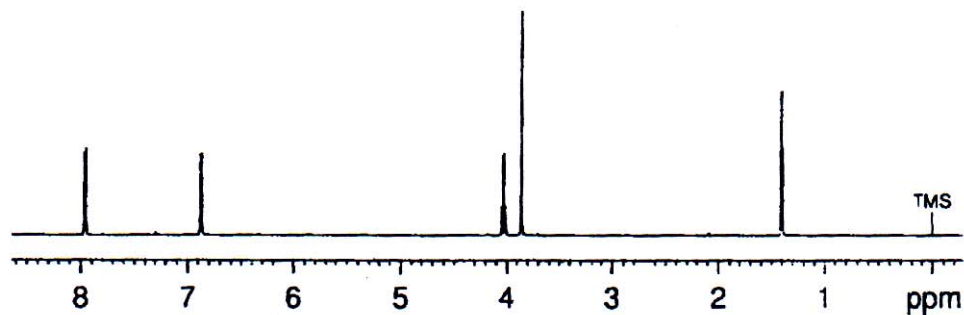
^{1}H NMR Expansion
(CDCl$_3$, 500 MHz)

8.0 7.9   6.9 6.8   4.1 4.0 3.9 3.8 3.7   1.5 1.4 ppm
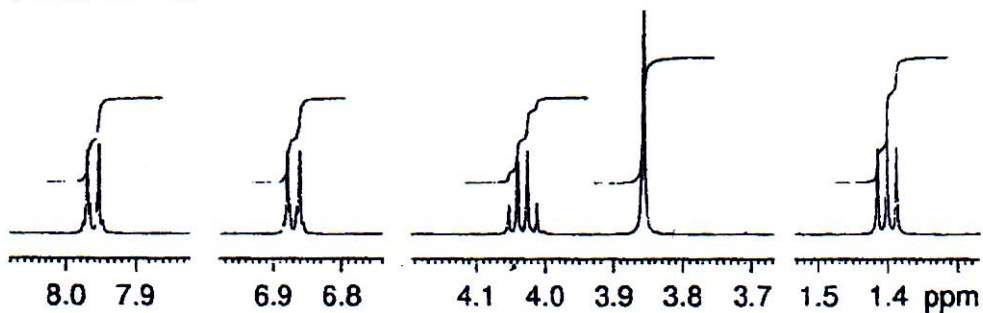
^{13}C{^{1}H} NMR Spectrum
(CDCl$_3$, 125 MHz)

Solvent

160   140   120   100   80   60   40   20   ppm

¹H–¹H COSY Spectrum
(CDCl₃, 500 MHz)

¹H–¹³C me-HSQC Spectrum
(CDCl₃, 500 MHz)

Solvent
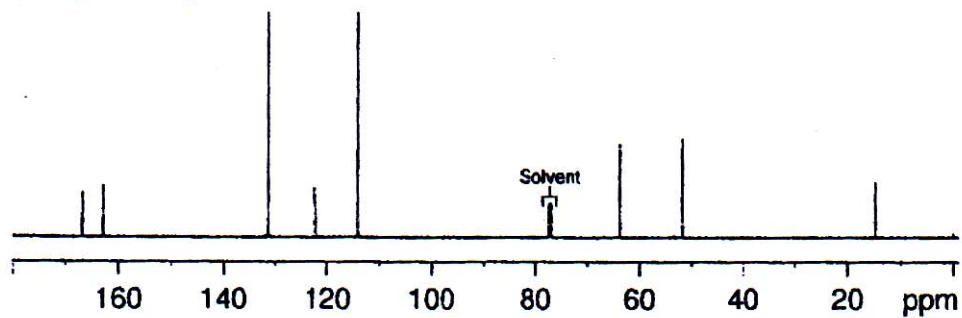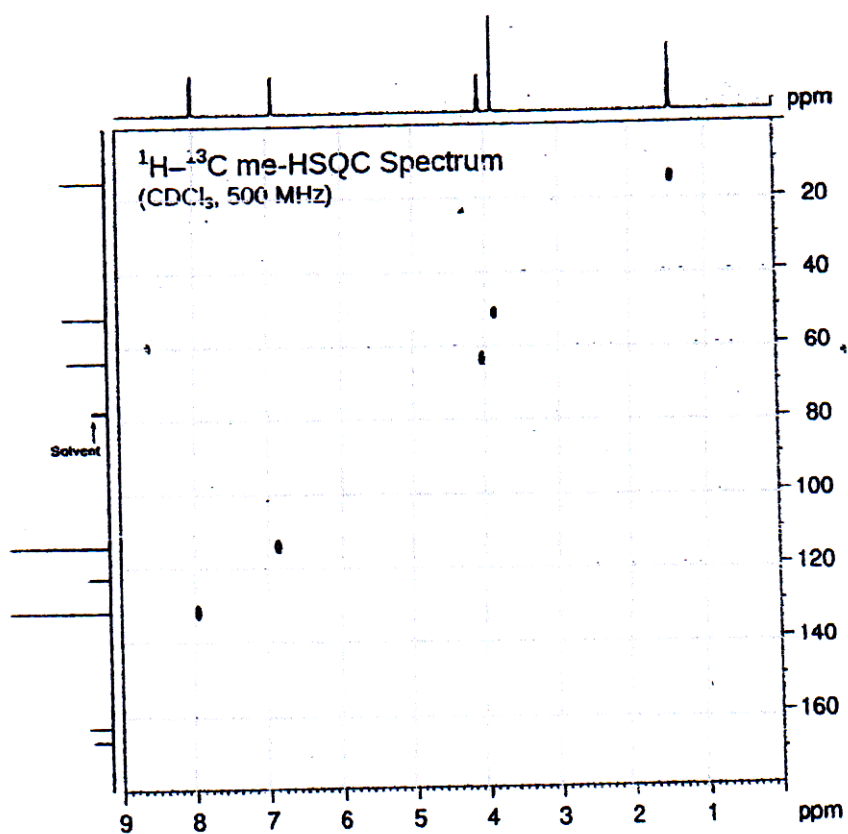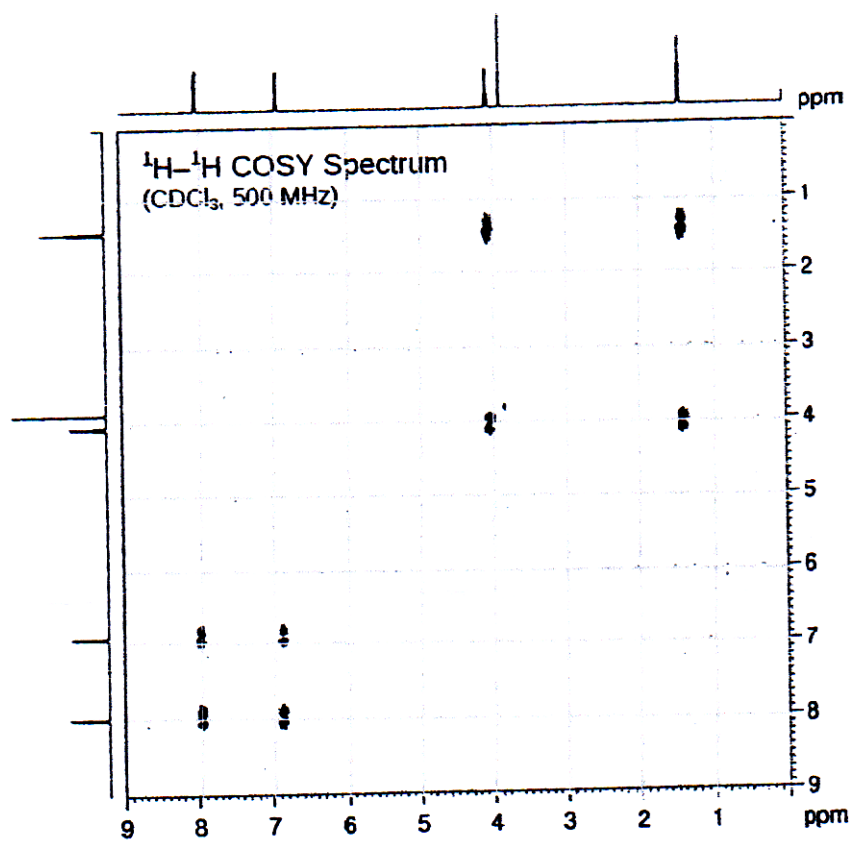
Q6) a)   Assign the signals to various protons in following compound. Use the decoupling data for the confirmations of the assignments. Justify your assignments and draw the correct structure with assignments.   **[6]**
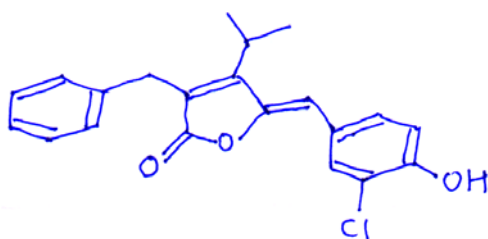
1.31 (d, J = 7.1 Hz, 18mm)

3.14 (septet, J = 7.1 Hz, 3mm)

3.79 (S, 6mm)

6.09 (S, 3mm)

7.03 (d, J = 8.5 Hz, 3 mm)

7.18-7.32 (m, 14.8 mm)

7.61 (dd, J = 8.5 & 2.1 Hz, 3 mm)

7.83 (d, J = 2.1 Hz, 3 mm)

Decoupling experiments.

Irradiation at   change at

3.14   1.31 d → S

7.03   7.61 dd → d, J = 2.1 Hz

b)   Assign the chemical shifts to the various carbons. Justify your assignments.   **[6]**
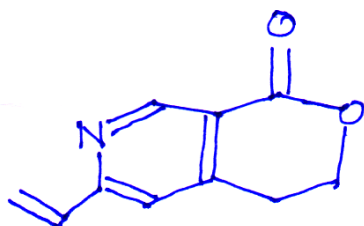
24 (t), 66.12(t)

120.26(t), 120.82(s)

129.44(d), 130.72(s)

144.66(s), 150.20 (d)

150.88(d), 163.46 (s)

Q7) Attempt any four of the following :   **[12]**
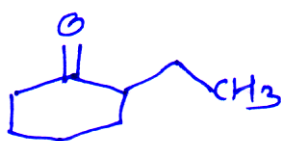
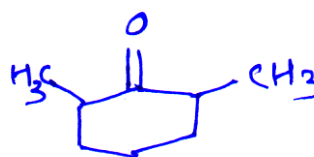a)   Differentiate between following compounds by mass spectroscopy.
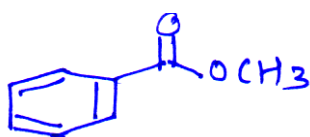
   and
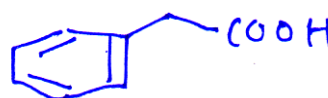
b)   Differentiate following compounds by mass spectroscopy.

   and
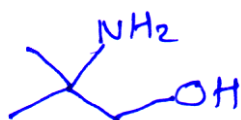
c) Write the genesis of ions given below.

 m/z = 56, 41

d) Write the genesis of ions given below

 m/z = 89, 74, 58, 31

e) The mass spectrum of n-pentanol exhibits prominent peaks at m/z = 31, 42 and 70. Explain.

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

a) Discuss various ionization techniques used in mass spectroscopy.

b) Write a note on applications of isotope peaks in mass spectroscopy.

c) An aromatic compound $C_{11}H_{14}O$ shows following peaks in its mass spectrum. Deduce its structure.

M.F. : $C_{11}H_{14}O$

Mass (m/z) : 162, 134, 119,91,77,71,43

d) A compound $C_5H_{11}NO$ exhibits following mass spectral data. Analyse the data and arrive at a structure consistant with the data

M.F. : $C_5H_{11}NO$

Mass (m/z) :   101 (0.8%), 85(3%)

72 (19%), 59(100%)

57 (11%), 44(38%)

43 (11%), 29(15%)

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[6063]-321
M.Sc. (Part-II)
ORGANIC CHEMISTRY
CCTP 9 : CHO-352: Stereochemisty and Asymmetric Synthesis of Organic compounds
(2019 Pattern) (Semester-III)

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

Instructions to the candidates:

1) *Q.1 and Q.5 are compulsory.*
2) *Attempt any two questions from Q.2 to Q.4.*
3) *Attempt any two questions From Q.6 to Q.8*
4) *Answers to the two sections should be written in separate answer book.*
5) *Figures to the right indicate full marks.*

SECTION-I

Q1) a)   Answer the following.   **[5]**

   i)   Write a note on types of tacticity giving examples.

   ii) Draw the correct stereostructures of cis and trans-1- decalone. Comment on their optical activity.

   b)   Explain the resolution of racemic modification of acids, bases and alcohols via Formation of diasterecomers   **[3]**

   c)   Write the correct stereochemical names of Following compounds   **[3]**

   i)

   ii)

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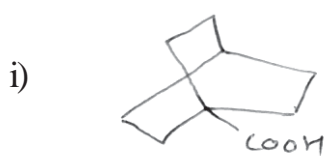
Q2) Attempt any three of the following. **[12]**

a) Discuss the sterecochemistry of hydrindane, mentioning its confermations, stability and optical activity.

b) Write a note on Cram's rule.

c) Explain the energy changes associated with respect to solvolysis of cis and trans - 4- ter t-butyl cyclohexyl tosylate Fer S_N1 and S_N2. (With Symmetrical Substituents) reactions.

d) Draw all possible conformations of following compounds mention their stability.

i)



ii)
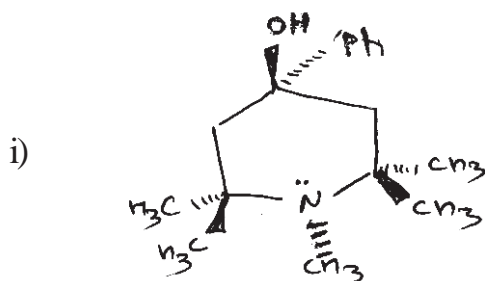
Q3) Give reasons (any four) **[12]**

a) A Solvent sensitive uv absorption band is observed in trans-but not in cis-5- cyclo decenone.

b) (cis-syn-cis perhydro phenanthrene is less stable than cis-anti-cis perhydro phenanthrene.

c) In 6- membered ring usually the reactions involving charge in hybridiza-tion From $Sp^2 \rightarrow Sp^3$ are more Favoured than $Sp^3 \rightarrow Sp^2$.

d) Explain the observation for rate of following epoxidation of chloro cholesterol
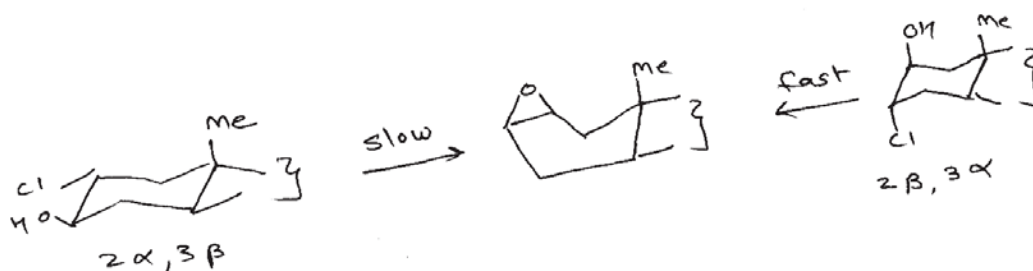
e) cis-anti-cis Perhydroanthracene shows inseparable dl-pair Justify your answer with the help of correct stereostructure.
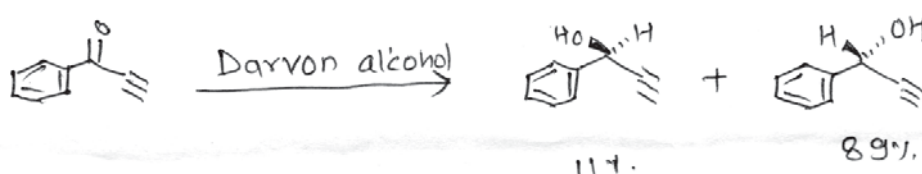
Q4) Predict the products. Justify your answer by givinng mechanism and stereochemial Principles involved in it. (any four) **[12]**

a)

b)

c)

d)

e)
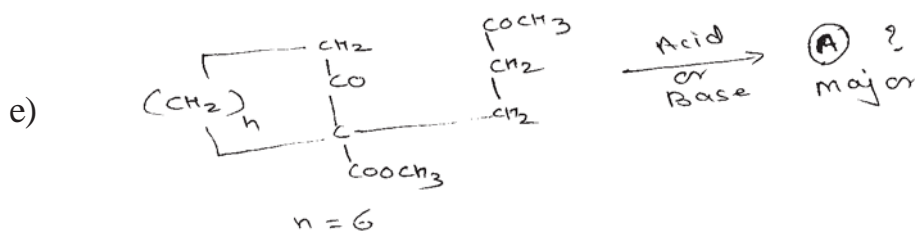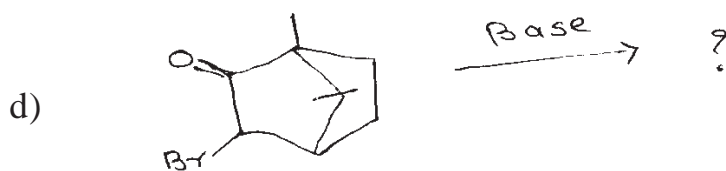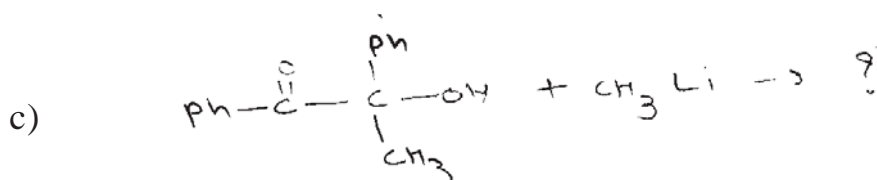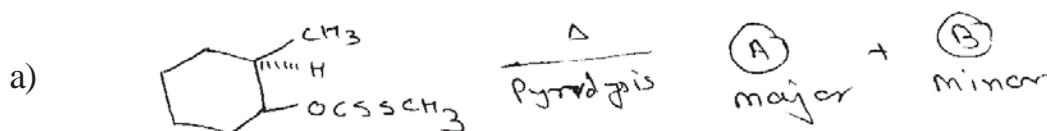
SECTION-II

Q5) a) Answer the following. **[8]**

  i) Explain the sterefacial selectivity

  ii) Write a note on asymmetric Aldol reaction of achiral enolate with achiral aldehyde.

  iii) Calculate the enantiomeric excess in the following reaction

  iv) Explain the disadvantages of chiral auxiliary

  b) Complete the following conversion **[3]**
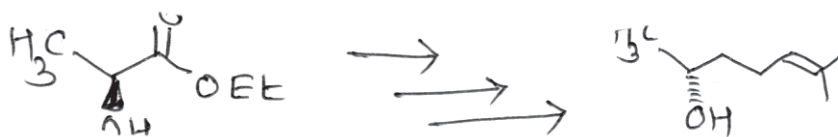
Q6) a) Answer the following (any two) **[6]**

  i) Explain the steps involved in Cram's dipolar model.

  ii) With the help of suitable example explain the term 'Regioselectivity'.

  iii) Explain the major and minor products formed in following reation.
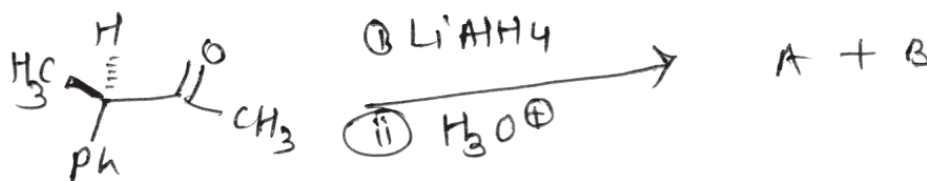
b)   Predict the products (s) and justify the mechanism   [6]

i)

ii)
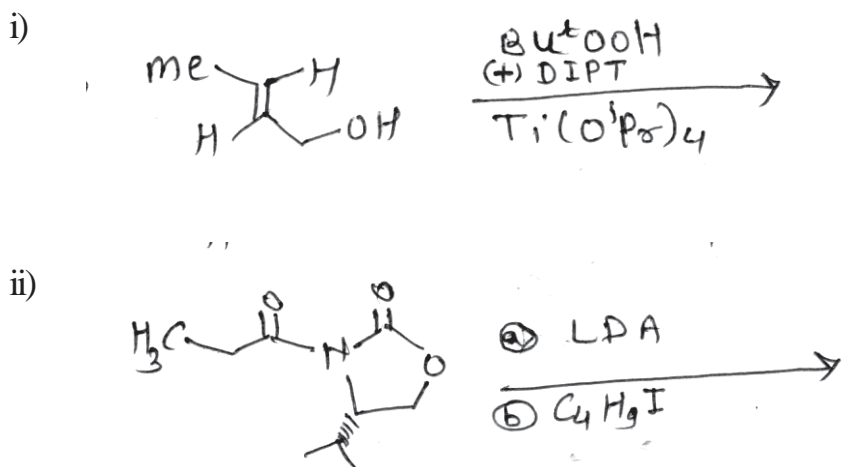
Q7) a) Answer the folloiwng (Any Two)   [6]
   i)   Explain the synthesis of CBS reagent.
   ii) Write any two synthetic applications of L-Proline in asymmetric synthesis.
   iii) Write a note on 'asymmetric hydroboration'.

b)   Predict the product(s) and Justify the mechanism   [6]

i)

ii)
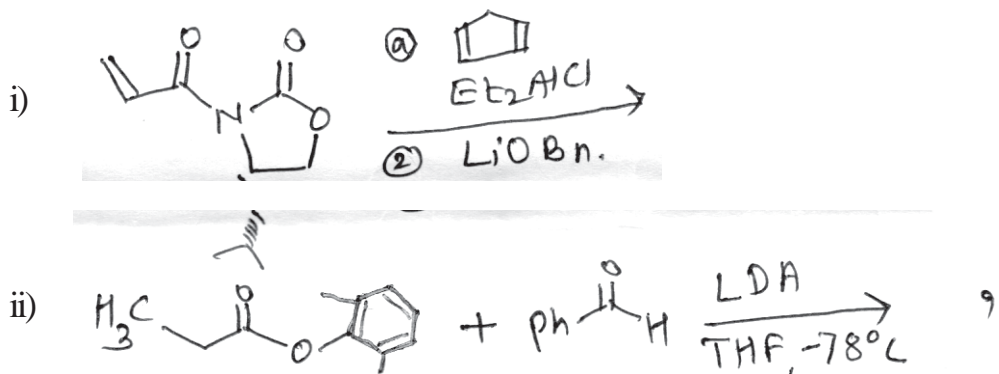
Q8) a) Answer the folloiwng (Any Two)   [6]
   i)   Explain the Jacobsen-katsuki epoxidation.
   ii) Explain the steps involved in asymmetric synthesis using chiral auxiliary.

iii) Explain the steps involved in the synthesis of (S)(-) - Ipsenol.
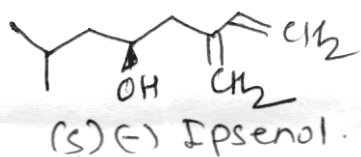
(S)(-) Ipsenol.

b) Predict the product(s) and Justify the mechanism. [6]

i)

$(DHQD)_2$ PHAL
K_2CO_3 OsO_4
K_3 Fe(CN)$_6$
meso$_2$NH$_2$

ii)

H_2
[(R) BINAP] Ru OAc$_2$

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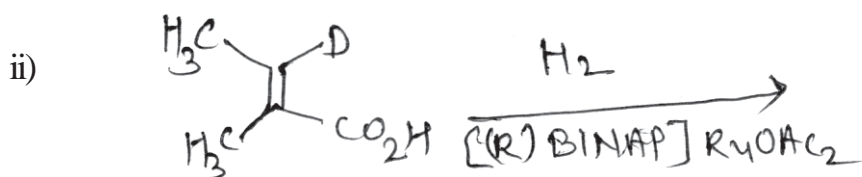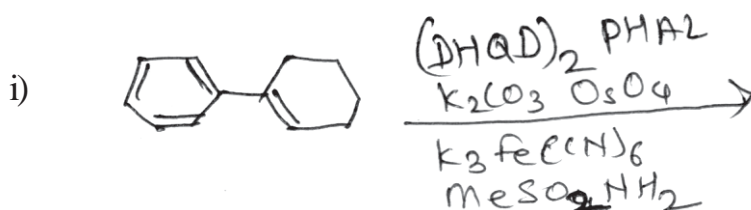
[6063]-322
M.Sc. (Part-II)
ORGANIC CHEMISTRY
CBOP3 : CHO-353 A : Protection-Deprotection Chiron Approach and Carbohydrate Chemistry.
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

  1)   Q.1 and Q.5 are compulsory and carry 11 makrs each.

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

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

  4)   Figures to the right indicat full makrs.

SECTION-I

Q1) a)   Write short note on protection and deprotection of 1,2 and 1,3 diol. **[6]**

    b)   Explain with mechanism protection of amine by using BOC and fmoc.**[5]**

Q2) Explain any two of the following   **[12]**

    a)   Solid phase tripeplide synthesis from L-leucine.

    b)   Write the synthesis of (–) multistraitin from.
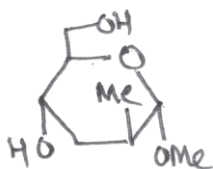
    c)   Write the coupling reaction of amine with acid with mechanism using DCC and DIPCDI.

Q3) Solve any two of the following: **[12]**

a) Outline the synthesis of (–) pentenomycin.

b) Arrange the reagents sequentially with mechanism in the following conversion.

LAH; HBr ; $\equiv$–Li ; NaH, BnBr ; PPh$_3$, NBS

c) Arrange the reagents sequentially with mechanism in the following conversion.
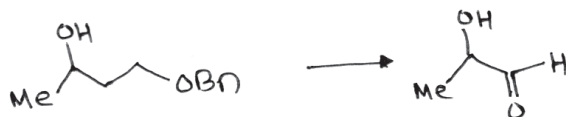
ZnCl$_2$; H$_2$ Pd/C ; O$_3$; Mom–Cl, NaoH ; alc.KOH

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

a) Complete the following conversion.
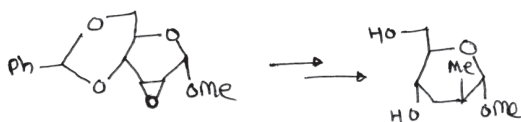
b) Write the steps involved in following reaction.
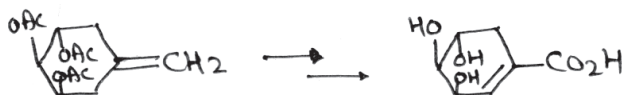
c) Outline the following synthesis with mechanism.

SECTION-II

Q5) A) Draw the mills structure of the following molecule and convert it into fischer projection. **[5]**

   a) D-Mannose

   b) D-Galactose

   c) D-Glucose

   B) Solve any two of the following: **[6]**

   a) Explain with mechanism role of protecing group in carbohydrate chemistry.

   b) What is glycosylation? Suggest any two promoters for glycosylation.

   c) Write the reeves pyranose from of following molecules.

   i) β-D Glucopyranose

   ii) α-D Altropyranose

   iii) β-D Mannopyranose

Q6) Attempt any two from the following: **[12]**

   a) Write the synthesis of the following tetra saccharide.
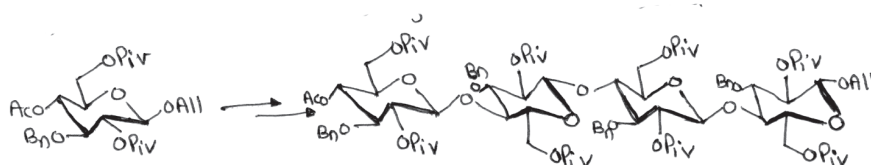
   I (i) SeO_2/ACOH ; (ii) CCl_3CN, DBU (II) DBU/MeOH (III) $BF_3.Et_2O$

   b) What are glycosyl donors? Give example of any two glycosyl donors.

   c) Explain the role of polar and non polar solvent in stereo selectivity at anomeric centre.

Q7) Solve any two from the following: **[12]**

   a) What are thioglycosyl donors? Write any two examples of the promotors which activates thio glycosyl donor.

   b) Explain the role of participation group at C-2 position in glycosylation.

   c) Synthesis of Maltose.

Q8) Solve any two of the following: **[12]**

   a) Explain oxidative and reductive cleavage of benzylidene acetals with suitable example.

   b) Step up and step down synthesis of monosaccharides.

   c) What is anomeric effect/ Explain the factors affecting anomeric effect.

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[6063]-322

M.Sc. - II

ORGANIC CHEMISTRY

CBOP-3CHO-353B: Designing Organic Synthesis and Heterocyclic Chemistry

(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

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

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

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

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

SECTION-I

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

        i)   Use of nitroalkanes as umpolung of reactivity.

        ii)   Write the synthetic equivalent for synthons.

                1) $\overset{\oplus}{C}H_2 COOH$

                2) $\overset{\ominus}{C}H_3$
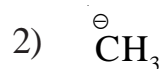
        iii)   What are linear & convergent synthesis? What is difference between them.

        iv)   Importance of acetylene in organic synthesis.

        v)   Acyl anion equivalent can be prepared from enol ether

   b)   Explain Julia olefination coupling reaction in the synthesis of Indolizomycin.**[3]**

Q2) Using retrosynthetic analysis, suggest suitable method for the synthesis of following compounds (Any three) **[12]**

a)

b)

c)

d)
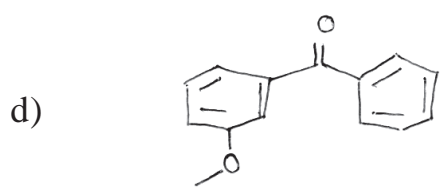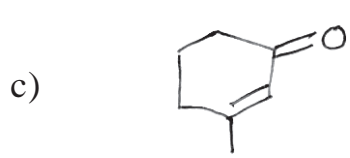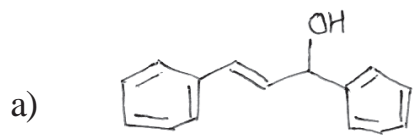
Q3) How will you effect the following conversions. **[12]**

a)

b)

c)

d)
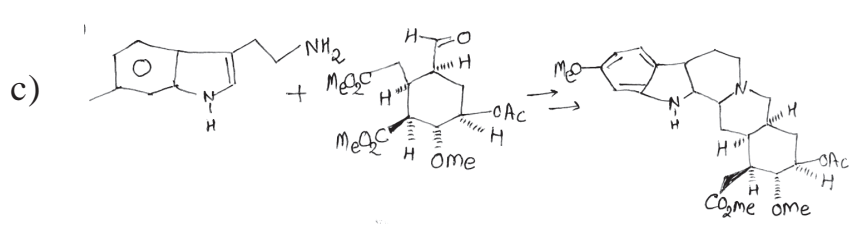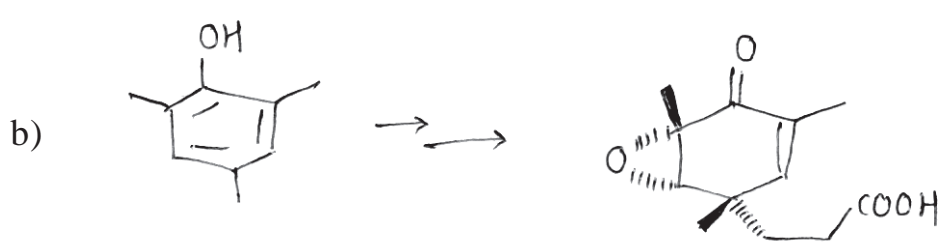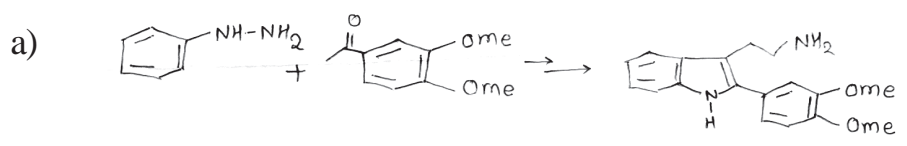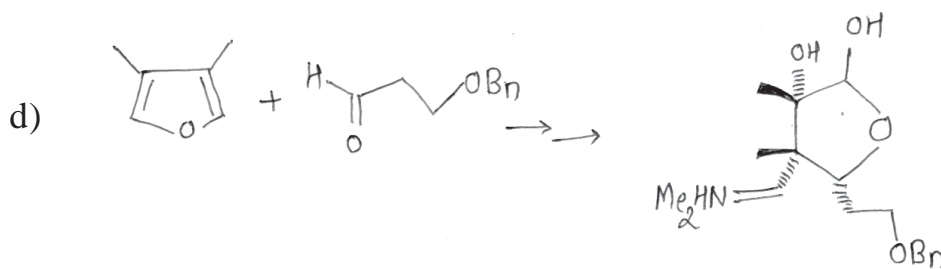
Q4) Answer the following: **[12]**

   a) Explain disconnection in 1,3 dicarbonyl compounds with suitable example.

   b) Write a short note on retrosynthetic analysis of thienamycin.

   c) Explain the alkylation of aldehyde or ketone using enamine.

   d) Write a short note on retrosynthetic analysis of Astel toxin.

SECTION-II

Q5) A) Suggest the mechanism **[5]**

   a)

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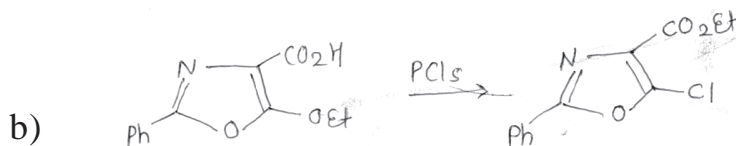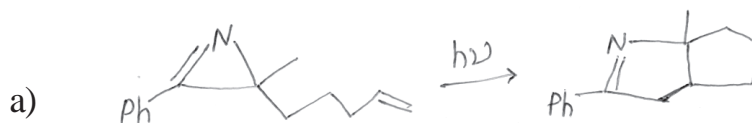
   B) Answer the following: **[6]**

   a) Name the following hetero cycles using.

      i) Recognized trivial names and

      ii) By Systematic Hantzsch-widman nomen clature.
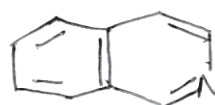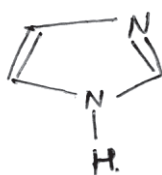
b) Arrange the heterocycles as per their basicity and match the pka values (Pka=0.8, 2.5, 5.2, 7.1) to the corresponding heterocycles.
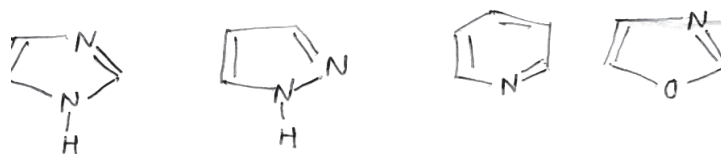
Q6) Predicts the products for the following reaction. [12]

a)

b)

c)

d)
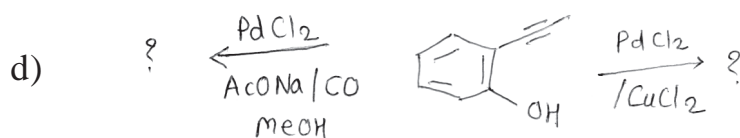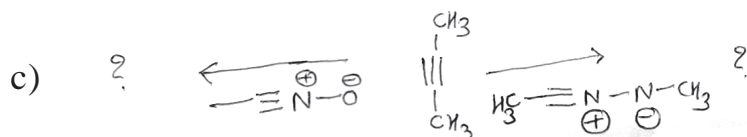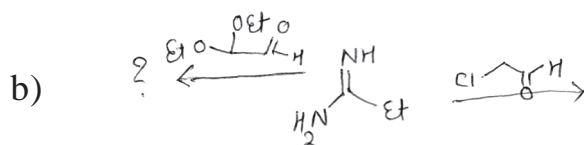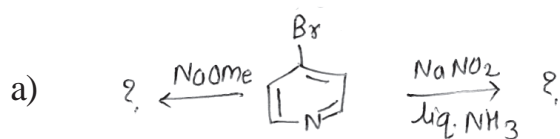
Q7) Provide a plausible mechanism. [12]

a)

Cilostazol

b)

Omeprazole

c)

1) KMnO₄
2) Heat / Δ
3)

Nicotine

d)

1)
2)
3) NO₂
4) Zn | HCl

Amlodipine
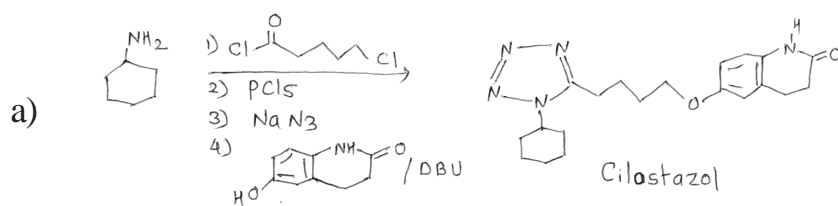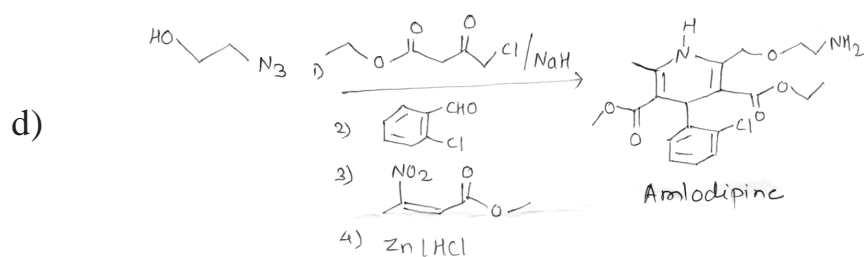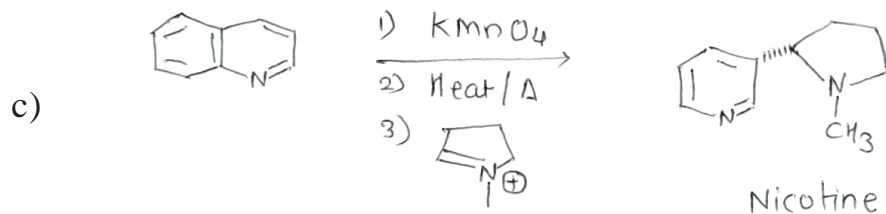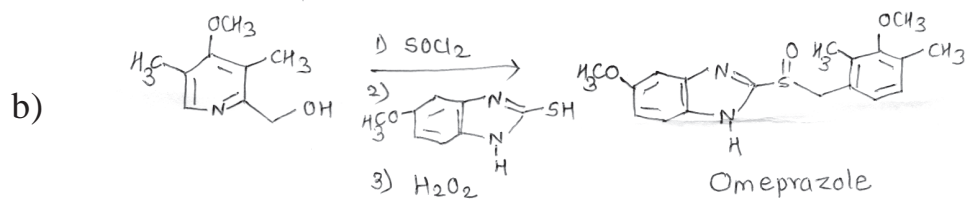
Q8) Predict the product's and complete the reaction sequence.　　　　**[12]**

a)

$\xrightarrow[\text{H}_2\text{SO}_4,\ 50°\text{C}]{\text{C} \cdot \text{HNO}_3}$　A　$\xrightarrow[\begin{array}{c}\text{C} \cdot \text{H}_2\text{SO}_4\\70°\text{C}\end{array}]{\text{C} \cdot \text{HNO}_3}$　B

b)

$\xrightarrow[-78°\text{C}]{\text{LDA} | \text{THF}}$　A　$\xrightarrow{\text{Furfural}}$　B

c)

$\xrightarrow[\text{Bn Br}]{\text{NaH}}$　A　$\xrightarrow[\text{Pd (PPh}_3)_4 / \text{Et}_3\text{N}]{\text{Trimethylsilyl acetylene}}$　B

d)

$\xrightarrow[\overset{\text{O}}{\underset{}{}}]{\text{SiO}_2}$　A　$\xrightarrow[\text{Ph CH}_2\text{I}]{\text{Bu Li}}$　B
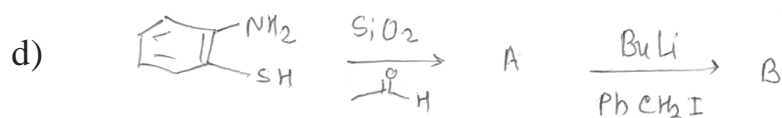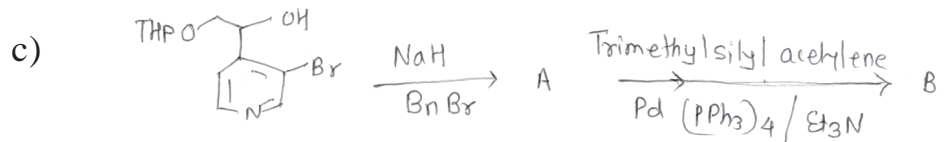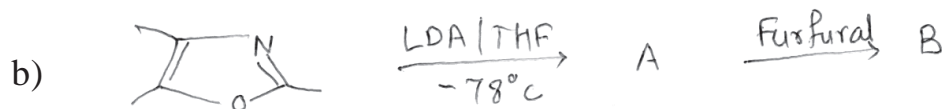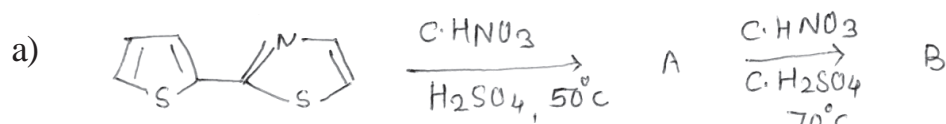
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M.Sc.-II

ANALYTICAL CHEMISTRY

CCTP-7, CHA-390 : Electrochemical and Thermogravimetric

Methods of Chemical Analysis

(2019 Pattern) (Semester-III)

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

Instructions to the candidates:

    1)   *Q 1 & 5 are compulsory.*

    2)   *Answer any 2 questions out of Q 2, Q3 & Q4 & any 2 questions out of Q6, Q7 & Q8.*

    3)   *Answer of two sections should be written on two answer books.*

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

    5)   *Use calculator and logtable is allowed.*

SECTION-I

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

    i)   Write Ilkovic equation and meaning of the terms with their appropriate units.

    ii)   What is constant current and constant potential coulometry?

    iii) What is the difference between linear swip voltammetry (polarography) and pulse voltammetry?

    iv) What is polarographic maxima and maxima supperesors?

    v)   What are reversible and Irreversible electrochemical reactions.

  b)   Constant current 320 mA was used in electrodeposition of Cu (ii) from aqueous solution for 20 minutes. If Atomic mass of Cu(II) is 63.5g then calculate the amount of copper metal deposited at cathode write reaction tecking place at cathode.   **[3]**

Q2) a)   What is cyclic voltammetry? What are the characteristics of cyclic voltammogram? Explain cyclic voltammogram of $K_3[Fe(CN)_6]$/ $K_4[Fe(CN)_6]$ System.   **[6]**

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

    i)   Explain differential pulse voltammetry in detail.

    ii)   Explain construction and working of cleark oxygen sensor.

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

    i) What is hydrodynamic Voltammetry? Explain cell used for hydrodynamic voltammetry.

    ii) Explain application of hydrodynamic voltammetry detectors in chromatography and flow injection analysis.

  b) Write notes on **[6]**

    i) Constant potential coulometry

    ii) Stripping methods

Q4) a) Discuss linear swip voltammogram (Polarogram) and terms **[6]**

    i) Residual current

    ii) Diffusion current

    iii) Half wave Potential

    iv) Limiting current.

    Give the equation which explain the relationship between Diffusion current and conc. of reducible metal ion in solution.

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

   i) What are advantages and disadvantages of dropping mercury electrode?

    ii) Calculate diffusion current if 2 μm Cu(II) solution is used for the experiment capillary constant is 3.4 and diffusion coefficient is 4.5×10^{-4} cm^2 s^{-1}.

SECTION-II

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

    i) Define the term differential thermal analysis and mention any two applications of this method.

    ii) What do you meant by crystalline phase transtion? which thermal method can be used to detect crystalline phase transtion?

    iii) What is dynamic mechanical analysis?

    iv) What is evolved gas analysis?

    v) Enlist four thermal methods of Simultanious analysis

b) A sample of inorganic compound is analysed for the moisture content and water of crystallization suppose anhydrous compound has molecular wt. 153 g. It shows % wt loss of 3.19% at 90 to 105°C and 24.12% wt loss from 140 to 225°C. Calculate moisture content and water of crystallization in the compound. **[3]**

Q6) a) Explain any three factors affecting results of the thermal methods of analysis. **[6]**

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

i) What is thermomechanical analysis? Give its application.

ii) What is the long form of DSC? Give its two types and differences between them. Mention which types of thermal changes can be detected by DSC method.

Q7) a) What is thermogravimetry? Explain instrumentation of thermogram. **[6]**

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

i) What is glass transsion temp? Explain use DSC in determination of glass transtion temperature.

ii) Which thermal method can be used to account following changes? why

1) Conversion of solid to liquid

2) Decomposition of inorganic complex

3) Change in dimentions of plastic rod due to load.

Q8) a) Write notes on **[6]**

i) TG-MS method for EGA.

ii) Dielectric thermal analysis.

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

i) Explain study of high alumina cement by DTA method.

ii) Calciam carbonate was dissolved in slight excess of oxalic acid which formed white coloured ppt. (compound -A). It was dried in air and analysed by TGA. 30 mg of compound -A showed wt loss of 6.65 mg at 140 to 260°C while total wt loss at 1000°C is 19.8 mg. Predict product -A and its thermal decomposion reaction on the basis of % wt loss.

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M.Sc.
ANALYTICAL CHEMISTRY
CHA-391 : Analytical Method Development and Extraction Techniques
(2019 Pattern) (Semester - III)

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

Instructions to the candidates :
1) *Question 1 & 5 are compulsory.*
2) *Questions 2 to 4 & Q.No.6 to 8 carry equal marks.*
3) *Solve any two questions from 2 to 4 & any two questions from Q.No.6 to 8.*
4) *Figure to the right indicate full marks.*

SECTION-I

Q1) a) Solve any four of the following.   **[8]**
     i) Compare ruggedness and robustness.
     ii) Define calibration.
     iii) What is method validation?
     iv) What are the factors affecting disolution test?
     v) Which agencies from Japan who are a part of ICH?

    b) The mean of four determinations of copper content of an alloy was 7.87%. with standard deviation s=0.15%. Calculate 95% confidence limit for true value [Given t = 3.18].   **[3]**

Q2) a) Explain in detail: **[6]**
     i) Write a note on interlaboratory qualification process.
     ii) Draw a neat labelled diagram for USP type II apparatus.

    b) i) Define and explain linearity and range with suitable example.   **[3]**
     ii) Percentage of chloride in $MgCl_2$ was reported by different persons as 30.26, 32.88, 33.12 and 33.76. Calculate mean deviation, standard deviation and relative standard deviation   **[3]**

Q3) a) What is an error? Discuss in detail different types of errors with examples.**[6]**

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

    i) Discuss method validation using HPLC technique as example.

    ii) Explain single point test vs dissolution profile.

Q4) a) Write an account on method validation report. **[6]**

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

    i) Write a note on initial harmonization.

    ii) Determine the relationship between response and concentration by linear regression analysis Data given is as follows:

Concentration °K Standard (mgll)	0.00	0.10	0.20	0.30	0.40
Response value	0.00	5.20	9.90	15.30	19.10

SECTION-II

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

    i) What are the function of the SPME holder?

    ii) Give the examples of reverse phase sorbent system.

    iii) What are the operating conditions for MAE?

    iv) What is emulsion in liquid-liquid extraction? How can an empulsion be remedied?

    v) Write five stages of SPE.

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

If distribution ratio is 10 calculate % extracted for a equal volume of aqueous and organic solvent.

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

    i) Draw a schematic diagram illustrating the principle of column switching. Explain automation and online SPE.

    ii) Explain in detail determination of Boron using Ferroin by solvent extraction.

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

Determine the separation efficiency for metals m_1 and m_2 when m_1 was 70% extracted into CH_2Cl_2 with dithiozone and m_2 was 25% extracted under similar conditions of pH and equal volumes of both the solvents.

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Q7) a) Attempt the following. [6]

  i) Draw a diagram of microextraction in a packed syringe and explain in detail MEPS.

  ii) What is microwave assisted extraction? Explain its theoretical basis.

  b) Attempt the following. [6]

  i) Explain the process of coupling of SPME with HPLC.

  ii) Explain in detail factors affecting on SPE.

Q8) a) Attempt the following. [6]

  i) Explain in detail method development for PFE.

  ii) Explain in detail direct immersion SPME.

  b) Attempt the following. [6]

  i) Discuss different types of SPE media.

  ii) Give any one application of Ion exchange SPE.

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M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CCTP-9, CHA-392 : Advanced Chromatographic Methods of Chemical Analysis
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:
1) *Q. 1 & Q.5 are compulsory.*
2) *Attempt any two questions from Q . 2 to Q. 4 and any two questions from Q. 6 to Q. 8.*
3) *Figures to right indicate full marks.*
4) *Answers to two sections should be written on a separate answer books.*
5) *Use of log-table and calculator is allowed.*

SECTION - I

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

   i)   What do you mean by retention factor?

   ii)   Enlist different liquid stationary phases used in gas chromatography.

   iii) What is peak capacity?

   iv)   What is probability based matching in GCMS?

   v)   Draw the block diagrams of mass spectrometer.

   b) In a chromatographic analysis of lemon oil a peak for limonene has a retention time of 8.36min with a baseline width of 0.96 min. Terpinene elutes at 9.54 min with a baseline width of 0.64 min. What is the resolution between the two peaks?   **[3]**

Q2) a) Explain the construction and working of time of flight mass analyzer. What accelerating potential is required to focus an ion with m/z 356 on the entrance slit of a detector, if the magnetic analyzer has a radius of curvature at the location of the detector of 22.5 cm. and if the applied magnetic flux density is 1T?   **[6]**

   b) i)   Explain the determination of phenols in waste water by LLE-GC method.   **[3]**

      ii) Write a note on selected ion monitoring.   **[3]**

P.T.O.

Q3) a) Write the principle of GCMS. Give its importance and advantages. What are the basic elements of a GCMS? **[6]**

b) i) Explain the term mass to charge ratio. **[3]**

ii) Explain the construction and working of a flame ionization detector (FID). **[3]**

Q4) a) A GC column was operated under the following conditions. **[6]**

Column	1.20m × 2.0m, packed with chromosorb P, weight of stationary liquid added = 1.40g, density = 1.02 g/ml
Measured outlet flow rate	25.3ml/min
Temperature	Room = 21.2°C, Column = 102.0°C
Refention times	Air = 18s, methyl acetate (MA) = 1.98min, methyl propionate (MP) = 4.16 min, methyl n-butgrate (MB) = 7.93 min

Calculate the following :

i) The retention factor (k) for each component.

ii) Selecting factor (α) for each adjacent pair of compounds.

iii) The average number of theoretical plates ($\bar{N}$) and plate height (H) for the column (Given : $W_{MA} = 0.19$min, $W_{MP} = 0.39$ min, $W_{MB} = 0.79$ min)

b) i) Explain positive chemical ionization with suitable example. **[3]**

ii) Explain the terms : **[3]**

1) Deactivation of surfaces.

2) Special stationary phases.

SECTION - II

Q5) a) Solve any four of the following : **[8]**
  i) List four properties of supercritical fluids.
  ii) What is the principle of size exclusion chromatography?
  iii) What are mass sensitive (solvent property) and solute selective detectors in HPLC?
  iv) What are the functions of precolumn?
  v) What is indirect detection in HPLC?

  b) A standard solution of a substance is prepared in a mobile phase at a conc. of 00.03 ms/ml. It gives peak area 6240 units. 25 mg sample was dissolved in 1000 ml mobile phase and analysed. It shows peak area 4790. Calculate percent purity of sample. **[3]**

Q6) a) Discuss the following : **[6]**
  i) Criteria used for the selection of mobile phase in HPLC analysis.
  ii) Principle of ion-exchange chromatography.

  b) Answer the following : **[6]**
  i) Explain construction and working of thermospray interface LC-MS.
  ii) What is supercritical fluid extraction? Explain in detail.

Q7) a) Write notes on : **[6]**
  i) Reverse stationary phases in HPLC.
  ii) Fluorescence detector in HPLC.

  b) Answer the following: **[6]**
  i) How molecular weight is determined by using size exclusion chromatography?
  ii) Explain importance characteristics of detector used HPLC.

Q8) a) Solve the following : **[6]**
  i) What is the function of pump in HPLC? Explain short stroke piston pump in brief.
  ii) What is calibration factor? How calibration factor is calculated in external and internal standard method.

  b) Answer the following: **[6]**
  i) Discuss any one application of LC-MS in detail.
  ii) Aspirin in ecosprin tablet was analysed by NPLC. Standard aspirin with conc, 0.02, 0.04 and 0.06 mg/ml shows peak heights 90, 195, 261 mv. Average wt of ecosprin tablet is 102 mg. 25 mg powdered tablet was dissolved in mobile phase and diluted to 100 ml. From this solution 10 ml was further diluted to 100 ml. It showed peak height 95mv. Calculate mg of aspirin per tablet.

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M.Sc. (Part-II)

ANALYTICAL CHEMISTRY

CBOP-3, CHA-393 (A) : Bioanalytical chemistry

(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

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

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

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

4)   Figures to the right indicate full marks.

5)   Use of log tables & calculatar is allowed.

SECTION-I

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

   i)   Give the types of electrophoresis.

   ii)   Define electro osmosis.

   iii) Give difference between Hydrodynamic and electrokinetic injection.

   iv)   Write principle of TLC.

   v)   Enlist plannar chromatographic detector.

   b)   Explain in detail conductometric detection.   **[3]**

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

   i)   Explain in detail instrumentation of capillary electrophoresis.

   ii)   Write a short note on electroendoosmotic flow.

   Explain in detail fluoroscence detection.   **[6]**

P.T.O.

Q3) a) Attempt the following. [6]

    i) Derive equation for electrophoretic mobility.

    ii) Write a note on diode array scannar.

    b) Explain in detail amperometric detection. [6]

Q4) a) Attempt the following: [6]

    i) Explain mass spectrometric detection in TLC.

    ii) Explain general aspects of quantitative and qualitative analysis.

    b) Write a short note on kubelka-munk equation. [6]

SECTION-II

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

    i) Explain immune response.

    ii) Draw the structure of vitamin-C

    iii) Write a deficiency disease and sources of vitamin D

    iv) How to presered and stored the urine sample.

    v) Mentioned the various steps of RIA.

    b) Unknown blood sample of patient were analysed for creatinine content by picric acid method. The absorbance of sample is 0.008 and absorbance of standard is 0.045. calculate the concentration of creatinine in 100ml of sample. [3]

Q6) a) Attempt the following: [6]

    i) Explain the estimation of Na, k, and ca by flame photometry.

    ii) Explain in detail innate and adaptive immune system.

    b) Attempt the following: [6]

    i) Explain in detail competion ELISA method.

    ii) Explain the determination of thiamine from biological sample by fluorometry.

Q7) a) Attempt the following: [6]

  i) Explain determination of urea in urine by urease method.

  ii) Explain oral glucose tolerance test.

  b) Explain in detail substrate and chromophore [Enzyme conjugates] commonly used in ELISA.   [6]

Q8) a) Attempt the following: [6]

  i) Explain in detail collection of Blood sample.

  ii) Unknown blood sample of pateint were analyzed for inorganic phosphate by TLA method. The absorbance of sample is 0.088 and absorbance of standard is 0.110.Calculate the concentration of inorganic phosphate in given sample.

  b) Explain the vitamin B6 (Pyridoxine) with respect of functions, defciency diseas, daily requirement and analytical method.   [6]

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M.Sc. (Part-II)
ANALYTICAL CHEMISTRY
CBOP-3, CHA-393B : Analysis of Food and Controled Substances
(2019 Pattern) (Semester - III)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
1) *Q.1 & Q.5 are compulsory and carry 11 marks.*
2) *Attempt any two questions from Q.2 to Q.4 and any two questions from Q.6 to Q.8.*
3) *Figures to the right indictae full marks.*
4) *Answer to the two sections should be written on separate answer books.*
5) *Use of log tables & calculator is allowed.*

SECTION-I

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

        i)   Write the steps in food analysis.

        ii)   Give the significance of ash value.

        iii)   What is the importance of protein analysis?

        iv)   What are reducing sugars?

        v)   Why food additives are added to the foods?

    b)   1 gm oil sample of saponification value 180 mg KoH was saponified using 0.40 N alc. KOH solution. The blank fitration reading was 50 ml. of 0.40 N HCl. Find the quantity of alc. KOH consumed by the oil per gram.   **[3]**

Q2) a) Explain the Bradford protein assay the following set of data was obtained in the lab for Bradford protein assay, standard curve. Calculate the concentration of protein in the sample.   **[6]**

Protein concentration mg/ml	0	0.2	0.4	0.6	0.8	Sample
Absorbance at 595 nm	0.01	0.23	0.476	0.661	0.811	0.116

b) i) Write a note on Nelson-Somogyi method. **[3]**
ii) Explain the terms. **[3]**
1) Sample
2) population
3) Sampling plan.

Q3) a) Explain the Mojonnier method for Lipid extraction. 2gm of predried sample of a food is transferred to a predried boiling flask that weighs 18.23 gm. After drying to a constant. weight, the total mass of the boiling flask was 19.33 gm calculate the amount of fat present in the given food sample.**[6]**

b) i) Write a note on dry ashing determination. **[3]**
ii) Explain phenol-Sulphuric acid method for carbohydrates. **[3]**

Q4) a) Discuss the determination of parabens from the food. calculate the amount of benzoic acid in 110 gm food material. When the alcohol extract is titrated with 0.049N NaOH Solution and required 9.5 ml of the titrant.**[6]**

b) i) What is KFReg? Write its formula and how it is used for the determination of moisture content? **[3]**
ii) What is protein digestibility-corrected amino acid score (PDCAAS)? How it is determined? **[3]**

SECTION-II

Q5) a) Attempt any four of the following: **[8]**
i) What is aqueous test technique?
ii) Give the sources of Khat.
iii) Explain the fluorescence testing for LSD.
iv) What are glandular trichomes?
v) Define-
1) Poppy straw
2) Opium Poppy

b) An amphetamine is estimated by gas chromatography and the sample shows a peak height of 21 mAUmin. The peak height for the reference standard solution of 50 μg/ml concentration is 25 mAUmin. Calculate the concentration of amphetamine present in the sample. **[3]**

Q6) a) Give an account of phytochemicals present in <u>Papaver somniferum</u> L. A sample of morphine was analysed by liquid chromotagraphy and following observation were obtained

$C_s = 4.3\,\mu$g/ml, $P_x = 4.6$ mAUmin, $A_x = 7.4$ mAUmin $P_s = 3.4$ mAUmin. $A_s = 6.7$ MaUmin.

Calculate the concentration C (C_x) of micrphine in the sample. **[6]**

b) i) Write a note on TLC analysis of mescaline. **[3]**

ii) Explain Zimmerman test for benzodiazepines. **[3]**

Q7) a) Discuss the quantification of cocaine by GCMS. **[6]**

b) i) Write the structures of following phytochemicals present in <u>Cannabis sativa</u>. **[3]**

1) $\Delta^9 - $ THC

2) CBD

3) CBN

ii) A drug was analysed for LSD content using 1% tartanic acid and HCl_3. The CHl_3 extract showed following observation using GCMS. calculate the amount of LSD in sample. **[3]**

LSD std (μg/ml)	0	50	100	150	200	Sample
Peak area Ratio	0	1.101	1.210	1.333	1.445	1.225

Q8) a) Discuss the identification of amphetamines by marquis test. Three samples. S_1, S_2 and S_3 were analysed by TLC using a mixture of CHl_3 and MeOH in 4:1 ratio as mobile phase. Calculate the R_f value of each sample if the distances travelled by solvent, S_1 S_2 and S_3 are 10.5cm, 5.2 cm, 3.5 cm and 6.3 cm respectively. **[6]**

b) i) Give the general procedure for chemical colour tests. What are the limitations of these tests? **[3]**

ii) What are barbiturates? Write the structures at amobarbital and phenobar bital. **[3]**

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[6063]-411
M.Sc. (Part - II)
PHYSICAL CHEMISTRY
CCTP-10, CHP-410 : Molecular Structure & Spectroscopy
(2019 Pattern) (Semester - IV) (Credit - 4)

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

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *Questions 1 and 5 are compulsory.*
3) *Answer any 2 questions out of Q2, Q3 and Q4 and any 2 questions out of Q6, Q7 and Q8.*
4) *Figures to the right side indicate full marks.*
5) *Use of logarithmic table, calculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.023 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^{-1} molecule^{-1}
			$= 1.38 \times 10^{23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{16}$ erg s
			$= 6.626 \times 10^{-34}$ Js
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1eV		$= 23.06$ 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} mo1^{-1}
7.	Faraday Constant	F	$= 96487$ C equavalent^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9.	1 cal		$= 4.187 \times 10^{7}$ erg
			$= 4.187$ J
10.	1 amu		$= 1.673 \times 10^{-24}$ kg
11.	Bohr Magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear Magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

SECTION - I

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

    i)   Explain the principle of NMR.

    ii)   Explain the advantages of TMS.

    iii)   Define Kramer's degeneracy.

    iv)   Why is the derivative mode preferred in esr spectra?

    v)   What are the limitations of NQR?

  b) Predict the intensity distribution in the hyperfine lines of the esr spectrum of the radical CH_3. **[3]**

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

    i)   Discuss zero field splitting in esr.

    ii)   Explain Larmor precession. What is Larmor frequency.

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

    i)   Explain factors affecting chemical shift.

    ii)   Give the applications of NQR.

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

    i)   Write a note on ^{13}C spectroscopy.

    ii)   Explain the factors affecting g-value in esr.

  b) Describe the instrumentation involved in high resolution nmr spectroscopy. **[6]**

Q4) a) Explain the application of NMR in various field with examples. **[6]**

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

    i)   Explain quadrapole coupling in NQR.

    ii)   Calculate the frequency separation of nuclear spin state in ^{13}C nucleus with magnetic field 14.4T. The magnetogyric ratio is 6.73×10^7 $T^{-1}S^{-1}$.

SECTION - II

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

    i) Define the terms pole strength and magnetic field.

    ii) What are the counter methods used to detect x-rays?

    iii) Write the Langevin equation for atomic susceptibility and explain the terms involved therein.

    iv) What are the two major limitations of electron diffraction technique?

    v) Define the term structure factor, F_{nkl}. Give its general expression for j atoms in a unit cell.

  b) What are the methods to overcome the phase problem observed in x-ray diffraction pattern? **[3]**

Q6) a) Discuss the applications of x-ray diffraction technique. **[6]**

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

    i) Explain paramagnetism and diamagnetism.

    ii) The gram susceptibility of a magnetic complex is 11.03×10^{-6} cgs units at 293 k. Find the susceptibility at 300 k.

Q7) a) Draw a neat labeled diagram of neutron spectrometer and explain its working. **[6]**

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

    i) Give any three differences between x-ray diffraction and electron diffraction techniques.

    ii) Explain with a neat diagram constructive and destructive interferences observed in x-ray diffraction pattern.

Q8) a) Discuss the applications of electron diffraction technique. **[6]**

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

    i) Calculate the Molar magnetic susceptibility of acetate ($C_2H_3O_2^-$) ion

       Given : $\chi_C = -6.00 \times 10^{-6}$ cgs unit

             $\chi_H = -2.93 \times 10^{-6}$ cgs unit

             χ_{O_2}(carboxylate) $= -7.95 \times 10^{-6}$ cgs unit

    ii) What are the applications of neutron diffraction technique?

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[6063]-412
M.Sc.-II
PHYSICAL CHEMISTRY
CCTP-II CHP-411 :Surface Chemistry and Electrochemistry
(2019 Pattern) (Semester-IV) (New) (4 Credits)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
1) *Answer to the two sections should be written in separate answer books.*
2) *Questions 1 and 5 are compulsory.*
3) *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
4) *Figures to the right side indicte full marks.*
5) *Use of logarithmic table, calculator is allwoed.*
6) *Neat diagrams must be drawn wherever necessary.*

<u>Physico-Chemical Constants</u>

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

Q1) a)   Attempt any four of the following: [8]
   i)   What is differential heat of adsorption?
   ii) What is capillary condensation?
   iii) Define chemisorption.
   iv) Write B.E.T equation and explain terms involved in it.
   v)   Define Hysteresis of adsorption.
   b)   Discuss the mechanism of detergency.   [3]

Q2) a)   Answer the following: [6]
   i)   Write the assumptions of potential theory for multilayer adsorption.
   ii) Explain mercury porosimeter method of determination of pore size.
   b)   Answer the following.   [6]
   i)   How is Harkins- Tura equation used to determine the surface area of solid.
   ii) Nitrogen gas adsorbed on charcoal to extent of $0.921 Cm^2/g$ at 5 atm and 190k temperature. But at 250 k the same amount of adsorption is achieved only when pressure was increased to 32 atm. What is molar enthalpy of adsorption of N_2 on charcoal.

Q3) a)   Derive the equation for isosteric enthalpy of adsorption.   [6]
   b)   Answer the following: [6]
   i)   Describe the microtome method for verification of Gibbs equation.
   ii) Explain the mechanism of chemisorption on semiconductor.

Q4) a)   Derive and explain Gibbs adsorption equation.   [6]
   b)   Answer the following: [6]
   i)   Explain isothermal method for measurement of heat of adsorption.
   ii) The data given below was obtained for the adsorption of Co on charcoal at O°C and 1 atm. Verify that the data obey Langmuir monolayer adsorption. Determine the values of K and Vm.

P (torr)	100	200	300	400	500	600
V (cc)	10.2	18.6	25.5	31.4	36.9	41.6

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

  i) Define the terms activity and activity coefficient.

  ii) Write the equation for thickness of ionic atmosphere and explain the terms involved therein.

  iii) Explain the terms absolute mobility and conventional mobility with their unit.

  iv) Why does Debye-Huckel limiting law is referred to as limiting law.

  v) Define the terms fuel cells and primary batteries.

 b) Find the ionic strength of the following solution. Assuming complete dissociation. [3]

  400 ml 0.2M Na_3PO_4 + 100ml 0.4M $ZnCl_2$.

Q6) a) Derive the Einstein relation between the absolute mobility and the diffusion coefficient. [6]

 b) Answer the following: [6]

  i) Write the equation for fick's first law of steady-state diffusion and explain the terms involved therein with units.

  ii) What are the ways of transport of ions. explain.

Q7) a) Write a note on lithium-ion battery. [6]

 b) Answer the following. [6]

  i) Derive the Tafel equation.

  ii) If the Tafel constants 'a' and 'b' have values 1.54 V and 0.119 V respectively for the reduction of hydrogen ion at a lead cathode. Calculate the transfer coefficient and exchange current density i_0 at 298 K.

Q8) a) Describe the Gouy-chapman diffuse-layer theory. [6]

 b) Answer the following: [6]

  i) Ionic strength of KCl solution is 0.04. Calculate the mean activity coefficient of an electrolyte using Debye-Huckel limiting law. Given: Constant A=3.

  ii) Write the Butler-Volmer equation and explain the terms involved in it.

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[6063]-413
M.Sc.
PHYSICAL CHEMISTRY
CHP-412 (A) CBOP - 4 : Material Chemistry and Catalysis
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

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

    2)   *Questions 1 and 5 are compulsory.*

    3)   *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*

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

    5)   *Use of logarithmic table, calculator is allowed.*

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

Physico - Chemical Constants

1.	Avogadro Number	N	$= 6.023 \times 10^{23}$ mol^{-1}
2.	Boltzmann Constant	k	$= 1.38 \times 10^{-16}$ erg K^4 molecule^{-1}
			$= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
3.	Planck Constant	h	$= 6.626 \times 10^{-27}$ erg s
			$= 6.626 \times 10^{-34}$ Js
4.	Electronic Charge	e	$= 4.803 \times 10^{-10}$ esu
			$= 1.602 \times 10^{-19}$ C
5.	1 eV		$= 23.06$ 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} mor1^{-1}
7.	Faraday Constant	F	$= 96487$ C equivalent^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^8$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^7$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-24}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

SECTION - I

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

     i) What is Glazer notation? Give its one example.

     ii) Draw the unit cell diagram of YBCO super conducting cuprate.

     iii) Define reactive sputtering.

     iv) What is superconductor?

     v) Explain basic structure of capacitor.

   b) Explain different types of Langmuir-Blodgette deposition. **[3]**

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

     i) What are the characteristics of 1-2-3 superconducting cuprate materials.

     ii) Explain three modes of operation of transistor.

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

     i) Explain different types of elastic constant.

     ii) Discuss the chemical vapor deposition with the help of suitable examples.

Q3) a) Describe the operations for preparation of III-V semiconducting structure in MOCVD. **[6]**

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

     i) Explain construction and working of full wave rectifier.

     ii) Discuss the multigap structure in hitech materials.

Q4) a) Explain preparation and characteristics of 2-1-4 superconducting cuprate materials. **[6]**

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

     i) What is superconductivity? Explain the types superconductivity.

     ii) Explain the principle of DC sputtering system with the help of suitable diagram.

SECTION - II

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

    i) Define the term calcination.

    ii) Give any four factors which affects the activity of catalyst.

    iii) What are Zeolites? Give an example.

    iv) State the principle of X-ray photoelectron spectroscopy.

    v) Define the term photo catalysis.

  b) Write a note on ozone decomposition. **[3]**

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

    i) Discuss impregnation method of preparation of catalyst.

    ii) Explain the principle of photo catalysis with an example.

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

    i) Explain adsorption theory of catalysis.

    ii) Write any three principles of green chemistry.

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

    i) Explain the effect of temperature on enzyme catalysed reaction.

    ii) How is the characterization of catalyst done by using AES technique?

  b) Explain the sol-gel method used for preparation of catalyst. **[6]**

Q8) a) Derive the expression for kineties of bimolecular surface reaction. **[6]**

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

    i) Discuss mercury porosity meter method to determine pore size of catalyst.

    ii) Write a note on auto-exhaust catalysts.

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Total No. of Questions : 8]

P-2457

[6063]-413
M.Sc.
PHYSICAL CHEMISTRY
CHP-412 (B) CBOP - 4 : Biophysical Chemistry and Special
Topics in Nuclear & Radiation Chemistry
(2019 Pattern) (Semester - IV)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
  1)   *Answer to the Two sections should be written in separate answer books.*
  2)   *Questions 1 and 5 are compulsory.*
  3)   *Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.*
  4)   *Figures to the right side indicate full marks.*
  5)   *Use of logarithmic table calculator is allowed.*
  6)   *Neat diagrams must be drawn wherever necessary.*

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^4 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} mor1^{-1}
7.	Faraday Constant	F	$= 96487$ C equiv^{-1}
8.	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^8$ m s^{-1}
9.	1 cal		$= 4.184 \times 10^7$ erg
			$= 4.184$ J
10.	1 amu		$= 1.673 \times 10^{-24}$ kg
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24}$ J T^{-1}
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27}$ J T^{-1}
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31}$ kg

4

SECTION - I

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

  i)   Give different test of proteins.

  ii) Explain the structure of a cell membrane.

  iii) Mention the classification of RNA.

  iv) Define biological cell and mention its constituents.

  v)   Draw the structure of ATP.

  b) What are polypeptide and proteins? Explain primary, secondary, tertiary structure of proteins. **[3]**

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

  i)   Explain sedimentation and moving boundary sedimentation for the separation and characterization of macromolecule.

  ii) Discuss different electrophoretic techniques used for separation and characterization of biomolecule.

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

  i)   Write a note on non competative inhibition and line Weaver-Burk plot.

  ii) Calculate the pH of a 2L solution containing 20 ml of 5M acetic acid and 5M sodium acetate.

Q3) a) Discuss the biological significance of Donnan membrane equillibrium.**[6]**

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

  i)   Explain the use of electronic osmometer to determine osmotic pressure.

  ii) Explain passive transport. How it is facilitated by membrane protein.

Q4) a) Describe the instrumentation used for measuring optical rotatory dispersion. **[6]**

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

  i)   Discuss various types of viscometer used in biochemistry.

  ii) A polymer sample contain equal number of molecular weight 25000 and 30000. Calculate $\overline{M}_n$ and $\overline{M}_w$.

SECTION - II

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

        i)   Explain personal dosimetry.

        ii)   Explain cosmology.

        iii)   Classify radioisotope.

        iv)   Explain radioactive waste disposal.

        v)   Explain biological effect of radiation.

    b)   Explain Ionizing Radiation.   [3]

Q6) a)   Answer the following :   [6]

        i)   Discuss general application of radio-pharmaceuticals.

        ii)   Explain somatic and genetic effects.

    b)   Answer the following :   [6]

        i)   Write the biological effect of radiation.

        ii)   Find the dose absorbed by sodium periodate in 3 hr when exposed to ^{60}Co radiation in terms rads. Given : absorbed Fricks solution 2.15 Gy/min.

          Z of Na = 11, I = 53, 0 = 8.

          A of Na = 23, I = 127, 0 = 16, $\left(\dfrac{Z}{A}\right) = 055$.

Q7) a)   Answer the following :   [6]

        Discuss the principle of separation of isotopes. How gas diffusion method is useful in the separation of isotopes.

    b)   Answer the following :   [6]

        i)   Explain use of radiation for food preservation and sterilization.

        ii)   Explain maximum permissible dose - ICRP recommendations.

Q8) a)   Answer the following :   **[6]**

    i)   Discuss the in vivo diagnostic and in vitro diagnostic therapeutic use of radiation.

    ii)   Explain natural and man-made radiation sources.

  b)   Calculate resolving time of system in microsecond from following data.**[6]**

Sample	A	B	A + B
Count Rate	2600	1400	8800
Time in minutes	2	4	5

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[6063]-414

M.Sc. - II

INORGANIC CHEMISTRY

CHI-430 : Heterogeneous Catalysis and it's Applications

(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

   1)   *All questions are compulsory.*

   2)   *Draw neat diagrams wherever necessary.*

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

   4)   *Use of logarithmic tables and calculators are allowed.*

SECTION - I

(Heterogeneous Catalysis)

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

     i)   What is turn-over frequency? Give it's significance.

     ii)   What is adsorption isotherm? Differentiate between Freundlich and Langmuir adsorption isotherms.

     iii)   What are promoters and poisons? Explain with suitable examples.

     iv)   What is phase transfer catalysis? Explain with suitable example.

   b)   Give the classification of heterogeneous catalyst.   **[3]**

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

     i)   Describe the preparation of solid catalysts by precipitation method. Give it's advantages and disadvantages.

     ii)   Give an account of post synthetic treatments of heterogeneous catalyst.

   b)   Answer <u>ANY TWO</u> of the following :   **[6]**

     i)   What is chemical reactor? Explain the advantages of fluidized bed reactor.

     ii)   Give the classification and nomenclature of zeolite.

     iii)   Write a note on MFI and MEL type zeolite.

Q3) a) Answer <u>ANY ONE</u> of the following : **[6]**

    i)   Give an account of various process of deactivation of heterogeneous catalyst.

    ii)   Describe major applications of XRD technique for characterization of heterogeneous catalyst.

   b)   Answer <u>ANY TWO</u> of the following : **[6]**

    i)   Discuss the effect of pH and SiO_2/Al_2O_3 ratio on zeolite.

    ii)   Discuss the role of support in supported metal catalysts.

    iii)   Explain the importance of surface area and porosity of heterogeneous catalyst.

SECTION - II

(Applications of Heterogeneous Catalysis in Organic Synthesis)

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

    i)   What is solid acid catalyst? Give any two examples.

    ii)   What is shape selective catalysis? Give it's example.

    iii)   How methanol is produced in industry? Which catalyst is used for production of methanol?

    iv)   Which properties of TiO_2 makes it a very good photocatalyst?

   b)   What is catalytic converter? Give the different reactions that takes place in catalytic converter. **[3]**

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

    i)   Draw the scheelite structure for $BiMoO_4$. Discuss it's use as oxidation and ammoxidation catalyst.

    ii)   Describe the conversion of biomass on solid catalysts.

   b)   Answer <u>ANY TWO</u> of the following : **[6]**

    i)   Give an account of water-gas shift reaction.

    ii)   Discuss selective hydrogenation of hydrocarbons.

    iii)   Explain the use of clays and intercalated clays as a catalyst with suitable examples.

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

      i) Describe the process and advantages of Fischer-Tropsch synthesis.

      ii) What is MCM-41? Give it's synthesis and properties.

    b) Answer <u>ANY TWO</u> of the following : **[6]**

      i) What is hydrocracking? Give it's advantages.

      ii) Give an account of Aromatic Alkylation reaction.

      iii) Write a note on industrial electrocatalysis.

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[6063]-415

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 431 : Inorganic Nanomaterials : Properties, Applications and Toxicity

(2019 Pattern) (Semester - IV) (CCTP - 11)

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

Instructions to the candidates:

1) *All questions are compulsory.*

2) *Neat diagram must be drawn wherever neccessary.*

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

4) *Use of logarithmic table and calculator are allowed.*

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

SECTION-I

(Nano - structural Materials and its Applications)

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

     i) What is nano chemistry?

     ii) What are the advanstages of synthetic nanoparticle over natural nanoparticles.

     iii) Explain zero dimensional nanoparticle with suitable example.

     iv) Explain the Moore's law.

   b) Explain in detail magnetic properties of nanostructured materials. **[3]**

Q2) a) Answer Any one of the following. **[6]**

     i) What is carbon nanotube? Explain in detail types of carbon nanotube.

     ii) Explain different modes of classification of nanomaterials.

P.T.O.

b) Answer Any Two of the following. **[6]**

i) Explain the importance of advanced organic electronic materials for data storage.

ii) Explain the nanocomposite material with suitable example.

iii) What is nanobiotechnology? Explain the application of nanobiotechnology for agriculture.

Q3) a) Answer Any one of the following. **[6]**

i) Discuss bottom-up approach of synthesis of nanomaterials.

ii) What is nanophotonics? write the applications of nanophotonic in solar cell.

b) Answer Any Two of the following. **[6]**

i) Explain use of polymeric nanoparticles in drug delivery.

ii) Explain the surface to volume ratio of nanomaterials.

iii) Explain the are discharge method for synthesis of carbon nanotube.

SECTION - II

(Nanotoxicology and Biosafety)

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

i) What is the signiFicance of nanotoxicology?

ii) What is nanoetymology?

iii) Explain biosafety of nanomaterials with the help of suitable example.

iv) What is mean by cytotoxicity and genotoxicity?

b) Explain the effect of size of nanoparticle on human health. **[3]**

Q5) a) Answer Any One of the following. **[6]**

i) Give the fuctors affecting to wards nanotoxicity. Explain one fuctor of nanotoxicity indetail.

ii) Explain the physico-chemical characteristic dependent toxicology.

b)   Answer Any Two of the following.   **[6]**

   i)   What is vitro-toxicity ? Explain the vitro-toxicity assessment with the help of zeta potential analysis.

   ii)   Explain toxic effect of gold nanoparticle.

   iii) Explain the nanoparticle disposal.

Q6) a)   Answer <u>Any One</u> of the following.   **[6]**

   i)   Explain diagonastic methods of nanotoxicity.

   ii)   Explain the nanoparticle toxicity with the help of their physical properties.

   b)   Answer <u>Any Two</u> of the following.   **[6]**

   i)   Explain the prevention methods of toxicity of nanoparticle.

   ii)   Explain the apoptosis assay.

   iii) Explain the any two route of administration of nanoparticle causes toxicity.

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[6063]-416

M.Sc.II

INORGANIC CHEMISTRY

CHI-432(A) : Material Science

(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

1) All questions are compulsory.

2) Neat diagrams must be drawn wherever necessary.

3) Figures to the right indicate full marks.

4) Use of logarithmic table and calculator is allowed.

5) Write the two section on separate answer sheet.

SECTION - I

Crystal defect, Magnetic and Superconducting Material

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

　　i) What is line defect? Explain its types.

　　ii) What is ferromagnetism? Explain with suitable example.

　　iii) Difference between type I and type II superconductor.

　　iv) What is defect? Explain different types of defect.

　　b) Draw the structure of HCP and calculate the number of atoms per unit cell of HCP.　　　　　　**[3]**

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

　　i) What is kirkendall effect? Explain with the help of pure copper and brass alloy.

　　ii) Derive the expression, $X = \dfrac{C}{T - Tc}$ or Curie Law.

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

　　i) Explain the classification of superconductors.

　　ii) Explain the Meissner effect.

　　iii) Give the applications of superconducting material.

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

　　i) Explain the 'Josephen Effect' of magnetic properties of super conductivity.

ii) Calculate the Net magnetic moment per iron atom in crystal structure from following data
   1) Iron has HCP structure
   2) Lattice parameter = 2.87 Å
   3) 1B.M. = 9.273×10^{-24} A/m^2.
   4) Saturation Magnetization = 1600KA/m^2.

b) Answer Any two of the following.   [6]
   i) Write a short note on Garnet Ferrite.
   ii) Difference between hard and soft spinel.
   iii) State and explain Fick's law.

SECTION - II
Ceramic, Composit, Cementitious and Biomaterials

Q4) a) Answer the following.   [8]
   i) What is Piezoelectric effect? Explain with example.
   ii) What are carbon fibers? Explain with example.
   iii) What is Non-portland cement?
   iv) Write full form of C_4AF and C_2S

b) Define the terms   [3]
   i) Fiber for reinforced plastic.
   ii) Set retarder.
   iii) Concrete.

Q5) a) Answer Any one of the following.   [6]
   i) Explain Dielectric properties of ceramic materials.
   ii) What is Aspalt? What is mean by aspalt mixes.

b) Answer Any two of the following.   [6]
   i) What is biomaterials? Give its applications.
   ii) A piece of wood containing moisture weighed 150gm and after oven drying showed constant weight is 132 gm. Calculate % of moisture content.
   iii) What is bioactive glasses.

Q6) a) Answer any one of the following.   [6]
   i) What is cement? Explain manufacturing of cement.
   ii) What is sol gel process for manufacture of ceramic materials.

b) Write a note on (Any two) :   [6]
   i) Macro deffect free cement.
   ii) Heart wood and sap wood.
   iii) High Alumina cement.

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M.Sc.II

INORGANIC CHEMISTRY

CHI-432-(B) : Inorganic Chemistry Applications in Industry (2019 Pattern) (Semester - IV)

[Max. Marks : 70

Instructions to the candidates:

1) All questions are compulsory.

2) Neat diagrams must be drawn wherever necessary.

3) Figures to the right side indicate full marks.

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

5) Use of logarithmic table, calculator is allowed.

SECTION - I

Inorganic Chemistry Applications in Industry

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

i) Why is chemical safety important?

ii) Give the applications of corrosion inhibitor.

iii) Define electroplating.

iv) How can SO_2 emission can be controlled?

b) What is electrodeposition process? Give its principle and working process. **[3]**

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

i) Explain about green chemistry in day to day life.

ii) Explain the methods for electroplating of precious metals.

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

i) What is the difference between propellant and explosive?

ii) What are the effects of industrial gases? What are the major causes of industrial pollution?

iii) What are semi conductors? Discuss electrodeposition of semiconductors.

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

i) Discuss the different process available for electroplating of tin & tin alloys.

ii) What is the major disadvantages associated with solid propellants compared to liquid propellants?

b) Write note on any two. [6]
   i) Green synthesis.
   ii) Corrosion inhibitors for paint coating.
   iii) Handlings and storage of explosives.

SECTION - II
Inorganic Chemistry Applications in Environment

Q4) a) Attempt the following. [8]
   i) What is meant by reverse osmosis?
   ii) List the important difference between aerobic & anaerobic method?
   iii) Define the term BOD and COD.
   iv) What is power ball?

b) List the best option for energy sources for 21st century. [3]

Q5) a) Attempt any one of the following. [6]
   i) List the provisions of the clear water act (CWA).
   ii) Explain the primary and secondary sludge process.

b) Attempt any two of the following. [6]
   i) What do you understant by geothermal energy?
   ii) List four forms of biomass. What is the energy yield obtained from buring biomass?
   iii) Describe the various process used for softening water.

Q6) a) Answer any one of the following. [6]
   i) Explain how the detergents and pesticides are reponsible for water pollution.
   ii) Discuss the various chemical principles involved in
       1) Coagulation
       2) Filteration
       3) Water softening processes

b) Write note on (Any two) : [6]
   i) Tidal power
   ii) Trickling filters.
   iii) Solid phase extraction

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M.Sc. (Semester - IV)

ORGANIC CHEMISTRY

CHO - 450 : Chemistry of Natural Products

(2019 Pattern)

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

Instructions to the candidates :

1) *Question 1 and 5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from 2 to 4 and two questions from 6 to 8.*
3) *Answers to the two sections should be written in seperate answer books.*
4) *Figures to the right indicate full marks.*

SECTION - I

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

     i)   Write two protecting reagents for amine group with suitable example.

     ii)   Write any one retrosynthesis of longifolene.

     iii)   Give the structure and role of following reagents in the synthesis.

         I)   TBDMS - Cl   II)   NMO

     iv)   Write the structure of (–) - Ribisin B with correct stereochemistry.

     v)   Give the structure of Hirsutellone B with correct stereochemistry.

   b)   Write the correct sequence of reagents for the following conversion. **[3]**
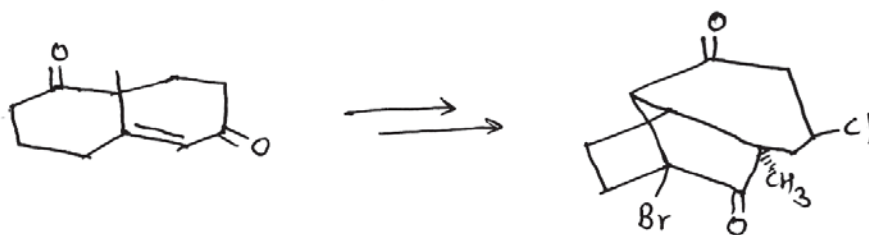
     i)   NBS   ii)   LDA, TMS - Cl

     iii)   DBU   iv) H_2, pd/c

     v) CH_2I_2, Et_2Z_n & $FeCl_3$ vi)   TMS-Cl, NaI, Et_3N

P.T.O.

Q2) Predict the products with mechanism. **[12]**

a)

b)

c)
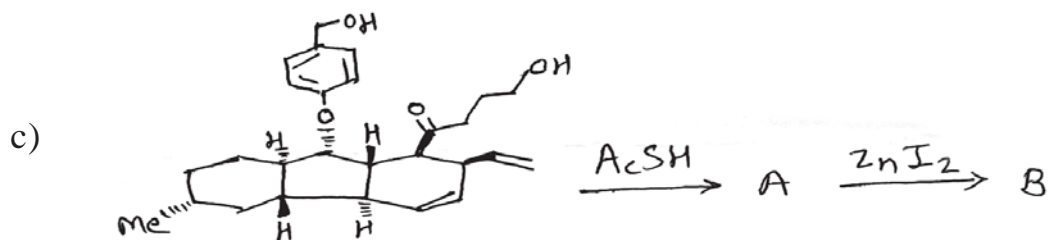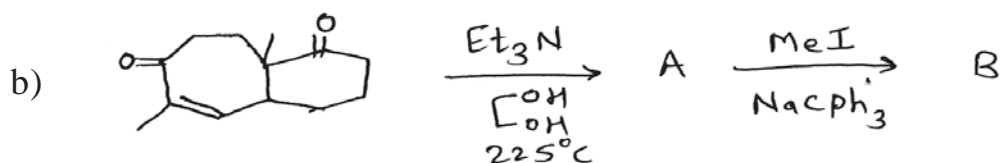
Q3) Write the missing reagents and intermediates for the following conversion.**[12]**

a)

b)

c)

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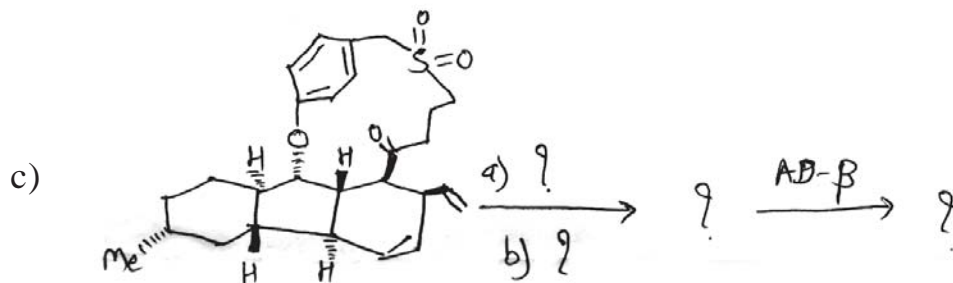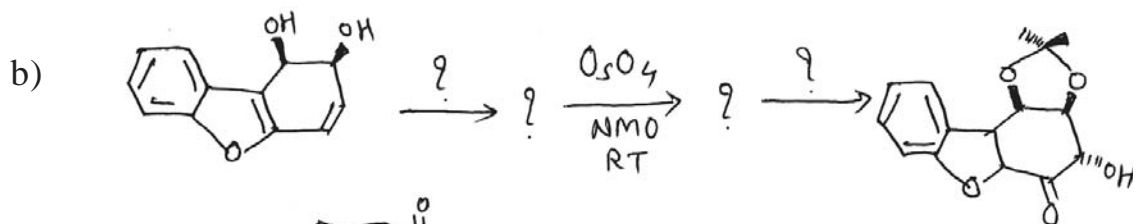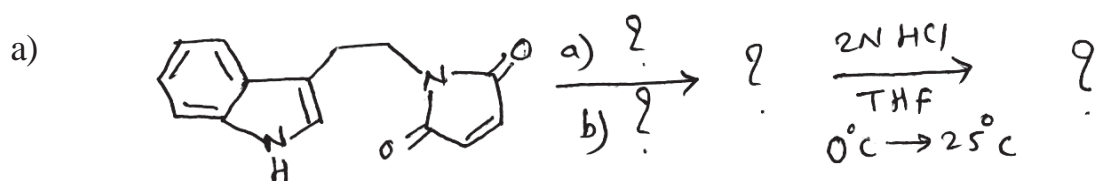
Q4) Outline the steps involved in the following synthetic sequence. **[12]**

a)

b)

→ (-)-Ribisin A

c)
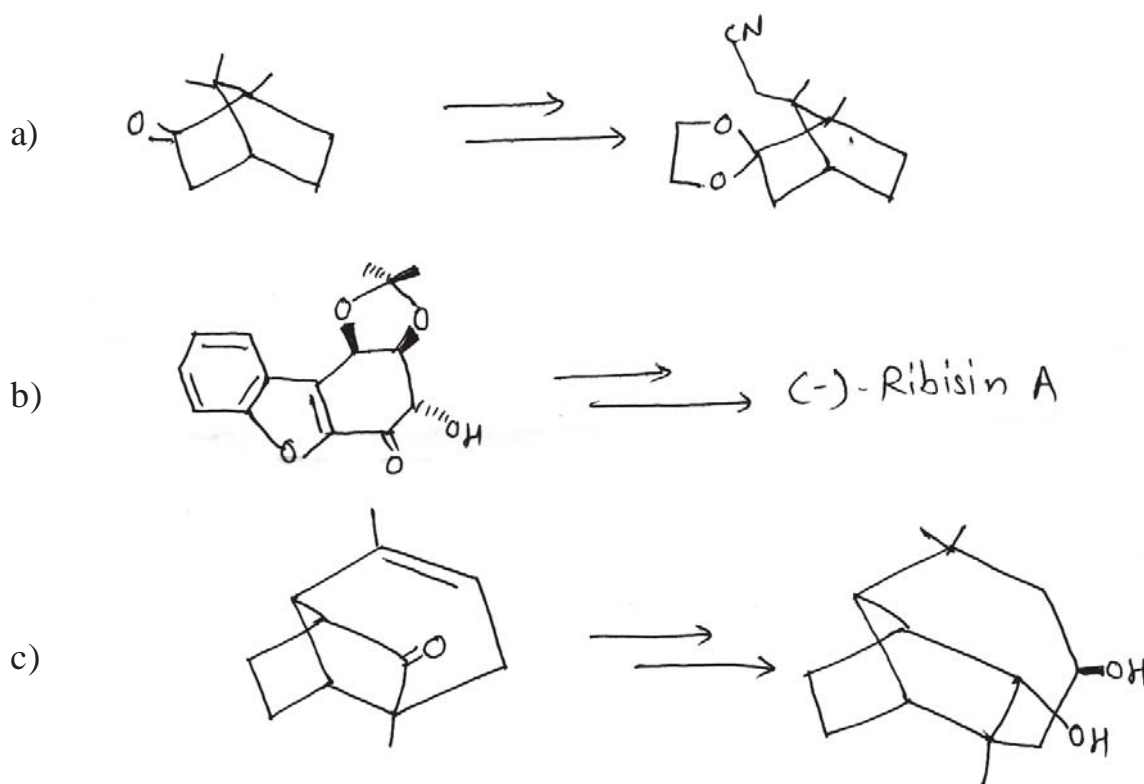
SECTION - II

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

i) Draw the structure of Pinnaic acid with correct stereochemistry.

ii) Write a note on Martin's sulfurane with reference to synthesis of originally assigned Vannusal B.

iii) Write a note on 'H chemical shift differences between originally assigned structure and natural Vannusal B (set to zero).

iv) Write the role of following reagents with mechanism.

I) p-$NO_2C_6H_5COOH$, Ph_3P ; DEAD

II) acetic anhydride, 4-DMAP

v) What is Pd-TMM [3+2] cyclisation used in pinnaic acid asymmetric total synthesis.

b) Write the correct structure, full form and use of the following with example.
[3]

i) HMPA   ii) TPAP

Q6) Predict the products. **[12]**

a) TiCl₄, acetone, Et₃N → Ⓐ DIBAL-H → Ⓑ aq. HF → Ⓒ

b) μWaves 200°C → Ⓐ BomCl iPr₂NEt → Ⓑ O₃, Ph₃P → Ⓒ

c) O₃, MeOH, Me₂S → Ⓐ TsNHNH₂ EtOH → Ⓑ NaBH₃CN, TsOH, THF → Ⓒ

d) LiHMDS THF → Ⓐ Aldehyde THF/ HMPA -78→25°C → Ⓑ alpine hydride → Ⓒ
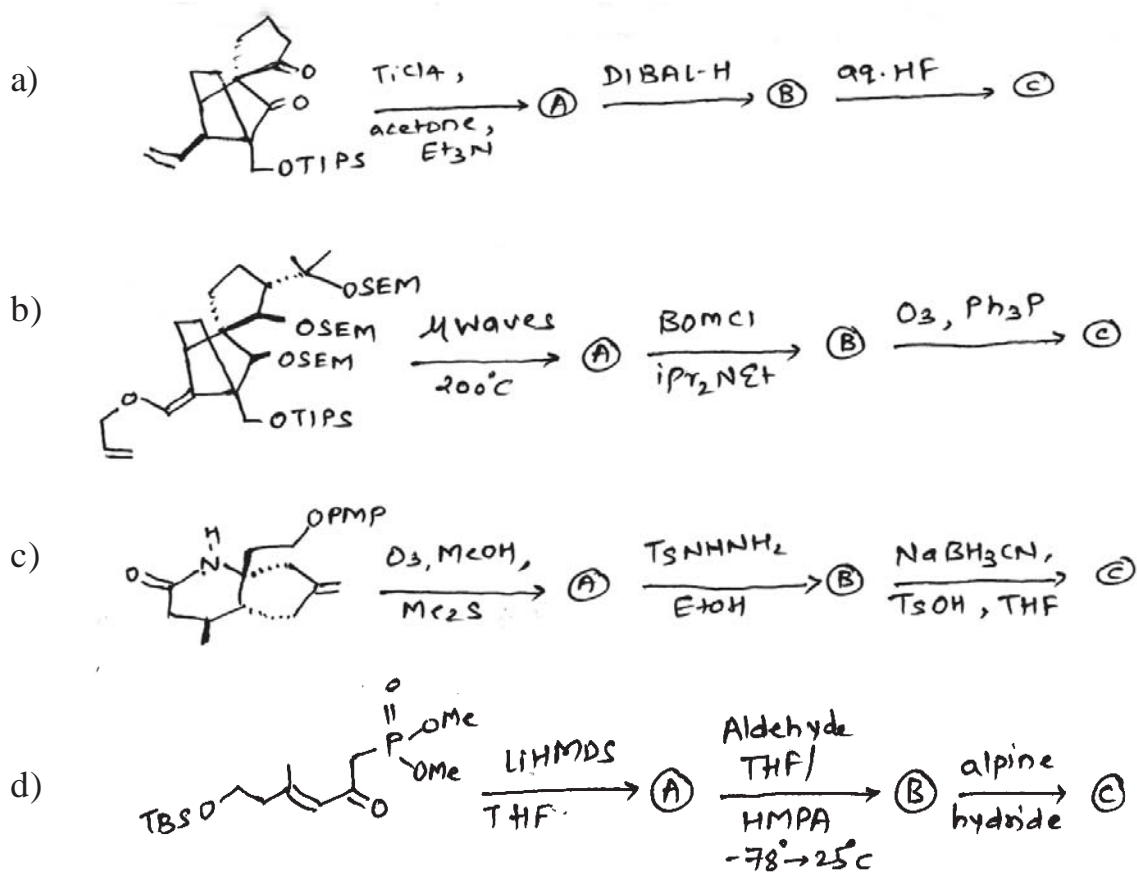
Q7) Write correct reagents and detailed steps involved in the following conversions.
[12]

a) ⟶

b) ⟶

c) ⟶
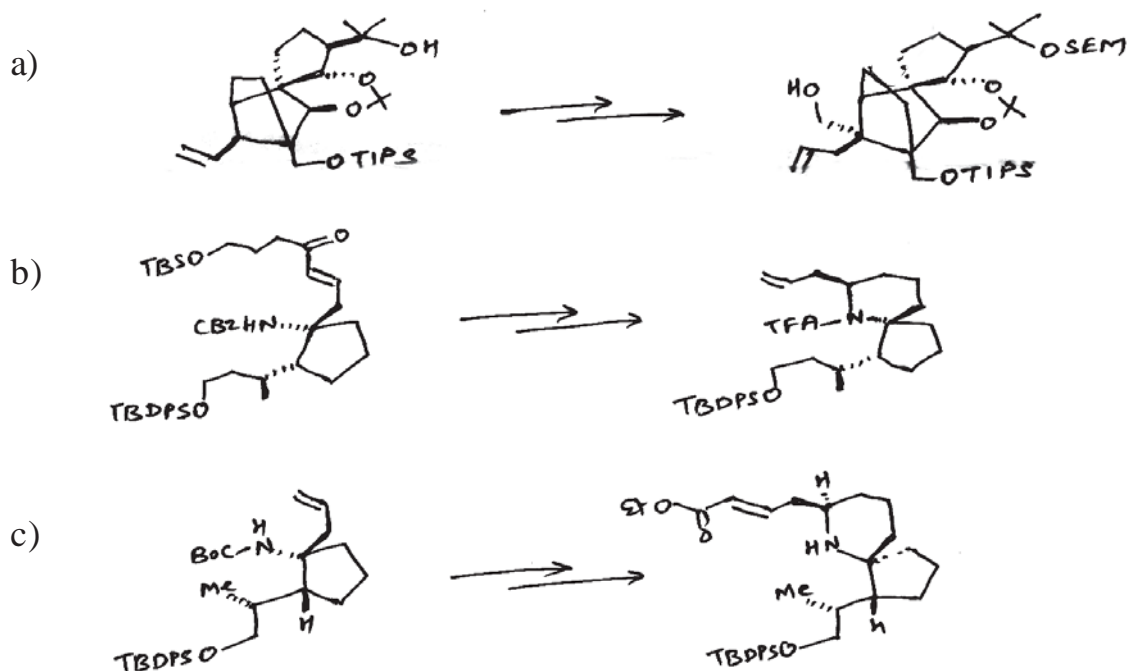
Q8) Answer the following : [12]

    a)   Write a note on cross olefin metathesis. Give one example with reference to Pinnaic acid asymmetric total synthesis.

    b)   Draw the structure of Eight possible Vannusal - B diastereomers with correct stereochemistry.

    c)   Discuss the steps in the retrosynthesis of originally assigned Vannusal - B.

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M.Sc.-II

ORGANIC CHEMISTRY

CCTIICHO-451 : Organometallic Reagents in Organic Synthesis

(2019 Pattern) (Semester-IV)

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

Instructions to the candidates:

1) *Answer to the two sections should be written in separate books.*
2) *Q.1 and Q.5 are compulsory and carry 11 marks each.*
3) *Write any 2 questions from Q.2 to Q.4 from section I and 2 questions from Q.6 to Q.8 from Section-II.*
4) *Figures to the right indicte full marks.*

SECTION-I

Q1) a) Explain the following: (any 4) **[8]**

   i) Regioselectivity of olefins in Heck reaction.

   ii) Role of base in suzuki coupling reaction.

   iii) Role of solvent in Bamford-stevens olefination.

   iv) Grignard reagent is effectively used for Ni catalyzed cross coupling reaction.

   v) Wittig-Horner reaction is preferred over witting reaction.

   b) Give catalytic cycle for Negishi coupling reaction. **[3]**

Q2) a) Predict the product for the following reactions. **[6]**

i)

ii)

iii)
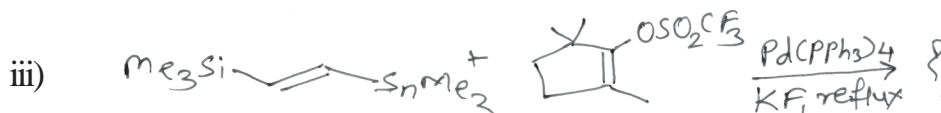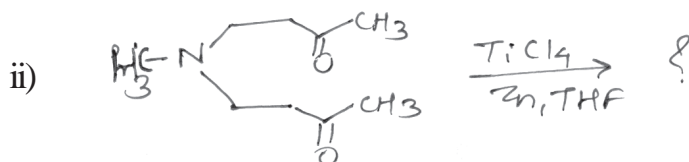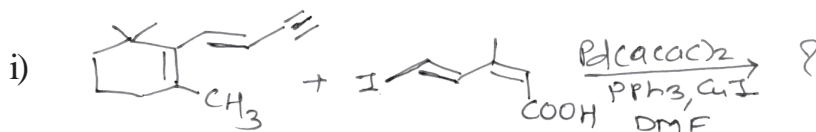
b) Suggest the mechanism **[6]**

i)

ii)
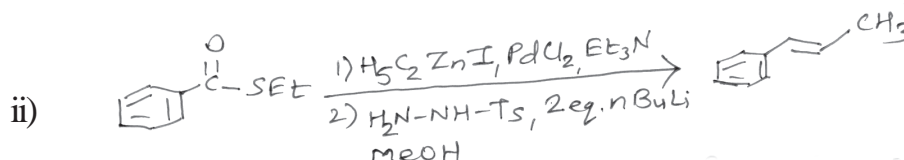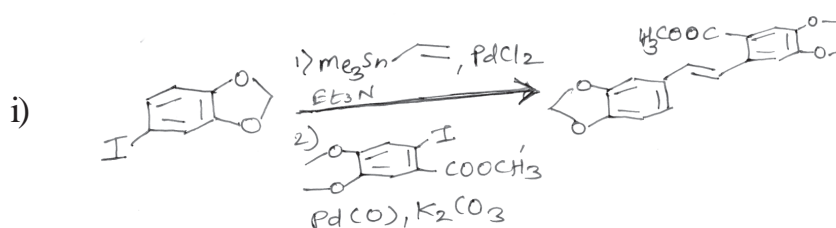
Q3) a) Answer the following **[8]**

i) Write a note on Reppe's process and it's application.

ii) Discuss the use of RuO_4 in transfer hydrogenation reaction.

b) Suggest the appropriate reagents for the following reaction. **[4]**
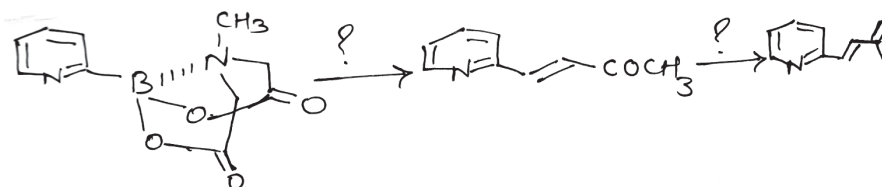
Rewrite the reaction with mechanism.

Q4) a) Write a note on **[6]**

i) Büchwald-Hartwig Amination reaction.

ii) Peterson olefination reaction.

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

i) Discuss Oxo process with example.

ii) Comment on the use of BT-sulphones in Julia-Lythogne Olefination.

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

i) Trimethylsilyl chloride is used as a protecting group for alcohol. Explain with suitable example.

ii) How 2-methy1 1- propanol can be synthesized using hydroboration approach.

iii) What is the disadvantage of using Cu(II) salts as catalyst in 1,3 dipolar cycloaddition of azides and alkynes? How this problem can be over come?

iv) What is Mannich base? How it can be prepared?

v) What is the driving force involved in cross metathesis reaction?

b) Predict the product and suggest the mechanism for the following reaction.**[3]**

$$CH_3CHO + \underset{OEt}{\overset{O \quad O}{||||}} + H_2N\overset{S}{||}NH_2 \longrightarrow \quad ?$$

Q6) a) Suggest the mechanism for the following reactions. **[6]**

i) $Me_3Si\,CH_2\,Cl \xrightarrow[CH_3COCH_3]{RLi}$

ii)

[6063]-418   3
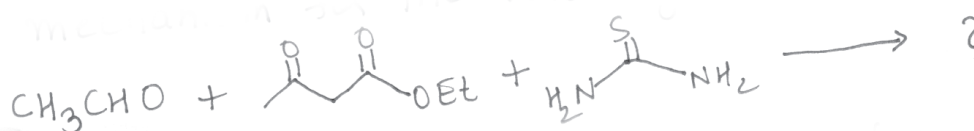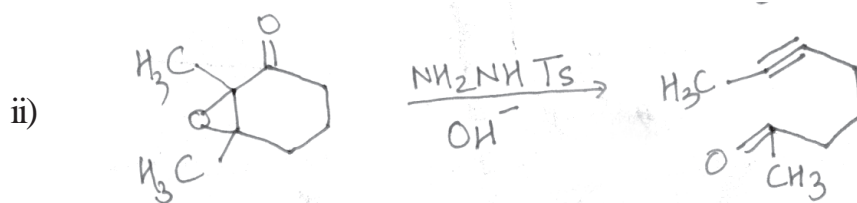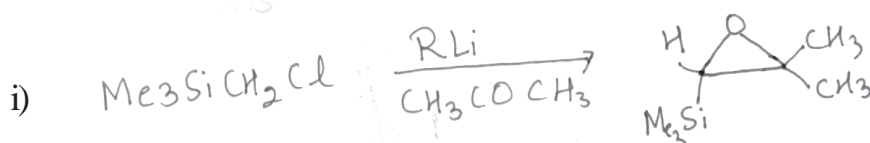
b) Predict the product/s of the following. [6]

i) $\xrightarrow{H_3PO_4}$ A $\xrightarrow{LiAlH_4}$ B

ii) $\xrightarrow[CHD]{h\nu}$ A $\xrightarrow[\text{ii) Zn-Hg /HCl}]{\text{i) } CH_3COCl/AlCl_3}$ B

iii) $Ph-\underset{\overset{|}{H}}{\overset{\overset{OH}{|}}{C}}-C_2H_5$ $\xrightarrow[\text{ii) Ph COOH}]{\text{i) PPh}_3, \text{ DEAD}}$?
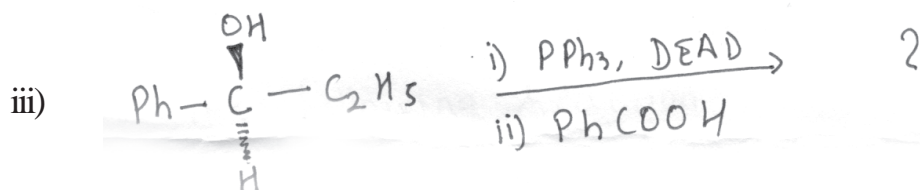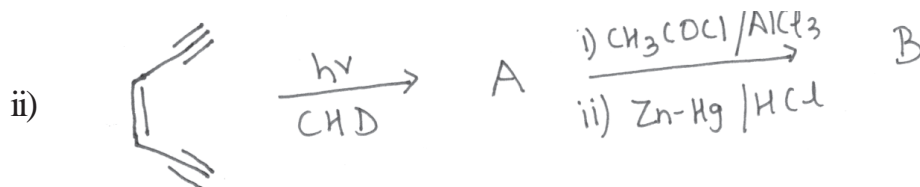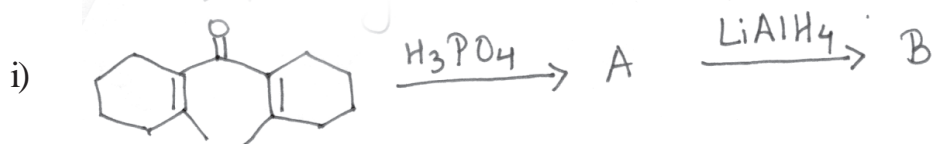
Q7) a) Write short notes on [6]

i) Baylis Hillman reaction

ii) Bis (isophenocam pheyl) borane

b) Predict the product for the following reactions. [6]

i) $\underset{H}{\overset{H_3C}{>}}C=C\underset{H}{\overset{CH_3}{<}}$ $\xrightarrow[\substack{\text{ii) CO, 125 C} \\ \text{iii) } H_2O_2/OH^-}]{\text{i) } B_2H_6}$?

ii) $\xrightarrow[\text{Catalyst}]{\text{Grubb's}}$ A $\xrightarrow{OsO_4}$ B

iii) $-SiMe_3$ $\xrightarrow[TiCl_4]{CH_3COCl}$?

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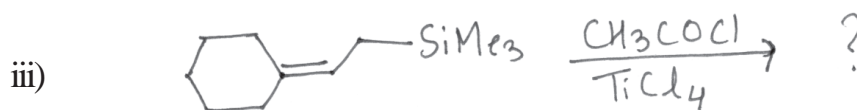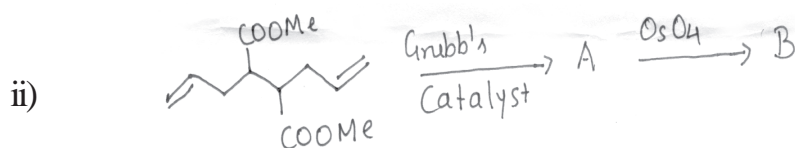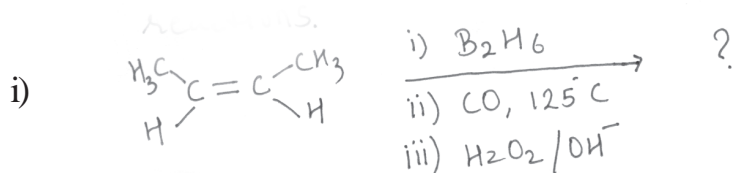
Q8) a) Solve the following: **[6]**

    i) Carry out the following conversion using organo silicon.

$$BuC\equiv C\text{-}H \longrightarrow BuC\equiv C\overset{\displaystyle O}{\overset{\|}{C}}CH_3$$

    ii) Predict the product and suggest the mechanism for the following reaction.

$$CH_3COSH + C_2H_5NH_2 + C_2H_5\overset{\displaystyle O}{\overset{\|}{C}}C_2H_5 + CH_3NC \rightarrow ?$$
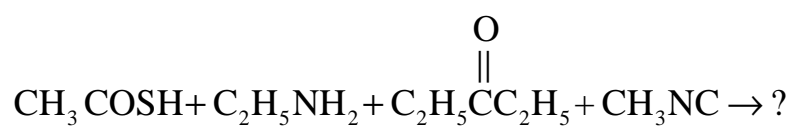
  b) Write short notes on **[6]**

    i) Grubb's second generation catalyst.

    ii) Hydrosilylation.

    iii) Isomerization of organoboranes.

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M.Sc. (Part - II)

CHEMISTRY

Organic Chemistry

CBOP-4 : CHO-452(A) : Concepts and Application of Medicinal Chemistry

(2019 Pattern) (CBCS) (Semester - IV)

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

Instructions to the candidates:

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

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

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

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

SECTION - I

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

       i)   What is drug?

       ii)   Write biological importance of folic acid.

       iii)   What is drug toxicity?

       iv)   What are peptides?

     b)   Explain biological functions of proteins.   **[3]**

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

     a)   Explain pharmacokinetics of drug.

     b)   Write note on TPP.

     c)   Explain modern drug discovery process.

     d)   Explain drug - receptor interactions.

P.T.O.

Q3) Answer the following (any three) : **[12]**

    a)   Explain enzymes are drug targets.

    b)   Explain journey of orally active drugs.

    c)   Explain the use of NMR in drug design.

    d)   Explain combinotarial and parallel synthesis.

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

    a)   Explain the concept of cofactors.

    b)   Explain importance of peptides in therapeutics.

    c)   Explain solution phase peptide synthesis.

    d)   Explain historical development of medicinal chemistry.

SECTION - II

Q5) a)   Attempt the following : **[3]**

    Draw the general structure of type-I statins. Explain their general mechanism of action.

    b)   Answer the following : **[8]**

        i)   What are tetracyclins?

        ii)   Explain : β-lactamase enzyme deactivates penicillin - G.

        iii)   What are antimetabolites?

        iv)   Write mode of action of chloramphenicol.

Q6) Attempt any four of the following : **[12]**

    a)   Write note on : Hansch analysis.

    b)   Discuss polyene antibiotics.

    c)   What are sulphonamides? Give their applications.

    d)   Explain : mode of action of cephalosporin - C

    e)   Explain : Acyclovir as prodrug.

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

　　a)　Write note on : physico-chemical parameters in drug design.

　　b)　Write SAR and Mode of action of Amphotericin - B.

　　c)　Write note on : Macrolides

　　d)　What are antiviral agents? Explain : Amantadine as an antiviral agent.

　　e)　Explain mode of action and applications of Rifamycins.

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

　　a)　Discuss selective toxicity of antibacterial agents with examples.

　　b)　Write note on : azoles

　　c)　Discuss atleast four requirements of a substance to be called an 'antibiotic'.

　　d)　Write note on : Quinines.

　　e)　What is partition coefficient? Explain its applications in drug design.

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M.Sc. (Part - II)
CHEMISTRY
Organic Chemistry
CBOP-4 : CHO-452(B) : Applied Organic Chemistry
(2019 Pattern) (CBCS) (Semester - IV)

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

Instructions to the candidates:

1) Q.1 and Q.5 are compulsory.

2) Attempt any two questions from Q.2 to Q.4.

3) Attempt any two questions from Q.6 to Q.8.

4) Answer to the two sections should be written in separate answer book.

5) Figures to the right indicates full marks.

SECTION - I

Q1) a) Draw the topology diagrams representing a general basis for COF design by using following symmetry in their building block monomers. **[4]**

     i) C_2 linear + C_2 square planer

     ii) C_4 + C_2 linear symmetry

   b) Explain the structure of 3D COF - 103, synthesized from monomer (X) by self condensation. **[4]**
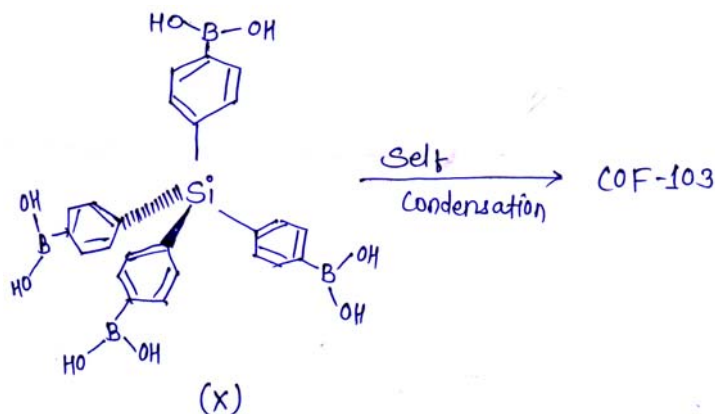
   c) Write a note on organic electroluminescence. **[3]**

Q2) Attempt the following :   **[12]**

   a) Give the typical examples of C_2, C_3, C_4 and Td symmetric monomers with adehyde functional groups for the synthesis of COFs.

   b) What is covalent organic frameworks? Explain properties of COFs.

   c) Explain different types of OLEDs.

Q3) Attempt the following :   **[12]**

   a) Write a note on fluorescent Depants.

   b) Write a note on organic Electro-luminescent materials possessing intra and inter molecular hydrogen bond interaction.

   c) Write a note on Hybrid MOF/COF structure with coordinative bonds and imine linkages.

Q4) Attempt the following :   **[12]**

   a) Explain significance of Boroxine and Boronic esters in COF synthesis.

   b) Give the difference between LCD and OLED.

   c) Explain role of transition metal complexes used in OLEDs.

SECTION - II

Q5) a) Explain non-covalent synthesis of supra-molecules.   **[4]**

   b) Explain spin switching in molecule switch.   **[4]**

   c) Write a note on light operated molecular Tweezers.   **[3]**

Q6) Attempt the following :   **[12]**

   a) Discuss the single molecule switch flipped on and off by light.

   b) What is supramolecular chemistry? Explain its advantages.

   c) Write a note on artificial molecular motors with example.

Q7) Attempt the following :   **[12]**

   a) Explain supramolecular chemistry of Boron containing organic molecule.

   b) Write applications of molecule switch.

   c) Explain artificial molecular machines.

Q8) Attempt the following :   **[12]**

   a) Explain the control of rotation in ferrocene complex through protonation.

   b) Explain the role of single molecule switch in biosensor.

   c) Discuss the Threading - Followed by stoppering approach.

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P-2464

[6063]-420

S.Y. M.Sc. (Analytical Chemistry)

CHA - 490 : ADVANCED ANALYTICAL SPECTROSCOPIC TECHNIQUES

(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

1)   Answer to the two sections must be written on separate answer books.

2)   Figures to the right indicate full marks.

3)   Use of calculator is allowed.

SECTION - I

Note : Question - 1 is compulsory. Solve any two questions from 2 to 4.

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

   i)   What is spectral interference in AAS analysis.

   ii)   What is the principle of RIS method?

   iii) Enlist the processes taking place in flame of flame atomizer.

   iv)   What is the difference between AAS and FES?

   v)   Why cathode lamp made up of same element being analysed is selected in AAS analysis?

   b)   Explain internal standard addition method with details of calculation for quantitative analysis by FES.   **[3]**

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

   i) Construction and working of premix burner.

   ii) Decomposition technique of solids by acid digestion method.

b) What is inductively plasma spectroscopy? What are advantages of this method over FES method? Explain construction and working of ICP torch. **[6]**

Q3) a) Write notes on the following : **[6]**

   i) Total sulfur analyser.

   ii) Hollow cathode lamp.

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

   i) What is spectrometer? Explain diffraction grating in detail.

   ii) Cu(II) in biological sample was analysed by AAS method. 10g sample was digested in acid, neutralized with alkali, filtered and diluted to 100ml. The sample showed absorbance 0.18. 5ml sample+5ml 6 ppm Cu (II) standard showed absorbance 0.42. Calculate mg of Cu (II) in 10g sample.

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

   i) LASERS as a source of radiation in AFS.

   ii) Forensic analysis of documents by ICP-MS method.

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

   i) Discuss the applications of AAS in chemical analysis.

   ii) Ca (II) in milk sample was analysed by AAS method. Series of standard 1, 2, 3, 4 and 5 PPM showed absorbance 0.14, 0.26, 0.41, 0.54 and 0.68. 1.0g milk powder was acid digested, neutralized and made 100 ml with water. Filtered sample solution showed absorbance 0.58. Calculate mg Ca^{2+} in 100g powder by calibration curve method.

SECTION - II

Note : Question - 5 is compulsory. Solve any two question from 6 to 8.

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

   i)   How element is identified by using X-ray photoelectron spectroscopy?

   ii)   Define the term fluorescence and phosphorescence.

   iii) CH_2OH free radical will consists of how many lines in ESR spectra and what will be the ratio of line intensities?

   iv)   Which of the following nucli is not ESR active? Why? ^1H, ^{14}N, ^{12}C.

   v)   Define the term quantum yield.

   b)   How intensies of lines in hyperfine ESR spectra of free radical with 4 equivalent protons with $I = ½$ are calculated? Draw the hyperfine ESR spectra of such free radical.   **[3]**

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

   i)   What is quenching of fluorescences? What is dynamic quenching and static quenching? Give stern - volmer equation.

   ii)   What is the difference between ESR and NMR transtions? Explain selection rules for ESR spectroscopy.

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

   i)   Characteristics of the photoelectron spectra.

   ii)   Explain any two factors affecting fluorescence and phosphorescene.

Q7) a) Write notes on : **[6]**

   i) Qualitative and quantitative analysis by XPS and AES.

   ii) Applications of ESR spectroscopy.

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

   i) Explain construction and working of X-ray gun for XPS analysis.

   ii) What is Chemiluminescence? Discuss applications of chemiluminescence.

Q8) a) What is hyperfine splitting in ESR? Why hyperfine splitting occurs in ESR spectra? Explain ESR spectra CH_2–CH_3 radical in detail. **[6]**

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

   i) Explain construction and working of fluorometer.

   ii) Zn^{+2} was analysed by fluorescence measurement. Zn^{+2} solution of 1PPM was used as standard. 5ml of this solution was extracted in CCl_4 in presence of 8-hydroxyquinoline and showed fluorescence intensity 12.4. Zinc solution stock (100 ml) is used as source zinc sample. 1-ml of this solution was diluted to 100 ml and treated similarly to standard. Calculate conc. of Zn stock solution if fluorescence intensity for sample is 16.3.

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P2465

[6063]-421

M.Sc.-II (Anylytical Chemistry)
CCTP-11-CHA-491 : CHEMICAL METHODS OF PHARMACEU-
TICAL ANALYSIS
(2019 Pattern) (Semester-IV)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:

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

2) *Use of logtable and calculator is allowed.*

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

SECTION-I

1) Solve any two questions from 2 to 4

2) Question-1 is compulsory.

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

     i) Define tablet Enlist the types of tablet.

     ii) What parental preparation.

     iii) Hydroxyl value.

     iv) Uniformality of weight of single close preparation.

     v) Define the cream.

   b) A 5.2 gm sample was subjected to saponification with 50 ml of alcoholic koH and it was titrated against 0.5N HCl with phenolphthalein as indicator it required 12.5 ml of It, if the blank value of alcoholic KoH was 50 ml of 0.5N HCl calculate the Saponification value of sample.   **[3]**

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

     i) Write a note on shelf life of pharmaceutical preparation.

     ii) Explain in detail dissolution test.

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

     i) Explain in detail limit test for Arsenic.

     ii) Explain in detail zone formation in agar diffusion assay.

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

     i) Differentiate between Gel and ointment.

     ii) Explain factors affecting on final cell count.

    b) Explain in detail Tube assay for growth promoting by vitamin. **[6]**

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

     i) Write a note on friability of un coated tablet.

     ii) Explain limit test for Iron.

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

     i) Write a note on particulate contamination.

     ii) Calculate the final to initial cell concentration when staphylococus aureus culture is in cubate at 30ºC for 180min.

SECTION-II

1) Questions-5 is compulsory.

2) Solve any two questions from 6 to 8

3) Figures to right indicate full marks.

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

     i) What are residual solvents? Give two examples of residual solvents.

     ii) Enlist the four methods used for the identification of pharmaceutical compounds.

     iii) What is the difference between foreign anion and anion as a part of pharmaceutical compound?

     iv) What is the basis of identification of pharmaceutical ingredient by LC method.

     v) What is Assay?

    b) 0.15 g ferrous fumarate (mol.wt. 169.9) was dissolved in 20 ml water and titrated against 0.1m ceric sulphate calculate percent purity and comment on the assay is passed or failed by the ferrous fumarate sample if Expected purity is 99 to 101%   **[3]**

Q6) a) Explain in detail. **[6]**

      i) Optical rotation method for the identification of pharmaceutical ingredient.

      ii) Non a queous titration method for the assay of pharmaceutical compound.

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

      i) What do you meant by API? Explain Uv spectroscopic method for the identification of paracetamol.

      ii) Omeprazole tablet was analysed by LC method. standard omeprazole was prepored by dissolving 12.13 mg pure omeprazole in 100ml mobile phase. For analysis 10 ml of this solution was further diluted to 100 ml which showed peak of area 108871.0.6 g tablet sample was similarly treated and showed peak area 109766. If tablet have average wt. 0.503 then calculate omepazole in one tablet.

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

      i) Elemental impurities and their method of analysis from the pharmacetutical preparation.

      ii) Determination of related substance by LC method.

   b) Write notes on the following: **[6]**

      i) Pharmacopoeia monograph.

      ii) Inorganic impurities in pharmaceutical preprasion and their identification.

Q8) a) Answer the following: **[6]**

      i) How sulphate and chloride is determined in pharmaceutical compound?

      ii) Explain the term uniformity in content of pharmaceutical dosage form with suitable example.

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

      i) Specific absorbance of paracetamol is 715. 20 tablet has Weight 11.264 g. from this power of 20 tablet 0.15 g was dissolved in 200 ml 0.05m NaOH. From this 1 ml sample was diluted to 100 ml with 0.01m NaOH. Absorbance of this sample was found to be 0.539 calculate amount paracetamol per tablet.

      ii) What is peroxide value? How it is determined? Give its importance.

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[6063]-422

M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CBOP-4 : CHA-492(A) : Laboratory Automation and Environmental Analytical Chemistry
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

1) Answer Q.No. 1 & 5 are compulsory. Solve any two questions from each section.

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

3) Figures to the right indicates full marks.

4) Use of logtable and calculators is allowed.

SECTION - I

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

 i)   Enlist any Four advantages of Automation.

 ii) What is Batch Flow Analysis.

 iii) What is parallel integration.

 iv) Enlist the optical sensors.

 v)   Give the types of calorimetric and optical sensors.

 b) Discuss the advantages and disadvantages of automation.   **[3]**

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

 i)   Batch and Continuous Flow Analysis.

 ii) Polymer Replication Technology.

 b) What is optical sensor and Explain Light Guides Sensor.   **[6]**

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

      i) Give the brief account of Biotransduction.

      ii) Surface Acoustic Wave Sensor.

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

      i) How would you design an Optical Biosensor to measure Glucose?

      ii) Flow Injection Analysis for Reproducible Sampling.

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

      i) Discrete Sample Analyser

      ii) Potentiometric Sensors

    b) Give principle and Basic Instrumentation of Flow Injection Analysis (FIA). **[6]**

SECTION - II

Q5) a) Solve <u>any four</u> of the following : **[8]**

      i) Define Salinity.

      ii) What are the sources of colour in waste water?

      iii) Define oxidant demand.

      iv) What is meant by BOD?

      v) Give specific example of each of the following

          A) Pesticides   B) Heavy metals

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

    100 ml of standard hard water required 48 ml of EDTA solution for titration upto end point. 100 ml of hard water sample required 30 ml of same EDTA solution. Calculate hardness if 1 ml standard hard water = 1.2 mg of $CaCO_3$ equivalent.

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

    i) Discuss the estimation of bromide by phenol red method.

    ii) Give an account of determination of Hydrocarbons from atmosphere.

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

    i) Explain the sources and health hazards of NO_x and NH_3.

    ii) 100 ml of an alkaline water sample required 6.0 ml of 0.02 HCl upto phenolphthalein end point and total 22 ml of same acid for complete neutralisation. Find the types and amounts of alkalinities in the water sample.

Q7) a) Discuss sampling of air samples. What are the sources and health hazards organohalide and organosulphur compounds? **[6]**

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

    i) Give an account of organic pollutants in waste water.

    ii) Discuss estimation of metal ions by FES technique.

Q8) a) Which are the methods used to estimate sulfide? Describe the methylene blue method. **[6]**

    b) i) Describe microwave assisted digestion. **[3]**

    ii) A 25 ml of waste water sample when treated with 20 ml $K_2Cr_2O_7$ solution, the unreacted dichromate requires 24 ml of 0.25N FAS. Under similar condition, for blank titration 30 ml of same FAS solution is consumed. Calculate the COD of waste water sample. **[3]**

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[6063]-422
M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CBOP-4 : CHA-492(B) : Analytical Chemistry of Agriculture, Polymer and Detergent
(2019 Pattern) (Semester - IV)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
1) *Answer Q. No. 1 & Q. No. 5 are compulsory. Solve any two question from each section.*
2) *Answers to the two sections must be written on separate answer books.*
3) *Figures to the right indicate full marks.*
4) *Use of logtable and calculators is allowed.*

SECTION - I

Q1) a)   Attempt the following (any four) :   **[8]**

         i)   Define Herbicides, pesticides and fungicides.

         ii)   Give loss on ignition method for determination of organic matter.

         iii)   Give the advantages of fertilizers.

         iv)   What is mean by exchangeable bases and base saturation.

         v)   Enlist clean-up techniques used for pesticides.

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

       0.385 gm of soil was analysed for nitrogen content by Kjeldhal's Method. The evolved ammonia was absorbed in 55 ml of 0.15N HCl, the remaining acid when back titrated with 0.15N NaOH gave burette reading of 16.4 ml. Then calculate % of Nitrogen.

       [Given : At. wt. N=14]

Q2) a) Attempt the following : [6]

   i) Write a note on weighing and dispensing error.

   ii) Give analytical method for organochlorine pesticide. Determination by GC.

   b) Attempt the following : [6]

   i) Explain in detail auto-analysis method for determination of total nitrogen in fertilizer.

   ii) Give method for determination of extractable phosphorus in soil.

Q3) a) Attempt the following : [6]

   i) Write a note on milling, grinding and homogenization.

   ii) Give method for 2% citric acid soluble phosphorus. (Thomas phosphate method).

   b) Solve the following : [6]

   Orthophosphate was determined by weighing as ammonium phosphomolybdate $(NH_4)_2PO_4. 12 MoO_3$. Calculate percentage of phosphorus and P_2O_5. If 1.673 gm precipitate was obtained from 0.328gm of sample.

   [Given : Atomic mass : Mo = 95.94, P = 30.97]

Q4) a) Attempt the following : [6]

   i) Give colorimetric method for determination of organic carbon.

   ii) Give general scheme for analysis of pesticide.

   b) Attempt the following : [6]

   i) Give analytical method for determination of calcium and magnesium by atomic absorption. Spectroscopy.

   ii) Explain in detail method for analysis of captafol by GC method.

SECTION - II

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

    i) Explain the term stress and strain.

    ii) Explain the term copolymers.

    iii) Define the following terms :

        A) Anionic surfactants and

        B) Cationic surfactants

    iv) Which reference compound is used in ^{1}H NMR spectroscopy. Give determination of chemical shift expression.

    v) Identify which all of the possible isomers that can result from the addition polymerization of butadiene.

  b) A polymer with a weight average chain length of 200 was found to have a melt viscosity of 100 poise. What is the viscosity of this polymer when the weight average chain length is 800? **[3]**

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

    i) What is amphoteric surfactant? Explain common types of amphoteric surfactants.

    ii) Explain the terms :

        A) Acid value

        B) Ester value and

        C) Saponification value
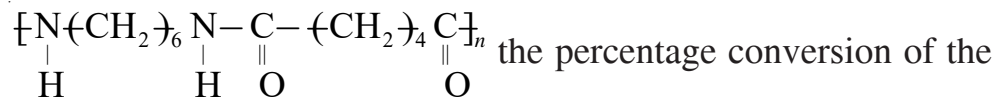
  b) Attempt the following : **[6]**

    i) Describe preliminary identification methods of polymers.

    ii) Describe end group analysis method for determination of molecular weight.

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

i) Describe the determination of elemental nitrogen from surfactant.

ii) Describe determination of mean molecular weight of alkane monosulphonates.

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

i) Draw the schematic of a typical laser Raman Spectrometer. Describe use of Raman spectroscopy for identification of polymers.

ii) For a polyamide with the structural repeat unit

$$\left[N(CH_2)_6 \, N - C - (CH_2)_4 \, C \right]_n$$
$$\quad | \qquad\qquad | \quad \| \qquad\qquad\qquad \|$$
$$\quad H \qquad\qquad H \quad O \qquad\qquad\qquad O$$

the percentage conversion of the groups was found to be 96%. Calculate the number and weight average molecular weights of this polymer.

[Given : mol. wt. of repeat unit is 220 gm mol^{-1}]

Q8) a) Attempt the following : **[6]**

i) Explain Creep test for viscoelastic behaviour.

ii) Discuss injection moulding and Extrusion processing method for thermoplastics.

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

i) Discuss the determination of molecular weight and total, primary, secondary and tertiary ammine contents of fatty amines.

ii) The density and associated crystallinity data for two polypropylene samples as follows :

Density (g cm^{-3})	% Crystallinity
0.904	62.8
0.895	54.4

Determine the density of a sample having 74.6% crystallinity.

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