[5830]-101
M.Sc.
PHYSICAL CHEMISTRY
CHP 110 : Fundamentals of Physical Chemistry - I
(2019 Pattern) (Semester - I)

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, claculator is allowed.*
6) *Neat diagrams must ber drawn wherever necessary.*

Physico-Chemical Constants

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

SECTION-I

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

    i) Give the conditions for well behaved function.

    ii) What is colligative property? Name the colligative properties.

    iii) Write an equation of de Broglie hypothesis and explain the terms in it.

    iv) What is Clausius inequality?

    v) Differentiate between valence bond theory and Molecular Orbital Theory.

  b) Calculate the Gibb's free energy of mixing when 2 moles of CO_2 and 3 moles of N_2 are mixed at 500K. **[3]**

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

    i) What is Black Body Radiation? Explain its any one application.

    ii) What is chemical potential? Derive an expression to determine the chemical potential.

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

    i) Calculate the concentration of urea $\left(\begin{array}{c} H_2N-C-NH_2 \\ \| \\ O \end{array} \right)$ that has osmotic pressure of 30 atm at 300 K.

    ii) Calculate the energy of light in Joules having $\lambda = 450$ nm.

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

    i) Explain the experimental evidence of Heisen berg uncertainty principle.

    ii) What is partial molar volume? Explain any one method of determination of partial molar volume.

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

    i) Derive an expression for the determination of entropy of mixing.

    ii) A cathode in a photovoltic cell has threshold wavelength of 2300Å. It is irradiated by UV of 180nm. Calculate the energy of emitted electron.

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

i) Explain the hybridisation, geometry and type of bonding in PCl_5 with the help of valence bond theory.

ii) Explain the variation of vapour pressure with change in the mole fraction when two liquids are mixed.

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

i) Calculate the mass of the particle having uncertainty in position and velocity as 10^{-9} m and 2×10^{-14} ms^{-1}.

ii) Explain Hückel theory for 1,3 butadiene.

SECTION-II

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

i) Define order of reaction. Obtain the unit of rate constant of second order reaction.

ii) Give the different steps involved in chain reactions.

iii) Distinguish between flow technique and stoppered-flow technique.

iv) Explain the effect of temperature on enzyme catalysed reactions.

v) What are the main postulates of Fermi-Dirac Statistics?

b) The rate constant of the first order reaction is 2.5×10^{-16} sec^{-1} and initial concentration of reactant is 1.0 m. Calculate the rate of reaction in mole cm^{-3} sec^{-1}. **[3]**

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

i) Explain the contineous flow method to study the fast reaction.

ii) What is steric factor? Explain, how it is determined by Collision theory?

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

i) Discuss the diffusion controlled reaction in solution.

ii) Specific reaction rate of a reaction increases four times, if the temperature is increased from 27°C to 47°C. Calculate the energy of activation.

Q7) a) Answer the following: [6]

  i) Explain the term 'Pre-equilibrium approximation' with suitable example.

  ii) What are parallel and consecutive reactions? Give it's suitable examples.

 b) Derive the Michaelis-Menton equation for enzyme catalysed reaction.[6]

Q8) a) Derive the expression for translation partition function. [6]

 b) Answer the following: [6]

  i) Describe the relaxation technique used to study the fast reaction.

  ii) Calculate the translational partition function of a hydrogen molecule confined to a 100 cm^3 vessel at 25ºC [Given: mass of H_2 = 2.016 amu]

$$\bigstar\,\bigstar\,\bigstar$$

SEAT No. :

[**Total No. of Pages : 3**

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M.Sc. - I

INORGANIC CHEMISTRY

CHI - 130 : Moleculor 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 books.*

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

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

SECTION-I

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

    i)   Mention the symmetry elements, order and classes of C_3V point group.

    ii)   Using matrix multiplication method find $\hat{i} \times \hat{6} = ?$

    iii) Assign the PCl_5 molecule into appropriate point group justify it.

    iv) What is the point group symmetry of square and reactangle.

  b)   Derive the character table for C_2V point group using great orthogonality theorem.   **[3]**

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

    i)   Show that AB_3 molecule belong to C_3V symmetry possesses A_1 and E symmetry orbitals of B atoms using the reduction formula and character table of C_3V point group.

C_3V	E	$2C_3$	$3\sigma V$
A_1	1	1	1
A_2	1	1	−1
E	2	−1	0
C_3V	E	$2C_3$	$3\sigma V$
Γ_B	3	0	1

P.T.O.

ii) Find out the normolized SALC using projection operator of $^1A_1$ irreducible representation on σ_1 orbital of BF_3 molecule.

D_3h	E	$2C_3$	$3C_2$	σh	$2S_3$	$3\sigma V$
$^1A_1$	1	1	1	1	1	1

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

i) Define and explain symmetry elements and symmetry operations with the help of suitable examples.

ii) Explain with appropriate sketches different types of planes in $[Ni(CN)_4]^{-2}$ complex ion.

iii) Give the general matricess for the

1) E

2) i

3) σxy symmetry operations.

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

i) What are the conditions of a mathematical group? Show that C_2V forms a mathematical group.

ii) For a tetrahedral molecular ion $[MnCl_4]^{-2}$. Find out reducible representation for which sigma bonds form the basis and find out which orbitals from central atom will be offered for sigma bonding.

Td	E	$8C_3$	$3C_2$	$6S_4$	$6\sigma d$		
A_1	1	1	1	1	1	-	$x^2+y^2+z^2$
A_2	1	1	1	-1	-1	-	
E	2	-1	2	0	0	-	$(2z^2-x^2-y^2, x^2-y^2)$
T_1	3	0	-1	1	-1	(Rx, Ry, Rz)	-
T_2	3	0	-1	-1	1	(x,y,z)	(xy,xz, yz)

b) Attempt <u>any two</u> of the following. **[6]**

i) Draw possible isomers of $[M(A\text{-}A)_2b_2]$ complex. Explain which isomer is optically active.

ii) How do you distinguish between Cnv and Cnh point group.

iii) Using molecular symmetry, give the product of σ_v^1 and σ_v^2 operation in NH_3 molecule.

SECTION-II

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

    i) Give the classification of the binary hydrogen compounds with examples.

    ii) Solutions of alkali metals in non-aqueous media are used as reducing agents. Explain.

    iii) What are pseudohalogens? Explain with examples.

    iv) Give the reactions for the synthesis of Xenon Fluorides.

  b) Give the synthesis and physical properties of borazine. **[3]**

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

    i) Write a note on carboranes and metalloboranes.

    ii) Give an account of oxyacids and oxoanions of sulpher.

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

    i) Write a note on electron precise hydrides.

    ii) How the alkali metals are separated by using crown ethers. Explain in detail.

    iii) Give an account of interhalogen compounds.

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

    i) Write a note on carbon nanotubes with respect to classification, synthesis, properties and applications.

    ii) Write a note on PN and SN compounds.

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

    i) Write a note on activation of nitrogen.

    ii) Give the synthesis and reactions of Xenon oxides.

    iii) Give the synthesis and reactions of organolithium compounds.

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M.Sc. - I

ORGANIC CHEMISTRY - I

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 questions from Q.6 to Q.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)   Attempt the following.   **[9]**

          i)   Comment on Antiaromaticity.

          ii)   Explain synthesis of pyrrole by using 1,4 diketone.

          iii)   Pyridine does not undergo electrophillic substititution Reaction easily. Explain.

      b)   Define enatiomer and distereomers.   **[2]**

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

      a)   Draw all possible conformational isomers of 1, 3 dimethyle cyclohexane.

      b)   Explain with suitable example aromaticity in Annulenes.

      c)   Assign E/Z designation to the following.
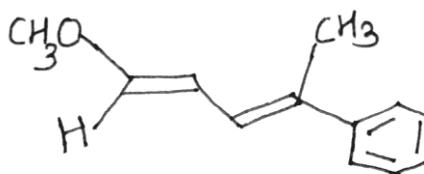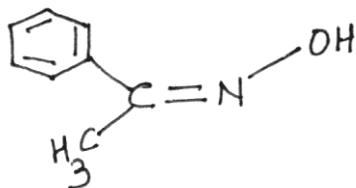
d) Assign Re and Si face labels to the followings.
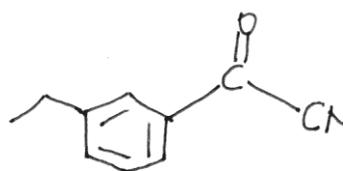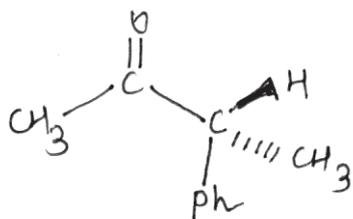
e) Write the mechanism for following reaction and Justify your answer.
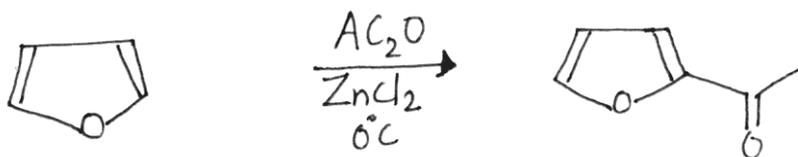
*Q3*) Attempt any four of the following. [12]
   a) Comment on the optical activity of spiranes.
   b) Electrophillic substitution Reaction on Imidazole takes place at 2- position. Explain.
   c) Assign R/S configuration to the following. Compound and Justify your answer.

   i)

   ii)
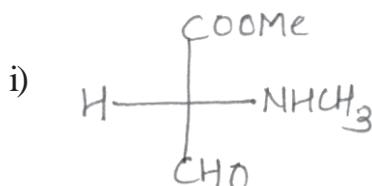
   d) Comment on optical activity of the following. Justify.
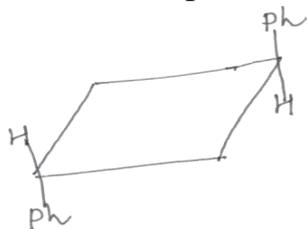
   e) Comment on the stability of the following.
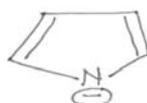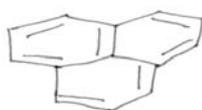
Q4) Attempt any four of the following. [12]
  a) Write note on : Stereospecific Reactions.
  b) Write note on : Huckel's Rule.
  c) Assign Pro-R and Pro - S labels to H_A & H_B.

  i)

  ii)
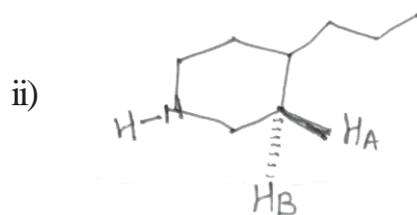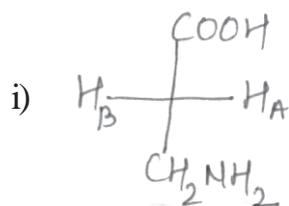
  d) Convert Fisher projection to Newmann Projection as shown.
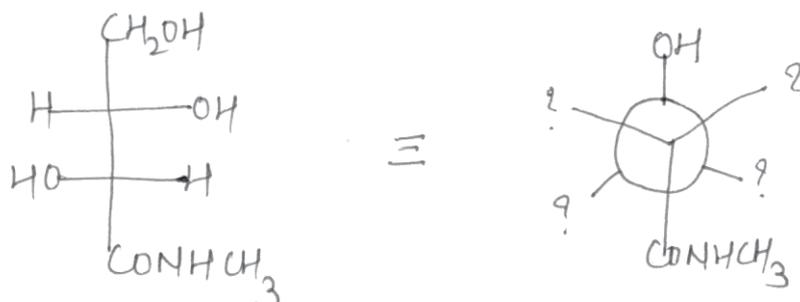
  e) What is the stereochemical reletionship between the following compounds. Justify.
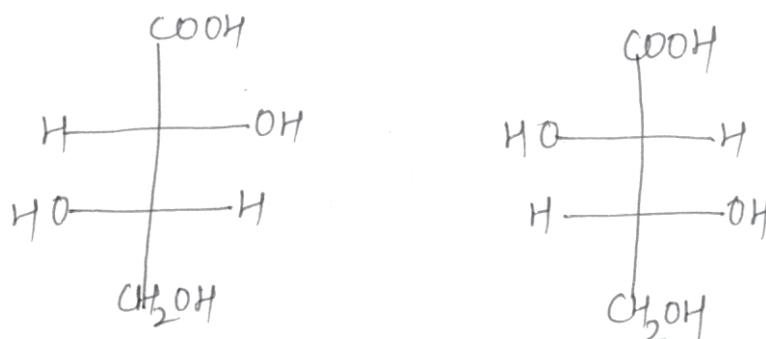
SECTION - II

Q5) a) Attempt the following: [9]
  i) Explain structure and stability of carbocation.
  ii) Describe the use of Fries Rearrangement in Organic Synthesis.
  iii) What is Nitrogen ylides? Explain the preparation methods for Nitrogen Ylides.

b) Write any two Applications of   **[2]**

   i)   PDC

   ii) KMnO$_4$

Q6) Attempt any four of the followings.   **[12]**

   a)   Write Note on : Pinacol - Pinacolone Rearrangements.

   b)   Write Note on : Wolff - Kishner Reduction.

   c)   Predict the products & Justify your answer.
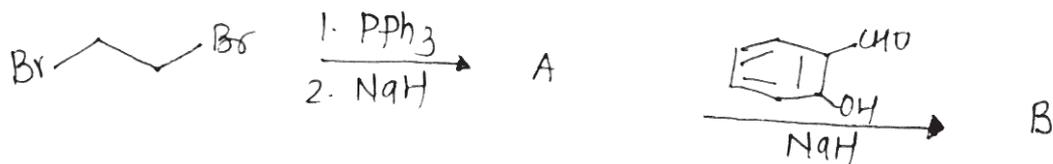
   d)   Predict the products & Justify your answer.
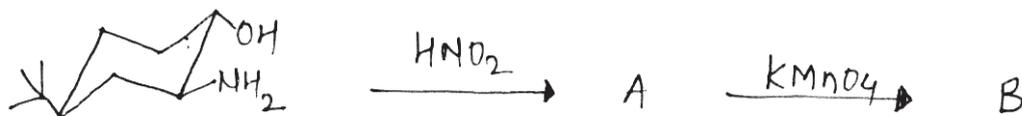

   e)   Explain NGP of Pi - compounds with suitable example.

Q7) Attempt any four of the following.   **[12]**
   a)   Explain the uses of Boranes in organic synthesis.
   b)   Comment on Neighbouring group participation.
   c)   Write the mechanism and Justify your answer.
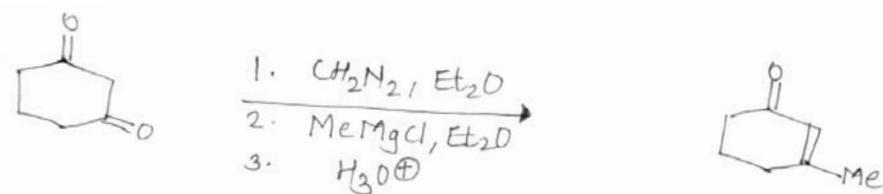
   d)   Write the mechanism and Justify your answer.
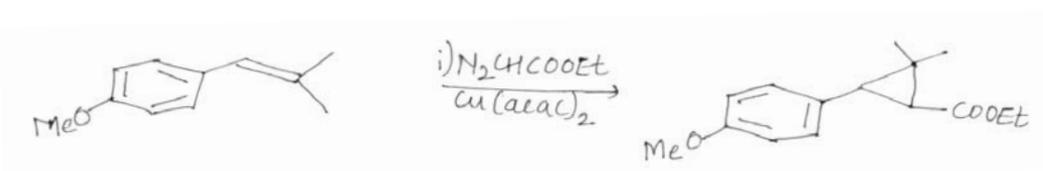
   e)   Cis 2-amine cyclohexanol on reaction with nitrous acid gives only a single product, while its trans isomer gives two products. Explain?

Q8) Attempt any four of the followings. [12]

a) Describe curtius Rearrangements with suitable example.

b) Explain any one method for the synthesis of alpha - hydroxy ketones.

c) Write the synthesis of Nitrenes with suitable example.
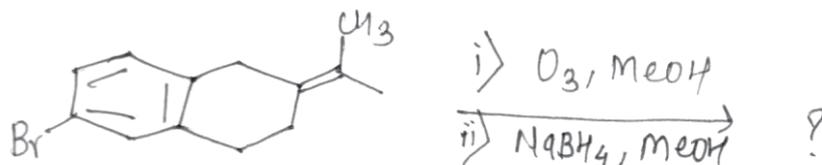
d) Predict the products and suggest the mechanism.

i) O_3, MeOH

ii) $NaBH_4$, MeOH ?

e) Predict the products and suggest the mechanism.

$\dfrac{NaOH/Br_2}{H_2O}$?
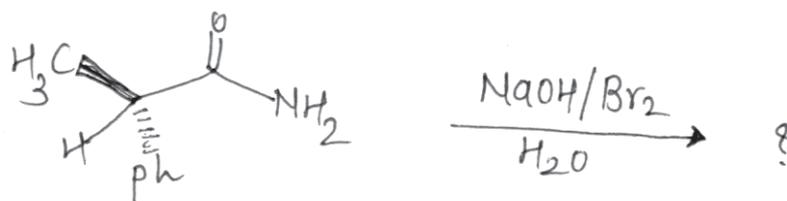
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M.Sc. - I

CHEMISTRY

CHG-190 : Introduction to Solid State of Matter

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

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

Instructions to the candidates:

1) *Question 1 is compulsory.*
2) *From Q.2 to Q.4, solve any two.*
3) *Q.2, to 4 carry equal marks.*
4) *Figures to the Right side indicate full marks.*

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

   i)   What is the difference between 'n' and 'p' type of semiconductor?

   ii) What is silsbee effect?

   iii) Define schottky and frenkel defect.

   iv) What are solid electrolytes? Give two examples.

   v)   What are non-stoichiometric compounds? Give example.

   b) Explain mechanism of ionic conductivite in solids.   **[3]**

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

   i)   Hydrothermal method for synthesis of solids.

   ii) Sol-gel method for synthesis of solids.

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

   i)   Write note on oxygen sensor.

   ii) What is colour centre? Explain 'F' and H centre.

Q3) a) What are metals, semiconductors and insulators? on the basis of MOT explain conductivity in metals, semiconductors and insulators. **[6]**

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

   i) Write note on superconductivity.

   ii) Explain semiconductivity in Gallium Arseride by using MoT.

Q4) a) What are defects in crystal structure? What are non-stoichiometric defects Explain non-stoichiometry in Tio. **[6]**

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

   i) Explain bonding in solids and electrical conductivity on the basis of free electron theory.

   ii) Explain synthesis of gold nanoparticles.

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M.Sc. - I
GENERAL CHEMISTRY
CHG-190 : Mathematics for Chemists
(2019 Pattern) (Semester - I) (Elective Option-B) (2 Credits)

Time : 2 Hours] [Max. Marks : 35
Instructions to the candidates:
1) *Question 1 is compulsory.*
2) *From Q.2 to Q.4, carry equal marks.*
3) *Solve any two questions from 2 to 4.*
4) *Figures to the Right side indicate full marks.*

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

    i) What is scalar triple product?

    ii) What is a diagonal matrin?

    iii) Find the order of the following.

$$\text{matrin} \begin{bmatrix} -1 & 0 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 0 & 3 & -2 & 4 \end{bmatrix}$$

    iv) Write any two rules of partial differentiation.

    v) What is the derivative of $\csc x$?

  b) Explain Taylor and Mclaurin theorem. [3]

Q2) a) Solve the following. [6]

    i) Find the differential coefficient of the following function.

    $y = \log \log \log x$

    ii) Find the differential coefficient of the following function.

    $y = (2x + 3)^{x+5}$

  b) Find the inverse of the matrix A. [6]

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

Q3) a) Solve the following. [6]

     i) If $x = \dfrac{1+t^2}{1-t^2}$ and $y = \dfrac{1-t^2}{1+t^2}$ find $\dfrac{dy}{dx}$.

     ii) Find the maximum and minimum values of $x^3 - 3x^2 - 9$

   b) Evaluate the following integrals [6]

     i) $\int x e^x dx$

     ii) $\int \dfrac{dx}{(x-a)(x-b)}$

Q4) a) Solve the following. [6]

     Evaluate by substitution method.

     i) $\int (ax+b)^{10} dx$

     ii) $\int \sqrt{ax+b}\, dx$

   b) Define the following. [6]

     i) Determinant

     ii) Conjugate point

     iii) Node

     iv) Indefinite integral

     v) Scalar

     vi) Transpose

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M.Sc. - I
GENERAL CHEMISTRY
CHG-190 : Introduction to Chemical Biology-i
(2019 Pattern) (Semester - I) (Elective Option-C) (2 Credits)

Time : 2 Hours]   *[Max. Marks : 35*
Instructions to the candidates:
1) *Question 1 is compulsory.*
2) *From Q.2 to Q.4, carry equal marks.*
3) *Slove any two Questions from 2 to 4.*
4) *Draw diagram wherever necessary.*

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

     i) How is prokaryotic cell structure different from eukaryotic cell?

     ii) What are amphi pathic lipids? How do they behave in water?

     iii) What are the biological significance of carbohydrate?

     iv) Explain titration curve of amino acid.

     v) What is a concise definition of proteomics? Why is proteomics so important.

   b) Discuss protein quaternary structure with function. [3]

Q2) Answer the following questions. [6]

   a) Define and classify carbohydrates with suitable example.

   b) Solve the following.

     i) Discuss the factors affecting membrane fluidity. [3]

     ii) Write a note on phospholipids. [3]

Q3) Attempt the following questions. **[6]**

a) Discuss in detail secondary and supersecondary structure of proteins with examples.

b) Solve the following.

   i) Define facilitated diffusion Explain with suitable example. **[3]**

   ii) What do you mean by Rancidity of lipids? Explain with example.**[3]**

Q4) Solve the following questions.

a) Comment on structure and functions of different organelles of Eukaryotic cell. **[6]**

b) i) What are essential and non-essential amino acids? Draw the structures of essential amino acids. **[3]**

   ii) Describe in brief pinocytosis and phagocytosis. **[3]**

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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) *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, claculator is allowed.*
6) *Neat diagrams must ber 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	$= 8.314 \times 10^{7}$ erg K^{-1} mol^{-1}
			$= 8.314$ J K^{-1} mol^{-1}
			$= 1.987$ cal K^{-1} mol^{-1}
7)	Faraday Constant	F	$= 96487$ C equiv^{-1}
8)	Speed of light	c	$= 2.997 \times 10^{10}$ cm s^{-1}
			$= 2.997 \times 10^{8}$ m s^{-1}
9)	1 cal		$= 4.184 \times 10^{7}$ erg
			$= 4.184$ J
10)	1 amu		$= 1.673 \times 10^{-27}$ kg
11)	Bohr magneton	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. **[8]**

    i) Classify the molecules on the basis of their moments of inertia

        HCl, H_2O, $CHCl_3$ and BF_3.

    ii) What are the selection rules for vibrational transitions in simple harmonic oscillator and anharmonic oscillator?

    iii) What are the criteria for a molecule to be infra-med active and Raman active?

    iv) Define : predissociation.

    v) Which of the molecules show quadrupole splitting in mossbaver spectroscopy?

        IF_6^+, IF_6^-, TeF_6^- and XeF_4

  b) Solve the following. **[3]**
Calculate the positions of the fundamental mode of vibration and first overtone of CH_3Cl if the vibrational frequency and anharmonicity constant are 200 cm^{-1} and 3.5×10^{-3} respectively.

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

    i) How many normal modes of vibration does the infra-red spectrum of CO_2 show? Draw the atomic displacement for each mode of vibration.

    ii) Discuss Franck-Condon principle and its application in electronic spectroscopy.

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

    i) Explain the principle of Mossbover spectroscopy

    ii) The first line in rotational spectrum of $^1H^{35}Cl$ at 21.18cm^{-1} Calculate the bond length of $^1H^{35}Cl$.

Q3) a) Explain the operation of Frank-Condon principle for internuclear distance upper (r') and lower case (r'') **[6]**

    i) r' = r''   ii) r' > r''

    iii) r'<r''   iv) r' >> r''

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

i) Explain the occurence of Stokes and anti-stokes lines with respect to quantum theory.

ii) Calculate the population of an excited non-degenerate energy level at 25ºC if the energy separation between the excited state and ground state are

1) 4.3×10^{13} Hz   2) 254µm

The population of the ground state energy level is 100000

Q4) a) Explain Raman effect using classical and quantum theoreis. **[6]**

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

i) Explain the order of the isomeric shift in Mossbaver spectra of iron compounds as Fe(II) , Fe(III) and Fe(IV)

ii) The vibrational spectrum of Na_2 given $\bar{v}_e = 153.125 \text{cm}^{-1}$ and $\bar{v}_e \bar{x}_e = 0.7255 \text{cm}^{-1}$ calculate the vibrational energy level where dissociation takes place.

SECTION-II

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

i) What is half life & mean life in radioactivity?

ii) Define the terms tracks and spurs.

iii) What is neutron evoporation?

iv) Write the equation for the natural preparation of tritium.

v) Explain the medical application of radioisotope with one example.

b) Calculate the thickness of Zn(Z=30, A=64) plate required to reduce the level of radiation from 1.2Gy/min to 1.2mGy/hr. **[3]**

(Given : eµ = 0.211 b/e. density of Zn = 7.1 9cm$^{-3)}$

Q6) a) i) Define curie. **[3]**

Find out value in dps if $t_{\frac{1}{2}} \left(\overset{226}{Ra} \right) = 1600\,yr.$

ii) Write a note on fricke dosimetry. **[3]**

b) i) Write a note on neutron evaporation & spallation. **[3]**

ii) Discuss the Szilard- Chalmer's reaction. **[3]**

Q7) a) Explain the following radioisotope application of the physico-chemical problem as. **[6]**

i) The Solubility of a sparingly soluble substance.

ii) The surface area of a powder or precipitate.

b) i) 87.5% at a radioactive substance disintegrates in 40 minutes. What is the half life of the substance. **[3]**

ii) Write a note on Geiger-nuttal's law. **[3]**

Q8) a) i) What is linear absorption coefficient, Mass absorption coefficient and Atomic absorption coefficient? **[3]**

ii) Find the biologically effective close in sieverts and in rem for a radiation dose of 0.6 Gy due to α particles. **[3]**

b) i) Explain the following medical application in radioactivity : Assessing the volume of blood in a patient. **[3]**

ii) Given the filiation relation. **[3]**

$$^{140}Ba \xrightarrow[12day]{\beta^-} {}^{140}La \xrightarrow[10hr]{\beta^-} {}^{140}Ce$$
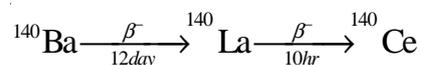
Find the activity due to ^{140}Ba at the end of 24 hr, if we had pure ^{140}βa only initially with an activity of 2000 disintegrations per seconds. **[3]**

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Total No. of Questions : 6]

P318

SEAT No. :

[**Total No. of Pages : 5**

[5830]-202
M.Sc.-I
CHEMISTRY
CHI-230 : Coordination and Bioinorganic Chemistry
(2019 Pattern) (Semester - II) (New 4 - Credits)

Time : 3 Hours]   *[Max. Marks : 70*
Instructions to the candidates:
   1)   *All questions are compulsory.*
   2)   *Answer to the two sections should be written in separate answer book.*
   3)   *Neat and labelled diagrams must be drawn whenever necessary.*
   4)   *Figures to the Right side indicate full marks.*

Given : Atomic number; Ni=28, Ce=58, Mn = 25 Fe=26

SECTION-I

Coordination Chemistry

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

    i)   Give ground state term symbol for the following ions.

       1) Ni^{2+} 2) Ce^{+3}

    ii)   State three Hund's rules to determine Ground state term symbols.

    iii)   Calculate total degeneracy of the following terms/state/ configurations.

       1) $2p^1 2d^1$ 2) ^3H

    iv)   Give the spin-only magnetic moment and spectroscopic ground state term symbol of manganese centre in $[MnF_6]^{3-}$ ion.

  b)   Write a note on charge transfer spectra_____.   **[3]**

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

    i)   Derive the allowed R-S term and hence prepare a table of microstates for np^2 configuration. Find out ground state R-S term.

    ii)   Describe in brief orgel diagram for F ground state term.

P.T.O.

b) Answer Any Two of the following. [6]

i) Assign the spin multiplicities to the state arising for $(t2g)2$ configuration in infinitely strong field is relaxed to string field using Bethes' method of descending symmetry coorelation table and direct product.

ii) Calculate effective magnetic moment for $[Ni(H_2O)_6]$ SO_4 complex.
Given , $\lambda = - 320$ cm^{-1}, $Dq = 850$ cm^{-1}

iii) Write a note on luminescence sepctra.

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

i) Give the splitting of ^4F R-S term in weak cubic field using character table for pure rotational point group 'O' and reduction formula.

ii) For a complex three absorption bands are observed at 7730 cm^{-1}, 12972 cm^{-1} and 24,040 cm^{-1} Calculate Δo and Racah parameter comment on nature of M-L bond.

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

i) Predict the expected electronic transition in $[FeCl_4]^{2-}$

ii) Classify the following transitions as vibronically allowed, orbittaly allowed and forbidden in an Octahedral complex justify your answer.

1) $A_2g \rightarrow A_1g$ 2) $Eg \rightarrow Eg$

iii) How would you account for the magnetic moment listed against each of the following complases.

1) $[CO(H_2O)_6]$ SO_4 $\mu_{est} = 5.1$ BM

2) $[Fe(CN)_6]^{3-}$ $\mu_{eld} = 2.40$ BM.

SECTION-II

Q4) a) Answer the following. [8]

i) Explain the roel of potassium in biological system.

ii) Which metal ion's of d-block are present in biological system.

iii) Explain the outer sphere electron transfer in metal complexes.

iv) What is chelate effect?

b) With the help of example show how metal ions affect the pka of the ligand. [3]

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

    i) What are model complexes? Explain the types of model complexes and concept of spontanous self assembly.

    ii) What is hydrolytic enzyme? Explain the types of hydrolytic enzyme.

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

    i) Explain types of substitution reaction in metal complexes.

    ii) Explain geometries and oxidation state of metal ion in biological system.

    iii) Explain inner sphere electron transfer in metal complexes with suitable example.

Q6) a) Answer <u>any one</u> of the following. [6]

    i) Explain the role of manganese in photosystem - II

    ii) What are metalloenzyme? Explain how chemical transformation occures in the substrate upon action of metalloenzyme.

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

    i) Write note on transferrin

    ii) Write note on iron sulfur cluster

    iii) Explain two pair electron transfer metalloprotein with suitable example.

Direct Product

1. **Group of the form G x i or G x σh**
   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 x A, B x B, A x 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 x E, B x 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 x 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		
E	2	0	2	-1	0		$(2z^2-x^2-y^2,$ $x^2-y^2)$
T_1	3	1	-1	0	-1	$(R_x,R_y,R_z);(x,y,z)$	
T_2	3	-1	-1	0	1		(xy,xz,yz)

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	A_g
A_2g	A_2	A_2	B_1g	B_1	B_1	A_2	A_2g	A_2	B_g
E_g	E	E	A_1g+B_1g	A_1+B_1	A_1+B_1	A_1+A_2	E_g	E	A_g+B_g
T_1g	T_1	T_1	A_2g+E_g	A_2+E	A_2+E	$A_2+B_1+B_2$	A_2g+E_g	A_2+E	A_g+2B_g
T_2g	T_2	T_2	B_2g+E_g	B_2+E	B_2+E	$A_1+B_1+B_2$	A_1g+E_g	A_1+E	$2A_g+B_g$
A_1u	A_1	A_1	A_1u	B_1	A_2	A_2	A_1u	A_1	A_u
A_2u	A_2	A_1	B_1u	A_1	B_2	A_1	A_2u	A_2	B_u
E_u	E	E	A_1u+B_1u	A_1+B_1	A_2+B_2	A_1+A_2	E_u	E	A_u+B_u
T_1u	T_1	T_2	A_2u+E_u	B_2+E	A_1+E	$A_1+B_1+B_2$	A_2u+E_u	A_1+E	A_u+2B_u
T_2u	T_2	T_1	B_2u+E_u	A_2+E	B_1+E	$A_2+B_1+B_2$	A_1u+E_u	A_1+E	$2A_u+B_u$

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[5830] - 203

M.Sc. - I

ORGANIC 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) *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) *Answers to the two sections should be written in seperate answer books.*
4) *Figures to the right indicate full marks.*

SECTION - I

Q1) A)   Predict the products with exact stereochemistry. Justify your answer.**[8]**

a)

(vapour phase)

b)

c)

d)
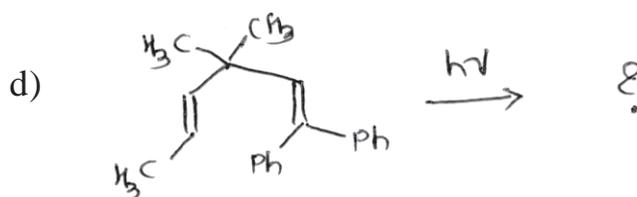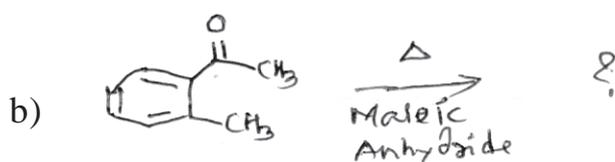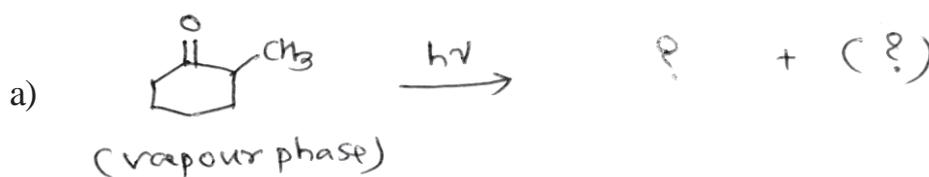
B)   Write a note on 'Barton Reaction'.   **[3]**

Q2) A) Attempt any three of the following. [9]

a) Explain 'Norrish - I' reaction with suitable examples.

b) Predict 'A' and 'B' in following reaction. Clearly mention stereochemistry and justify.
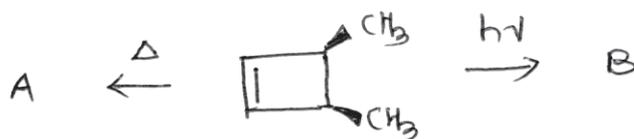
c) Explain the formation of product in following reaction.

d) Explain the formation of product in following reaction.
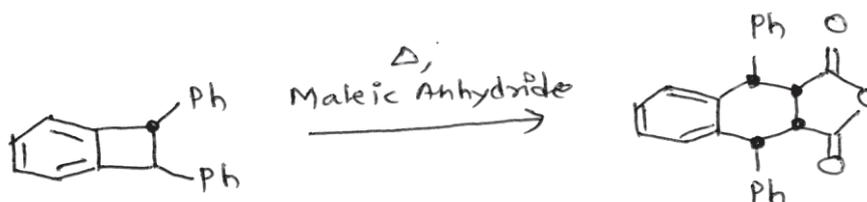
B) Suggest the suitable mechanism for following reaction. Justify your answer.
[3]
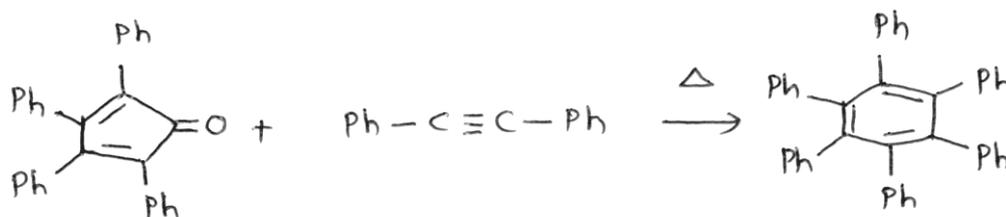
Q3) A) Attempt any three of the following. [9]

a) What are sigmatropic reactions? Explain with any two examples.

b) Using FMO approach, predict whether [2+2] cycloaddition reacction is thermally or photochemically allowed.

c) Write stepwise mechanism for following reaction.
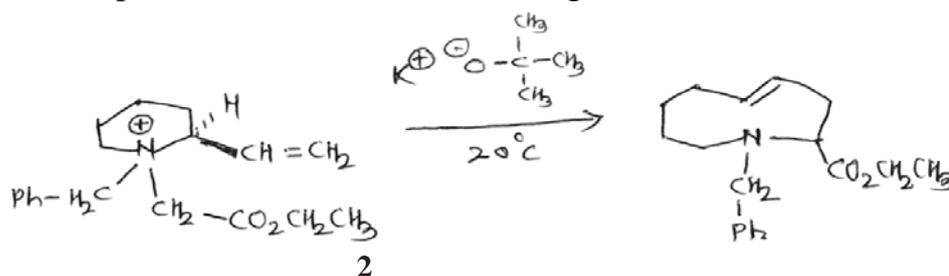
d) Identify the type of following reaction. Justify your answer.
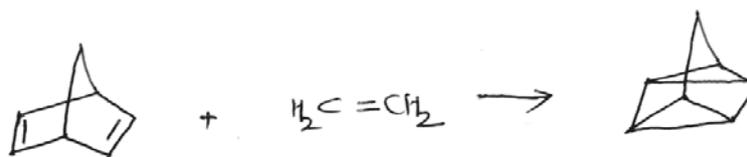
B) Explain McLafferty reaction with suitable examples. [3]

Q4) A) Attempt any three of the following. [9]
   a) Explain 1, 3 - dipolar reactions with suitable examples.
   b) Write a note on ' Ene reaction'.
   c) Write the detailed mechanism for the following reaction.

   d) Explain the formation of product in following reaction.
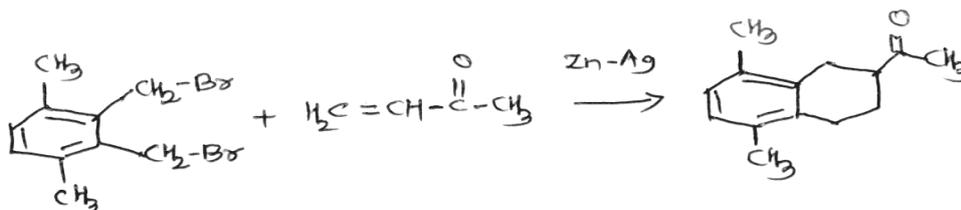
B) Explain Claisen reaction with suitable examples. [3]

SECTION - II

Q5) A) Attempt the following: [8]
   a) State the integration ratio for following compounds in ^{1}HNMR.
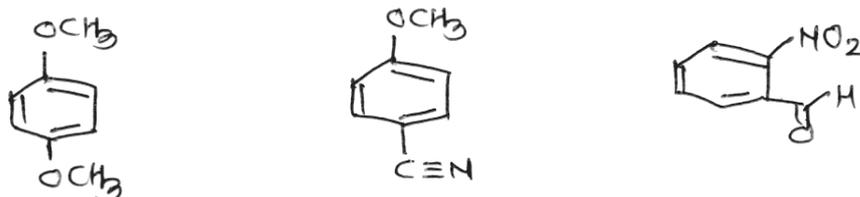
   b) Calculate X max for following compound.
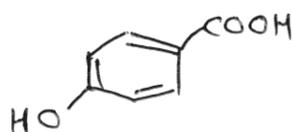
c)   Explain the genesis of peaks in following compound.
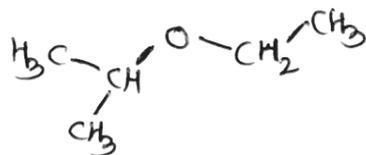
d)   Compound with molecular formula $C_4H_8O_2$ shows only singlet at 3.69 ppm. It shows one line at 67 ppm in 13C. NMR. Deduce the structure.

B)   Write a note on spin-spin coupling in ^1H - NMR.   **[3]**

Q6) A)   Attempt any three of the following.   **[9]**

a)   How will you follow following reaction conversions using IR spectroscopy?
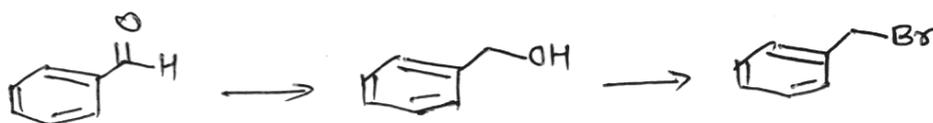
b)   Using 500 MHz NMR machine.

i)   How many Hz down field from TMS is a signal at 2.5 ppm?

ii)   If a signal comes at 1200 Hz downfiled from TMS at what ppm does it occur?

c)   How many lines will be observed for DMSO-d6 in ^{13}C-NMR? Explain.

d)   What is difference between base peak and molecular ion peak in mass spectroscopy? Explain with suitable example.

B)   How could the following pairs of isomeric compounds be differentiated by mass spectroscopy?   **[3]**
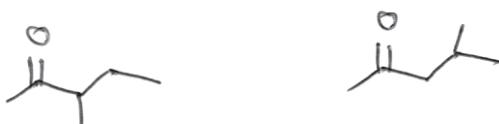
Q7) A) Attempt any three of the following. **[9]**
   a) Explain any two ionization methods in mass spectrometry with one example each.
   b) Distinguish following isomers using ^{13}C-NMR.

   c) Explain the anisotropic effect in benzene in ^{1}H.NMR.
   d) A compound is known to be a methyl anisole, but the orientation of two substituents (–CH$_3$ and –OCH$_3$) on aromatic ring is not known. The ^{13}C-NMR spectrum shows six peaks. Which isomer is it? Explain ^{1}H$^-$.NMR spectrum of this isomer.
   B) What OFF resonance in ^{13}C-NMR? Explain with suitable examples. **[3]**

Q8) A) Attempt any three of the following. **[9]**
   a) Explain the significance of TMS in ^{1}H. NMR spectroscopy.
   b) Distinguish following compounds using ^{1}C.NMR.
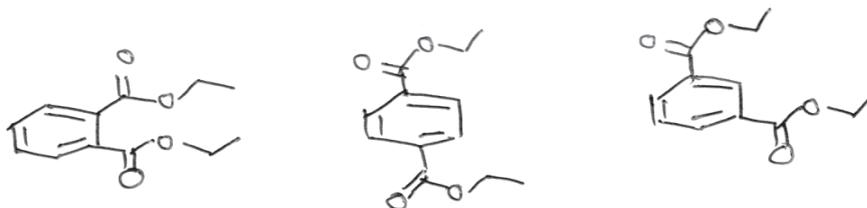
   c) Deduce the structure.
      M.F. : C$_6$H$_{14}$O
      PMR : 1.13 (d, J = 7.2 H$_2$ 12 H)
              3.61 (m, 2H)
   d) Deduce the structure.
      M.F. : C$_8$H$_{11}$N
      IR :- 1520, 1560, 1600 cm^{-1}
      PMR : 2.9 (S, 6H)
              6.6 - 6.8 (m, 3H)
              7.2 (m, 2H)

   B) Explain Pascal's triangle. Give any two examples that follow pascal's triangle. **[3]**

[5830]-204

M.Sc. -I

CHEMISTRY

CBOP-2, CHG-290, : Materials Characterization Technique

(2019 Pattern) (Semester - II) (2 Credits) (Option A)

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

Instructions to the candidates:

1) *Questions 1 is compulsory.*
2) *From Q.2 to Q.4, solve any two.*
3) *Figures to the Right side indicate full marks.*
4) *Q.2, 3,4 carry equal marks.*
5) *Use of Calculator/logtable is allowed.*

Q1) A)   Answer the Following (Any Four).   **[8]**

     i)   What is the use of wide angle diffraction or scattering?

     ii)   Enlist the operational variables in SEM.

     iii)   What is prethinning in TEM?

     iv)   Draw a neat labelled diagram for allowable electron transitions is k-shell of barium.

     v)   Describe in brief working atmosphere in XRF.

    B)   The diffraction of crystal of sample with X-rays $(\lambda = 1.54 \overset{\circ}{A})$ gives first order reflection at 26.5°. Calculate the interplanar distance in crystal. **[3]**

Q2) A)   Answer the Following.   **[6]**

     i)   Describe instrumentation of X-ray diffractometer with neat labelled diagram.

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

     i)   Explain electron - specimen interaction in SEM

     ii)   Discuss analyzing crystal in Wavelength dispersive spectroscopy.

Q3) A) Answer the following. [6]

     i) Explain Field emission gun in TEM

     ii) Describe compositional contrast in SEM

    B) Answer the following. [6]

     i) Discuss generation of x-rays and Auger electron with suitable diagram.

     ii) Describe x-ray fluorescence spectrometry.

Q4) A) Answer the following. [6]

     i) Explain Ultramicrotomy in TEM.

     ii) What are the applications of x-ray diffractometer? Explain one application in detail.

    B) Discuss the following. [6]

     i) Si(Li) detector in EDS.

     ii) Applications of XRF.

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[5830]-204

M.Sc.-I

CHEMISTRY

CBOP-2, CHG-290, : Organometallic and Inorganic Reaction Mechanism

(2019 Pattern) (Semester - II) (2 Credits) (Option-B)

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

Instructions to the candidates:

    1)   *Questions 1 is compulsory.*

    2)   *From Q.2 to Q.4, solve any two.*

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

    4)   *Q.2, 3,4 carry equal marks.*

    5)   *Use of Calculator/logtable is allowed.*

Q1) A)   Answer the Following (Any Four).   **[8]**

    i)   Determine valence electron count for the following compounds.

        a) $[C\eta^5 - C_5 H_5)\ Ru\ (CO)_2 C1]$

        b) $[CoCl(PPh_3)_3]$

    ii)   On the basis of $18e^-$ rule find the charges on the following:

        a) $[Ti\ (CO)_6]^x$ b) $[Mn(CO)_5(PF_3)]^y$

    iii)   Predict product and give the type of following reaction.
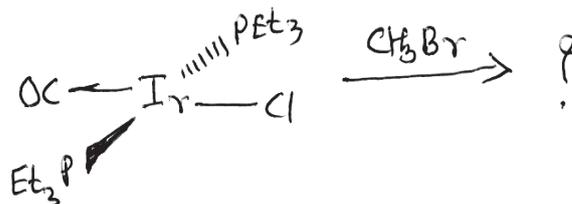
    iv)   Give the rate law for interchange reaction.

    v)   Define hydride elimination with suitable example.

B)   Explain water gas shift reaction with suitable example.   **[3]**

Q2) A) Explain characterization of organometallic compounds by   **[6]**

    i)   IR Spectroscopy

    ii)   NMR Spectroscopy

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

    i)   What is carbonyl insertion reaction? Explain any two possible mechanisms of carbonyl insertion reaction with suitable example.

    ii)   Draw orbitals for linear π systems in 1,3 butadiene.

Q3) A) Explain hydroformylation process in organometallic compounds with reaction mechanism and give any two applications of hydro-fromylation.   **[6]**

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

    i)   Write note on trans effect.

    ii)   Define inert and labile complexes classify following complexes into inert and labile.

        a) $[Cr(H_2O)_6]^{3+}$ b) $[V(H_2O)_6]^{3+}$ c) $[Cr(CN)_6]^{3+}$

Q4) A) Explain kinetic reaction pathways for dissociative and associative reactions.   **[6]**

    B)   Discuss the following.   **[6]**

    i)   Methods for synthesis of binary carbonyl complexes.

    ii)   Pd-catalysed cross-coupling cycle.

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[5830]-204

M.Sc. - I

GENERAL CHEMISTRY

CHG-290 : Introduction to Chemical Biology - II

(2019 Pattern) (Semester - II) (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 2 to 4.*

    3)   *Question Q.2 to Q.4, carry equal marks.*

    4)   *Draw diagram wherever necessary.*

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

        i)   What is the effect of temp on enzyme activity?

        ii)   What is deamination reaction? Give one example.

        iii)   What is meant by competitive inhibition? Give one example.

        iv)   Write the seceuence of mRNA molecule synthesize from DNA template strand having the sequence 5'–ATC GT CAT GCTA–3'

        v)   What are the advantages of gene cloning?

   b)   Discuss classification of enzymes with example.   **[3]**

Q2) Attempt the following questions.

   a)   Explain in detail principle, procedure and applications of Ion exchange chromatography.   **[6]**

   b)   Solve the following.

        i)   What is gene therapy? Mention its types.   **[3]**

        ii)   Discuss termination of transcription process.   **[3]**

Q3) Solve the following questions.

    a)   What is replication fork? Discuss the events that take place during movement of replication fork. **[6]**

    b)   i)   Explain the principle of NATIVE-PAGE. What is the difference between SDS-PAGE and NATIVE-PAGE? **[3]**

           ii)   Give the reactions of preparatory phase of glycolysis process. **[3]**

Q4) Attempt the following questions.

    a)   Explain in detail How are proteins synthesized on the ribosome. **[6]**

    b)   Solve the following.

           i)   What is meant by enzyme specificity? Mention its types. **[3]**

           ii)   How is gene cloning done? Describe the steps of gene cloning. **[3]**

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[5830]-301

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-310 : Quantum and Solid State Chemistry

(2019 Pattern) (Semester - III)

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, claculator 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
           $= 6.626 \times 10^{-34}$ 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

P.T.O.

SECTION-I

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

    i) State the postulate of quantum mechanics.

    ii) Define Hermitian operator giving example.

    iii) State the need of opproximation method in quantum chemistry.

    iv) What is the principle of variation method.

    v) Give the importance of Ladder operator.

b) State whether each of the following entites is an operator or a function . justify. [3]

    i) $\hat{A}\hat{B}$

    ii) $\hat{A} F(x)$

    iii) $f(x)\hat{A}\hat{B} g(x)$

Q2) a) Explain in detail. [6]

    i) Explain non degenerate state.

    ii) Expansion theorem.

b) i) Discuss the various steps involved in the application of the variation method. [3]

    ii) Formulate the Hamiltonian operators for H_2 molecule. [3]

Q3) a) Write a note on Hartree-Fock self consistent method. [6]

b) i) Show that Hermitian operator have real eigen values. [3]

    ii) What is commutative operator? Give one example. [3]

Q4) a) Derive the expression for first order correction to the energy of non degenerate unperturbed level. [6]

b) i) Explain Perturbation method. [3]

    ii) Classify with justification whether the following operators are linear or nonlinear. [3]

    1) $\dfrac{3x^2 d^2}{dx^2}$ 2) exp   3) $\int dx$

SECTION-II

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

    i) Given the classification of defects.

    ii) What is Van-Arkel process?

    iii) Define induction period for the decomposition reaction of a single solid.

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

    v) What is P-n junction?

  b) What is nucleation? Write its equation in case of decomposition of a single solid. **[3]**

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

    i) State and explain kirkendall effect.

    ii) Explain photoconductivity in ionic crystals.

  b) i) Discss the mechanism of diffusion in solids. **[3]**

    ii) The diffusion coefficient of L_i in G_e at 500°C is 10^{-6} cm^2/s. What is the distance penetrated in one and half hour? **[3]**

Q7) a) Derive the expression For frenkel defects in a crystal at a given temperature. **[6]**

  b) Attempt the following.

    i) Explain the mechanism of crystal growth from vapour phase. **[3]**

    ii) State and explain various methods of electrical breakdown in insulators. **[3]**

Q8) a) Draw and describe the various α-t plots for the decomposition of a single solid. **[6]**

  b) Attempt the following.

    i) Sketch and explain the hysteresis loop observed for magnetization of an insulator crystal. **[3]**

    ii) If 1ev energy is required to move an atom from the crystal's interior to the surface, what is the proportion of vacancies present in the crystle at 1000k? **[3]**

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[5830]-302
M.Sc. - II
PHYSICAL CHEMISTRY
CHP-311 : Nuclear, Radiation and Polymer Chemistry
(2019 Pattern) (Semester - III)

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

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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}
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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

SECTION-I

(Nuclear and Radiation Chemistry)

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

     i) Enlist the special nuclear reactions.

     ii) Describe the role of coolant used in nuclear reactors with examples.

     iii) What are different types of nuclear research reactions..

     iv) Draw schematic diagram of RBS experiment.

     v) What are the applications of PIXE

   b) Describe compound nucleus theory. **[3]**

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

     i) Discuss the theory of semiconductor detector

     ii) Explain scattering reaction of RBS

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

     i) Discuss the working of Li-drifted detector with schematic diagram.

     ii) Describe the conservation in nuclear reaction.

Q3) a) Write a note on collective and unified model. **[6]**

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

     i) Explain discontinuties in nuclear properties with reference to magic number.

     ii) On the basis of semi-empirical mass equation, predict stable nuclide of the isobaric series A=180

Q4) a) Describe general aspect of reactor design. **[6]**

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

     i) Explain channeling effect of RBS

     ii) Describe the working of surface barrier detector.

SECTION-II
(Polymer Chemistry)

Q5) a) Solve any four. **[8]**

    i) What is meant by thermoplastic polymer.

    ii) Define the term homochain polymer.

    iii) State the assumptions of krigbaum theory.

    iv) Define the term copolymerization.

    v) Define viscosity and state the SI unit of it.

  b) Solve the following. **[3]**

The degree of polymerization of polypropylene is 5000. Find out molecular weight of polypropylene.

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

    i) Discuss the molecular forces in polymer.

    ii) Explain end group analysis for addition polymer.

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

    i) Distinguish between condensation polymerization and addition polymerization.

    ii) Discuss the heat of mixing of polymer solutions.

Q7) a) Describe the vapour phase osmometry technique for molecular weight determination of polymer solution. **[6]**

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

    i) Write a note on thermochemistry of chain polymerization.

    ii) Discuss sedimentation velocity method.

Q8) a) Derive and explain copolymer equation. **[6]**

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

    i) Write a note on characterization of polymer,

    ii) 210 gm of vinyl acetate and 50gm of methyl acrylate copolymerize. Find the polymer composition.

    [Monomer reactivity ratios : 0.23 and 1.68 respectively

    At wts : C= 12, H=1, Cl=35.5, O = 16]

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[5830]-303
M.Sc.
PHYSICAL CHEMISTRY
CHP-312 : Physiochemical Methods of Analysis
(2019 Pattern) (Semester - III)

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, claculator is allowed.*
6) *Neat diagrams must ber drawn wherever necessary.*

Physico-Chemical Constants

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                                     $= 1.38 \times 10^{-23}$ J K^{-1} molecule^{-1}
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                                       $= 6.626 \times 10^{-34}$ J s
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                                       $= 1.602 \times 10^{-19}$ 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}
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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

SECTION-I

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

  i) What are x-rays ? Which is the useful region of x - ray for chemical analysis?

  ii) Define the terms binding energy and work function used in ESCA.

  iii) Define abosrptive edge. state its use.

  iv) What is the basic difference between DTA & DSC?

  v) What is meant by thermal analysis? Enlist the various methods of thermal analysis.

  b) Discuss the applications of DSC technique.   [3]

Q2) a) Solve the following.   [6]

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

  ii) Explain any one analyser used in ESCA with a neat labelled diagram.

  b) i) Discuss the applications of DTA technique.   [3]

  ii) The work function of a spectrometer is 35ev. The binding energy of the emitted electron is 1.0 50ev. It the kinetic energy of the electron is 1.75ev. Find the wavelength of x-ray.   [3]

Q3) a) Explain x-ray fluorescence and draw a neat labelled diagram of wavelength dispersive and energy dispersive instrument used in fluorescence technique.   [6]

  b) i) Explain spectral splitting abserved in ESCA technique.   [3]

  ii) Describe heat flux DSC instrument.   [3]

Q4) a) Draw the energy level diagram for the sample and spectrometer used in ESCA technique and Explain the same.   [6]

  b) i) State the principle of thermometric titrations explain thermometric titration curve for exothermic reaction.   [3]

  ii) 120 mg sample containing a mixture of HaCl (mol.wt. 58.5) and $CaC_2O_4.H_2O$ (mol.wt. 146) showed a loss of 7.00 my at 140°C on TG curve. Determine the percentage of calcium oxalate in the sample.   [3]

SECTION-II

Q5) a) Solve any four. **[8]**

      i) Draw the excitation signals for various voltammetry techniques.

      ii) State the characteristics of plasma.

      iii) What is controlled potential coulometry.

      iv) Enlist the essential components of the apparatus used to measure photoluminescence.

      v) Give the advantages of amperometric titration.

    b) Write a note on cyclic voltammetry. **[3]**

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

      i) Give factors affecting the photoluminescence.

      ii) Write the applications of potential coulometry.

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

      i) Describe quantitative analysis by chemiluminescence.

      ii) The initial current is 90 mA and decreases exponentially with K=0.0058 sec^{-1} the titration time is 714sec. How many milligrams of Uranium (VI) are reduced to Uranium (IV)

Q7) Answer the following. **[6]**

    a) Define amperometric titrations? Write their applications.

    b) i) Draw a neat labelled diagram of typical ICP source. **[3]**

      ii) Explain the 's' route mechanism for electro chemiluminescence. **[3]**

Q8) a) Discuss briefly the technique of pulse voltammetry with its advantages. **[6]**

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

      i) Given the mechanisim of chemiluminescence

      ii) A controlled - potential coulometric assay of 30 ml Cu^{2+} solution was performed with the following electro chemical reaction.

      $Cu^{2+} + 2e^- \rightarrow Cu$

      IF the area under the current - time curve is 20.6 mA. min. Claculate the concentration of Cu^{2+} in the solution.

      (At.wt. of Cu = 63.5)

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[5830]-304
M.Sc.
PHYSICAL CHEMISTRY
CBOP-3-CHP-313(A) : Photochemistry and Techniques in Polymer Chemistry
(2019 Pattern) (Semester - III)

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, claculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

Physico-Chemical Constants

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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

P.T.O.

SECTION-I

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

     i) What is short term effect of radiations.

     ii) Explain the photochemical equivalance.

     iii) Define oscillator strength. How it is related to natural radioactive life time of the molecule.

     iv) Define effective light of photochemical change.

     v) Explain the term spantaneous emmission.

   b) What are the types of electronic transition in organic molecule. **[3]**

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

     i) Discuss the working of linear accelators.

     ii) Write a note on depth profiling techniques.

   b) i) Discuss Einstein's treatment of emmision phenomena. **[3]**

     ii) Explain photochemical kinetics of unimolecular process. **[3]**

Q3) a) Explain the jablonski diagram depicting photophysical process. **[6]**

   b) i) What are the application of solar energy **[3]**

     ii) Explain the term phosphorescence. **[3]**

Q4) a) Explain in details energy transfer mechanism. **[6]**

   b) Solve the following.

     i) For the photochemical reaction :. $A \rightarrow B$, 2×10^{-5} moles of B were formed an absorption of 8.7×10^7 erg. at 1200 A° calculate the quantum yield. **[3]**

     ii) Calculate the energy in calories per moles for radiation of wavelength 1500A° **[3]**

SECTION-II

Q5) a) Solve any 4 of the following. **[8]**
   i) Define the term degree of polymerization.

   ii) What is conducting polymer?

   iii) What is meant by thermosetting polymer?

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

   v) Define the term random degradation.

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

Q6) a) Explain in detail. **[6]**
   i) Explain block co-polymerisation.
   ii) Write a note on re-inforcement.
   b) i) Describe the crosslinking of the polymer. **[3]**
   ii) Write note on Step-Polymerization. **[3]**

Q7) a) Derive the stress-strain equation for simple streching of an elastomer.**[6]**
   b) i) What is crystalline melting point. **[3]**
   ii) Define molding and enlist name of different types of molding process. **[3]**

Q8) a) What is Rheology? discuss the viscous flow phenomenon and it's mechanism in Polymer. **[6]**
   b) i) Give the application of conducting polymer **[3]**
   ii) What are the mechanical properties of crystaline polymer. **[3]**

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[5830]-304
M.Sc.
PHYSICAL CHEMISTRY
CBOP-3-CHP-313(A) : Photochemistry and Techniques in Polymer Chemistry
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:
1) *Answer to the Two sections should be written in SEPARATE answer books.*
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5) *Use of logarithmic table, claculator is ALLOWED.*
6) *Neat diagrams must be drawn WHEREVER necessary.*

Physico-Chemical Constants

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12)	Nuclear Magneton	$\beta_n = 5.051 \times 10^{-27}$ J T^{-1}
13)	Mass of an electron	$m_e = 9.11 \times 10^{-31}$ Kg

SECTION-I

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

    i) Define the terms: mean and median.

    ii) What is logarithmic concentration diagram?

    iii) Explain the difference between absolute and relative error.

    iv) What is polyprotic acid? How to calculate they p^H of polyprotic acid?

    v) State and explain the principle of turbidimetry.

  b) The percentage of chlorine in $MgCl_2$ was reported by different persons as 32.64, 32.54, 32.61 and 32.53%. Calculate the mean deviation, standard deviation and relative mean deviation. **[3]**

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

    i) Write a charge balance equation for a solution containing KI and AlI_3.

    ii) Define the term significant figures. Explain it with suitable example for numerical addition and subtraction.

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

    i) What is regression model? State the assumptions of the least-squares method.

    ii) Calculate the P^H, the hydrogen and hydroxyl ion contentrations of a 3.2×10^{-3} M solution of barium hydroxide in water at 25°C.

    [Given: $K_W = 1.00 \times 10^{-14}$]

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

    i) State and explain the principle of nephelometry. How nephelometric technique is different then fluorimetry?

    ii) Sketch and explain the logarithmic concentration diagram for diprotic acid.

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

    i) Give the applications of turbidimetric method of analysis.

    ii) What is correlation coefficient? State the person's correlation coefficient equation and explain the terms.

Q4) a) Write mass balance expressions for the system formed when 0.01M ammonia solution is saturated with slightly soluble silver bromide.

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

      i) What is permutation and combination?

      ii) Explain, the method of nephelometric determination of chlorida in water sample. **[6]**

SECTION-II

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

      i) Define magnetic anisotropy.

      ii) Explain, Why point defects occur in the ceramic nanoparticles?

      iii) Explain the term chemisorption.

      iv) Give any four characteristics of physiosorption.

      v) Define active smart materials. Give one example .

   b) What are passive smart materials? Explain with two examples. **[3]**

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

      i) State the applications of nanomaterials in heterogeneous catalysis.

      ii) What are samrt ceramics? give its uses.

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

      i) What are magnetostrictive materials? Give it's uses.

      ii) Write a short note on carbon nanofibers.

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

      i) Discuss physical methods for synthesis of nanoparticles.

      ii) Give an account of ferrofluids.

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

      i) Write a short note on smart gel.

      ii) Explain the electrochemical adsorption of hydrogen.

Q8) a) Explain the applications of carbon nanoparticles in the storage of hydrogen.**[6]**

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

      i) Describe in brief spray pyrolysis method for synthesis of ceramic nanoparticles.

      ii) Write a note on carbon nanostructure.

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[5830]-305

M.Sc. - II

INORGANIC CHEMISTRY

Organometallic and Homogenous Catalysis

(2019 Pattern) (Semester - III) (CHI-330)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

SECTION-I

(Organometallic Chemistry)

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

  i) Explain the difference in IR spectra of $Mo(PF_3)_3 (CO)_3$ and $Mo(Pme_3)_3 (CO)_3$.

  ii) Which of the following complexes obey 18 $\bar{e}$ rule?

   1) $Fe_2 (CO)_9$

   2) $CO_2 (CO)_8$
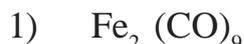
   (Atomic No. of Fe=26, Co=27)

  iii) Give reaction for the synthesis of metal carbynes.

  iv) Find value of 'n' in the following.

   $Na_2Fe(CO)_n$, $Rh(\eta^5- C_5H_5) (CO)_n$
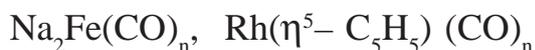
   (Atomic No. of Fe=26 Rh= 77)

 b) Attempt the following.   **[3]**

  Explain with the help of suitable example the role of organometallic compound as a protecting agent.

Q2) a) Answer any ONE of the following. **[6]**

    i)   Explain the bonding in metal alkene complexes.

    ii)   For the following molecules give the formal oxidation state of metal; 'd' electron count, total valence electron (TVE) and No.of M-M bonds if any.

        1) $[CpMo\ (CO)_3]^-$

        2) $Cp\ (\eta^6{-}C_6H_6)\ Mn$

        3) $Cp\ Mn\ (CO)_3$
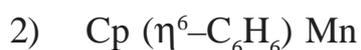
        (Atomic no. Mn = 25, Mo = 42)

  b) Answer any TWO of the following. **[6]**

    i)   Explain the typical reactions of arene compound.

    ii)   Draw the structure of zeise's salt, explain structural features of it.

    iii) Which of the complex $[V(CO)_6]^-$, $Cr(CO)_6$, $[Mn\ (CO)_6]^+$ has the shortest C-O bond justify your answer.

Q3) a) Answer any ONE of the following. **[6]**

    i)   Give the methods for the preparation of metal cycloheptatrienyls. compound.

    ii)   Give an account of synthesis and bonding properties and applications of phosphine compounds.

  b) Answer any TWO of the following. **[6]**

    i)   What heptacities are possible for following ligands?

        1) C_6H_6

   2)   butadiene

        3)   Cyclooctatetraene

    ii)   What is Fischer carbene and schork carbene?

    iii) What is synergic bonding? Explain with example.

SECTION-II

(Homogenous Catalysis)

Q4) a) Answer the following. [8]

i) Predict the type of reaction.

$$CH_3 - Mn(CO)_5 + CO \rightarrow \ CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - Mn(CO)_5$$
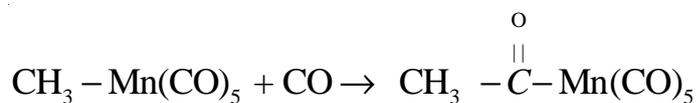
ii) What are the general features of homogenous catalysis?

iii) Define active catalyst and selective catalyst.

iv) What is Fenton's reagent? Mention it's advantages.

b) Attempt the following. [3]

Give catalytic cycle for Negeshi coupling reaction.

Q5) a) Answer any ONE of the following. [6]

i) Give Industrial applications of Heck reaction and explain catalytic cycle of Heck reaction.

ii) What is biphasic system? What are advantages? Discuss any one biphasic system.

b) Answer any TWO of the following. [6]

i) What is Insertion reaction? Give one example.

ii) What is epoxidation reaction? Give one example.

iii) Provide short account of the preparation and reactions of metal cyclobutadienes.

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

i) Give an account of polymerisation using zeiglar- Natta Polymerisation.

ii) What is cativa process? Explain catalytic cycle involved in cativa process.

b) Answer any TWO of the following. [6]

i) Explain with example oxidative addition reaction and insertion reactions.

ii) Give similarities between suzuki and Heck coupling reactions.

iii) Write a note on Metathesis.

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M.Sc. (Inorganic Chemistry)

CHI - 331 : INORGANIC REACTION MECHANISM

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

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 indicates full marks.*
4) *Use of Logarithmic table and calculator are allowed.*
5) *Answers to the two sections should be written in separate answer sheets.*

SECTION - I

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

i) What do you mean by 'inert' and 'labile' complexes?

ii) Four coordinated Td. or square planer complexes reacts faster than six coordinated oh. complexes. Why?

iii) Suggest the mechanism for following reaction

$[Co(NH_3)_5 \, NO_2]^{2+} \rightarrow [Co(NH_3)_5 \, ONO]^{2+}$

iv) Which of the following substitution reaction is faster? Why?

$[Ni(NH_3)_5 \, Cl]^+ + H_2O \rightarrow [Ni(NH_3)_5 \, H_2O]^{2+} + Cl^-$

$[Ni(H_2O)_5 \, Cl]^+ + H_2O \rightarrow [Ni(H_2O)_6]^{2+} + Cl^-$
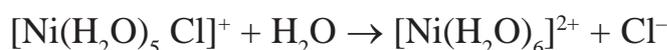
b) Discuss in brief about factors affecting stability constant. **[3]**

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

i) Discuss in detail Intimate and stoichiometric mechanism of ligand substitution reactions.

ii) What do you mean by base hydrolysis? Explain its mechanism with suitable example.

P.T.O.

b) Answer <u>Any Two</u> of the following : **[6]**

 i) Arrange the following metal complexes according to the increasing order of their rate of equation.

 Cis $[Co(en)_2 Cl_2]$, Cis - $[Co(NH_3)_4 Cl_2]^+$, Cis - $[Co(trien)Cl_2]^+$

 Justify your answer.

 ii) Discuss trans effect with suitable example.

 iii) Describe associative and dissociative mechanism in substitution reaction.

Q3) a) Answer <u>Any One</u> of the following : **[6]**

 i) Discuss the mechanism of cis-trans isomerism in octahedral complexes 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) Excited state outer sphere electron transfer reactions.

 ii) Mercus equation.

 iii) Racemization in trischelate metal complexes.

SECTION - II

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

 i) List out the reactions of coordinated ligands.

 ii) What is photochemical reaction. Give example.

 iii) What do you mean by oxidative addition reaction. Give an example.

 iv) What is the role of d-d transition in photochemical reaction.

 b) What do you mean by prompt and delayed reactions. Explain with suitable example. **[3]**

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Q5) a) Answer <u>Any One</u> of the following : [6]

   i) Explain the nucleophilic behaviour of coordinated ligands.

   ii) Give an account of Insertion reactions.

   b) Answer <u>Any Two</u> of the following : [6]

   i) Describe the photo physical processes of relaxation.

   ii) Discuss in brief quantum efficiency of photo chemical reaction.

   iii) Discuss in brief kinetic template effect involving reaction between one donor atom and one non donor atom.

Q6) a) Answer <u>Any One</u> of the following : [6]

   i) Give an account of photo chemical reactions of Co (III) complexes.

   ii) Discuss chelate ring forming reaction predominantly involving thermodynamic template effect.

   b) Write a note on (Any Two) [6]

   i) Chemical Actinometry.

   ii) Reductive elimination reactions.

   iii) Halogenation of Coordinated nitrogen atom.

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Total No. of Questions : 6]

P327

[Total No. of Pages : 3

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S.Y. M.Sc. (Inorganic Chemistry)

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 indicate full marks.*
3) *Draw neat diagram wherever necessary.*
4) *Answer to the two sections should be written in separate answer books.*

SECTION - I

Q1) A) Attempt the following : **[8]**
   i) Explain the function of Cu-Zn SOD.
   ii) Give an account of the metal deficiency related diseases.
   iii) Explain the mechanism of Rubredoxins.
   iv) What does Zinc-Finger proteins do?

   B) Attempt the following : **[3]**
   i) Name the different biological processess in which the iron-sulphur proteins are involved. Explain the structure & role of the Fe/S proteins participating in any one of the above processes.

Q2) A) Attempt <u>Any One</u> of the following : **[6]**
   i) Explain the active site, structure & function of enzyme galactose oxidase.
   ii) Explain the catalytic activity of Cu-Zn Super-oxide dismutase.

   B) Attempt <u>Any Two</u> of the following : **[6]**
   i) Explain the active site, structure & function of enzyme urease.
   ii) Give an account of metal cluster in nitrogenase.
   iii) Write a detailed account on Transition metal complexes as spectroscopic & conformational probes.

P.T.O.

Q3) A) Attempt <u>Any One</u> of the following : [6]

    i)   Which metal is present in carboxy-peptidase-A? Draw the coordination sphere of the metal in its active site & explain the action of this enzyme? Why the enzyme carboxypeptidase-A is essential in biological system?

    ii)   Give a detailed account on the different metal deficiency & overload related diseases.

  B) Write note on <u>Any Two</u> : [6]

    i)   Functions of copper in living system.

    ii)   Carbonic anhydrase.

    iii)   Antagonism.

SECTION - II

Q4) A) Answer the following : [8]

    i)   What is the role of metal ion-DNA binding in biology?

    ii)   Name the ligands with Au (I) and Au (III) forming stable complexes.

    iii)   Explain the use of Tc – 99 in radiopharmaceuticals.

    iv)   Discuss the binding of Bismuth with thiolate ligands.

  B) Attempt the following : [3]

    i)   What do you understand by chemotherapy? Name the metals used in chemotherapy and discuss their role in chemotherapy.

Q5) A) Attempt <u>Any One</u> of the following : [6]

    i)   What are radiopharmaceuticals? Which elements are used for radio imaging purpose? Give four examples and their role in radiopharmaceuticals.

    ii)   What is the oxidation state of vanadium in amavadin? Explain its structural features and insulin modification.

  B) Attempt <u>Any Two</u> of the following : [6]

    i)   What are the steps involved in Drug development?

    ii)   What do you mean by intercalation? Explain with diagram.

    iii)   Compare the therapeutic & diagnostic applications of radiopharmaceuticals.

Q6) A) Attempt <u>Any One</u> of the following :   [6]

      i)   Write note on

          a)   Platinum based anti-cancer drugs.

          b)   Metallofoot printing agents.

      ii)   Explain three kinds of adducts formed by DNA with platinum complexes.

   B) Write note on <u>Any Two</u> :   [6]

      i)   Drug resistance mechanism.

      ii)   Renal imaging agents.

      iii)   Unwinding, shortening and bending of double helix of DNA.

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M.Sc. - II (Inorganic Chemistry)

CHI - 333 A, CBOP - 3 (T) : MODERN INSTRUMENTAL METHODS IN INORGANIC CHEMISTRY

(2019 Pattern) (Semester - III) (4 Credits)

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

Instructions to the candidates :

1) *Answers to the two sections should be written in separate answer books.*
2) *All questions are compulsory.*
3) *Figures to the right indicate full marks.*
4) *Use of logarithm table and calculators is allowed.*

SECTION - I
(Thermal and Spectroscopic Techniques)

Q1) A) Attempt any <u>Four</u> of the following :   **[8]**
   i)   What is principle of DSC?
   ii) What are applications of TPD?
   iii) Which factors affect chemical shieft?
   iv) What is principle of FTIR Spectroscopy?
   v)   What is UHV? Why UHV is required in Auger electron spectroscopy?

   B) Explain ESR spectrum of methyl radical and Benzene.   **[3]**

Q2) A) Attempt any <u>One</u> of the following :   **[6]**
   i)   What is DTA? Explain construction, working, factors affecting an applications of DTA.
   ii) What are the different parts of XRD? What is monochromator? How many types of monochromator used in XRD?

   B) Attempt any <u>Two</u> of the following :   **[6]**
   i)   Explain working of TGA.
   ii) What is U.M. Counter?
   iii) Give applications of XRD?

P.T.O.

Q3) A) Attempt any <u>One</u> of the following : [6]

    i)   What is ESR? Explain construction, working and applications of ESR spectroscopy.

    ii)   a)   What is proportional counter?

           b)   Draw the Joblonski diagram.

  B) Attempt any <u>Two</u> of the following : [6]

    i)   What are applications of Fluorescence.

    ii)   Explain construction and working of Auger process.

    iii)   Explain working of DSC.

SECTION - II

Q4) A) Attempt any <u>Four</u> of the following : [8]

    i)   What is Principle of XPS?

    ii)   Explain working of TEM.

    iii)   What is Hysteresis loop?

    iv)   What is Chromophore? Explain with example.

    v)   Explain principle of Flame photometry.

  B) Draw flow sheet diagram of Flame photometer. [3]

Q5) A) Attempt any <u>One</u> of the following : [6]

    i)   What is STEM? Explain construction, working and applications of STEM.

    ii)   What is Magnetic Materials? Explain Ferromagnetic and antiferromagnetic materials. Distinguish between Hard and Soft magnets.

  B) Attempt any <u>Two</u> of the following : [6]

    i)   Explain factors affecting chemical shieft.

    ii)   Give applications of flame photometry.

    iii)   What is Beer's - Lambert's Law?

Q6) A) Attempt any <u>One</u> of the following :   [6]

     i)   What is cyclic voltametry? Explain construction working and applications of cyclic voltametry.

     ii)   a)   Define : 1) Corecivity 2) Aspiration 3) Neubulisation

            b)   Explain Scheibe-Lomakin equation.

   B) Attempt any <u>Two</u> of the following :   [6]

     i)   What is Hemispherical analyzer.

     ii)   Which element defected by flame photometry.

     iii)   What is Auxochrome? Explain with example.

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M.Sc. - II (Inorganic Chemistry)

CHI - 333 B, CBOP - 3 : INORGANIC MAGNETO AND POLYMER CHEMISTRY

(2019 Pattern) (Semester - III)

[Max. Marks : 70

Instructions to the candidates :

    1)   *All questions are compulsory.*

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

    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
(Magneto Chemistry)

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

     i)   What are anti-ferromagnetic materials? Give one example.

     ii)   What is magnetic susceptibility? Give it's unit.

     iii)   Give the formula for determination of magnetic moment in lanthanides.

     iv)   Give any two applications of magnetic materials.

   B)   Explain the experimental magnetic moment of the following ions.   **[3]**

     i) Ti^{3+} μ_{expt} = 1.7 to 1.8 B.M.

     ii) Co^{2+} μ_{expt} = 4.1 to 5.2 B.M.

     (Given : Atomic Number of Ti = 22 and Co = 27)

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

     i)   Write about magnetic properties of transition metal complexes in cubic and axially symmetric crystal fields.

     ii)   What are mixed valence compounds? How are they classified?

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

     i)   Explain anisotropy in magnetic susceptibility.

     ii)   Explain magnetic exchange interaction.

     iii)   Discuss ferrimagnetism in brief.

Q3) A)   Attempt <u>any one</u> of the following :   **[6]**

   i)   Write Van-Vleck equation. Give the applications of Van-Vleck equation.

   ii)   Give in brief an account of Gouy method.

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

   i)   Discuss the different types of magnetic substances.

   ii)   Write a note on spin canting.

   iii) What is photoinduced magnetism? Give it's mechanism.

SECTION - II

(Inorganic Polymer)

Q4) A)   Attempt the following :   **[8]**

   i)   Define heteropolar inorganic polymer with suitable example.

   ii)   What are polysilanes? Give their general formula.

   iii) What is borazine? Give it's structure.

   iv)   What is Curborundum? Give any one method for its preparation.

   B)   What is degree of polymerization? Discuss the relation between average degree of polymerization with average molecular weight of polymer. **[3]**

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

   i)   Discuss in detail the classification of polymers.

   ii)   Explain synthetic, natural and blended polymers, with suitable examples.

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

   i)   What is Chain depolymerization? Explain with suitable example.

   ii)   What is Coordination polymers? Write any two reaction yielding Coordination polymer.

   iii) Write a note on polythiazoles.

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Q6) A) Attempt <u>any one</u> of the following :   [6]

    i)   Discuss the polymer of aluminium nitride and phosphorous nitride.

    ii)   Explain the applications of inorganic polymer. With respect to it's catalytic and medicinal properties.

   B) Attempt <u>any two</u> of the following :   [6]

    i)   Write a note on polysiloxanes.

    ii)   Give any two methods for preparation of borazine.

    iii)   Differentiate between addition and condensation polymers.

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M.Sc. (Part - 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) *Question 1 and 5 are compulsory and carry 11 marks each.*
2) *Attempt any two questions from questions 2-4 and two questions from questions 6-8.*
3) *Answers to the two sections should be written in separate answer books.*
4) *Figures to the right indicate full marks.*

SECTION - I

Q1) Attempt the following :

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

i)

ii)
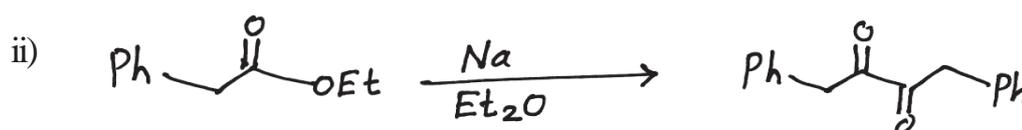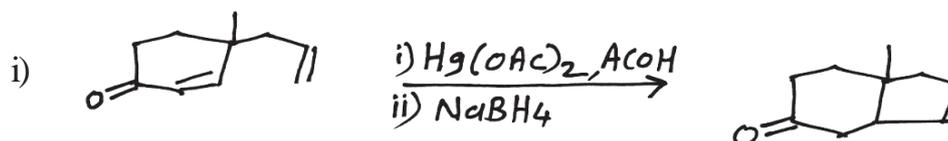
b)   Suggest the reagents and explain the mechanism for the following conversions.   **[6]**

i)

ii)
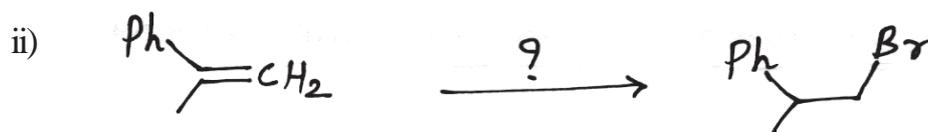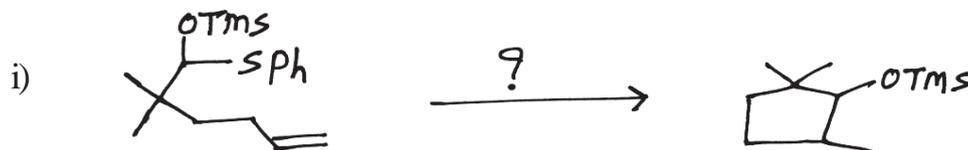
Q2) Write short notes on <u>any three</u> :　　　　　　　　　　　　　　　　　**[12]**

    a)　Cross-over experiment

    b)　Significance of sigma (σ) and rho (ρ) values

    c)　Kinetic isotope effect

    d)　Barton reaction

Q3) Attempt <u>any four</u> of the following :　　　　　　　　　　　　　　**[12]**

    a)　Predict the sign of Hammett sigma (σ) constant for following substituents.

        i)　　p–NH$_2$　　　　　　　　　　　ii)　　m–CN

        iii)　p–CH$_3$

    b)　Explain 'non linear Hammett Plot' for the hydrolysis of substituted benzoyl chloride in aq. acetone.

    c)　Describe kinetics of base catalyzed halogenation of acetone.

    d)　What are Persistent radicals? Explain with suitable example.

    e)　Explain Hunsdiecker reaction with suitable example.

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

    a)　Saponification of ethyl m-nitro benzoate is 63.5 times faster than the unsubstituted ester under the same conditions. What will be the comparable rate of hydrolysis of ethyl p-methoxy benzoate?

        Given :　　σm – NO$_2$ = 0.71

                σp – OCH$_3$ = –0.27

    b)　Predict the product and explain the mechanism for the given reaction.

$$Ph\!\!\!\diagup\!\!\!\overset{\displaystyle O}{\underset{}{C}}\!\!\!\diagup\!\!\!NO_2 \xrightarrow[THF]{Ph_3 B,\ O_2} \ ?$$

    c)　Predict the product and explain the mechanism.

$$BrCCl_3\ +\ H_2C{=}CEt_2 \xrightarrow{h\nu}\ ?$$

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d) Explain the rho(ρ) values for the given reactions.

i)

$$\text{Ar}_2\overset{\oplus}{C}-\overset{\oplus}{N_2} \xrightarrow{RCO_2H} \text{Ar}_2C-OCOR$$

ii)

$$\text{EtO-CO-CH}-\overset{\oplus}{N_2} \xrightarrow{RCO_2H} \text{EtO-CO-CH}_2-OCOR$$
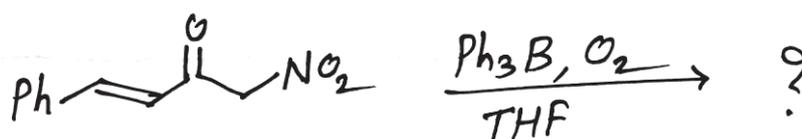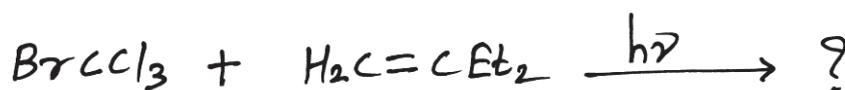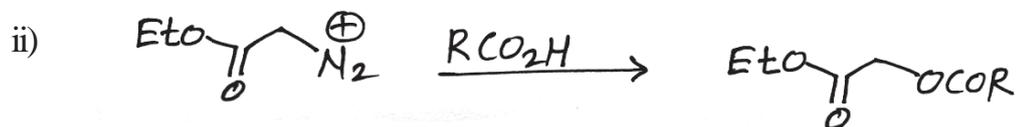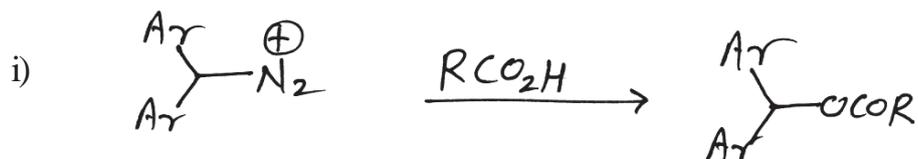
e) Predict the products for the given reactions.

$$? \xleftarrow[h\nu]{Cl_2} \text{ArO-CH}_3 \xrightarrow[AlCl_3]{Cl_2} ?$$
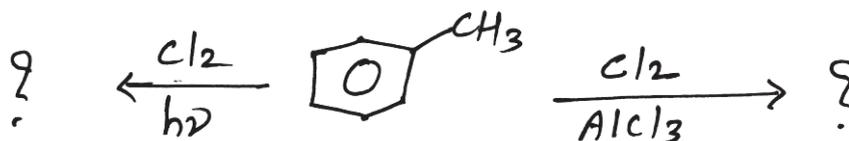
SECTION - II

Q5) Attempt the following :

a) Suggest the biogenetic steps. **[5]**

i) FPP $\longrightarrow\longrightarrow$

ii) L-ornithine $\longrightarrow\longrightarrow$
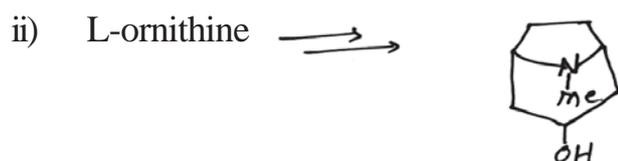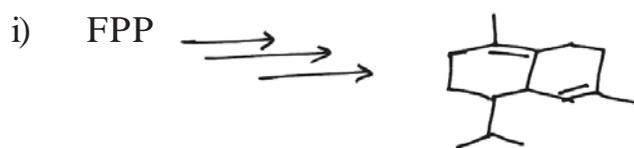
b) Complete the given biosynthetic steps. **[6]**

i) NPP $\longrightarrow\longrightarrow$

ii)
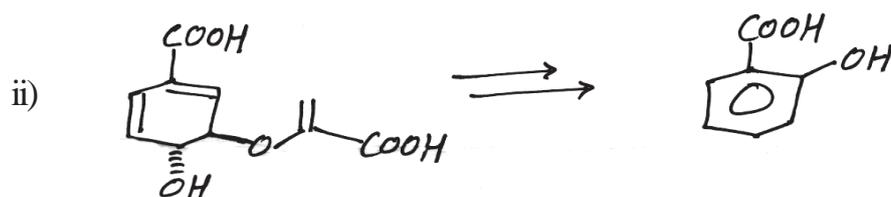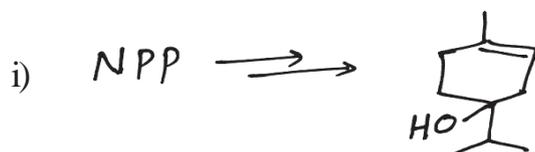
Q6) Write in brief - any three : [12]

    a) Irregular monoterpenes

    b) Biogenesis of DMAPP from Acetyl Co-A

    c) Metabolites of mixed biogenesis

    d) Oxidative deamination

*Q7)* Complete the biogenesis for <u>any four</u> of the following. [12]

    a) Squalene $\longrightarrow$

    b) $2 - {}^{14}C$ – ornithine $\longrightarrow$

    c) FPP $\longrightarrow$

    d) 4-Hydroxy cinnamic acid $\longrightarrow$

    e) Nicotinic acid $\longrightarrow$
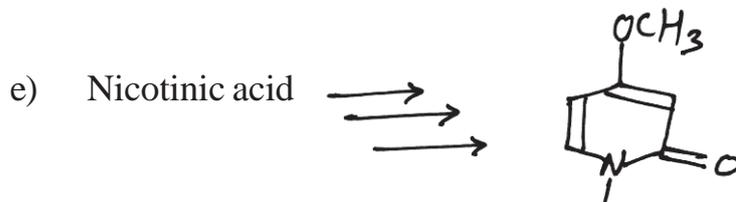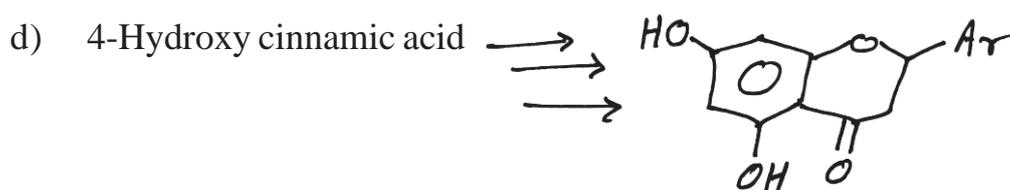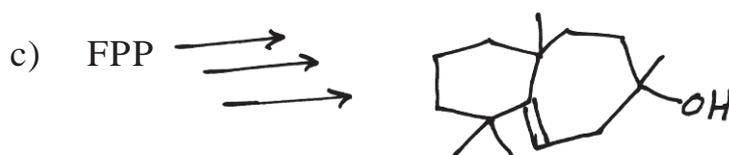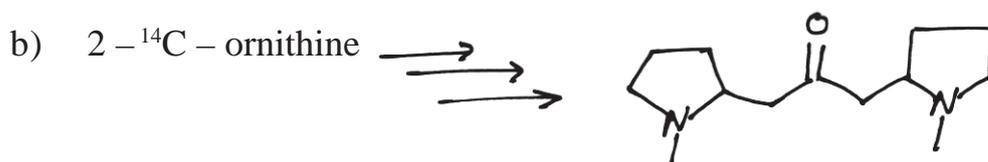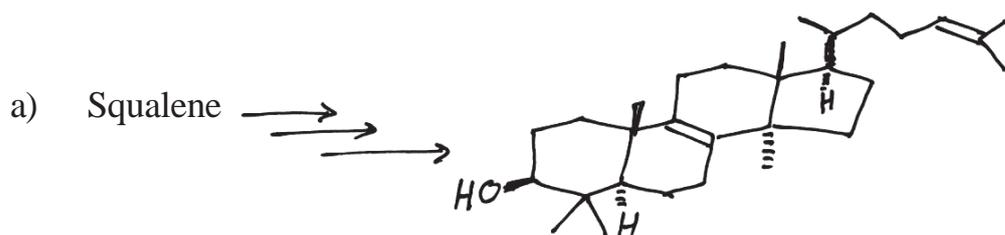
*Q8)* Solve <u>any four</u> of the following : [12]

a) Describe source, extraction and isolation of nigramide.

b) Complete the given biogenesis.

L - Tyrosine
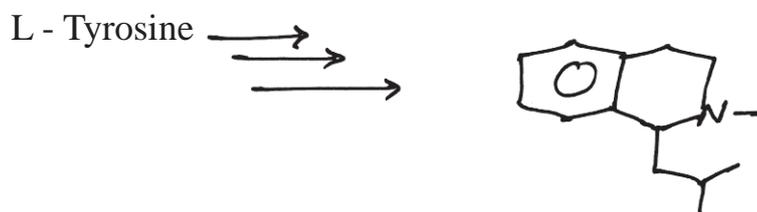
c) Outline the steps involved in the given biogenesis.
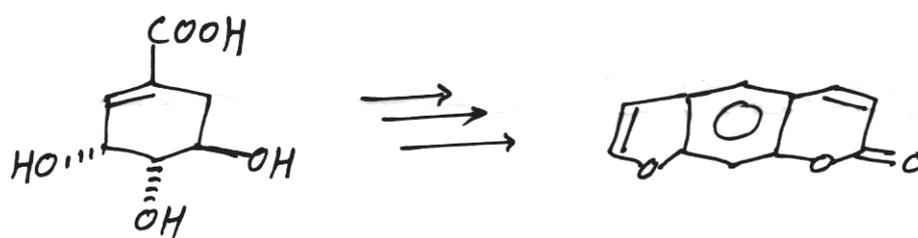
d) Complete the following biosynthetic steps.
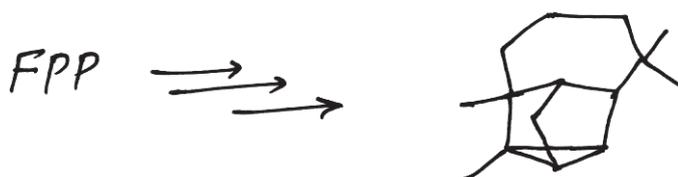
e) Complete the given biogenesis and depict the distribution of label in GPP.

▽ ▽ ▽ ▽

[5830]-310

M.Sc. - 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 Q.2 to Q.4 and two from Q.6 to Q.8.*

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

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

SECTION - I

Q1) a) Acetylacetone exhibits Keto-enol forms at 20ºC. The chemical shift of protons of each form are as follows.   **[3]**
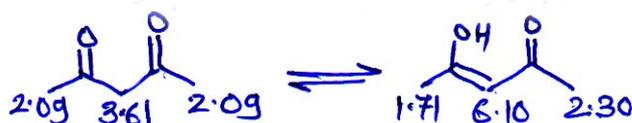
In the NMR spectrum, the integration at 3.61 and 6.10δ are 44 mm and 04 mm respectively. Calculate percentage of Keto and enol form at equilibrium.

    b) i)   Deduce the structure using following data :   **[8]**

            M.F : $C_8H_8O_3$

            I.R. :   1780, 1700, 1620 cm^{-1}

            NMR :   1.70δ 't' 20 mm

                        2.33δ 't' 20 mm

            CMR :   20.3 (t), 24.3 (t), 143.6 (s), 168.2 (s)

ii)   M.F : $C_8H_8O_3$

  I.R. :   3332 (br), 1760

  NMR : 3.76δ 's' 2H

      6.69δ 'dd' 1H (J = 8 & 2Hz)

      6.78δ 'd' 1H (J = 2Hz)

      6.96δ 'd' 1H (J = 8Hz)

      9.42δ 'bs' 1H

  CMR :   174.7 (s), 153.7 (s), 146.6 (s), 124.9 (s)

      114.1 (d), 111.7 (d), 110.3 (d), 33.1 (t)

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

   a)   Use of COSY in structure determination.

   b)   Importance of DEPT technique in C^{13} NMR spectroscopy.

   c)   Spin decoupling techniques.

   d)   2D resolved spectroscopy.

Q3) Attempt <u>any four</u> of the following :   **[12]**

   a)   In H' NMR amine protons show broad signal. Explain.

   b)   In CMR, DMSO d_6 shows seven lines with intensities 1:3:6:7:6:3:1

   c)   Calculate the line position of each line of H_a (5.2δ, 'd', J_{ab} = 6Hz q, j_{ac} = 16Hz) at 200 MHz for the following compound using a tree diagram.
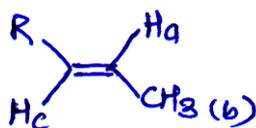
d) Deduce the structure

M.F : $C_{10}H_{10}O_3$

I.R. : 1680, 1602 cm^{-1}

PMR : 3.1δ, 't', (J = 6Hz), 2H

3.9δ, 'dd', (J = 2 and 8Hz), 1H

4.5δ, 't', (J = 6Hz), 2H

6.75δ, 'd', (J = 2Hz), 1H

6.9δ, 'dd', (J = 2 and 8Hz), 1H

8.05, 'd', (J = 8Hz), 1H

e) Deduce the structure and assign the signals.

M.F : $C_5H_4O_3$

I.R. : 1820 cm^{-1}, 1750 cm^{-1}, 1040 cm^{-1}

PMR : 2.3 δ, 's', 15 mm

5.6 δ, 's', 5 mm

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

a) In PMR spectrum of 18-annulene ring compound the inner six protons appear at 4.03δ while outer six protons appear at 8.88δ.

b) The PMR spectrum of compound A and B, H_a proton of compound A appears at 8.65δ while H_b proton of compound B appears at 10.35δ. Explain.
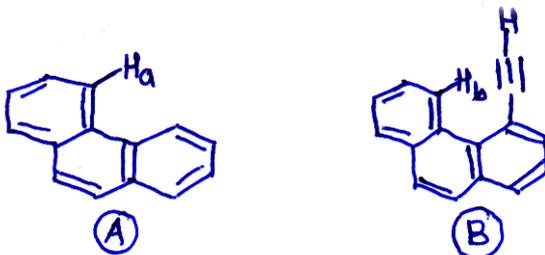
c) Deduce the structure

M.F : $C_5H_{10}O_2$

I.R. : 1200, 1770 cm^{-1}

PMR : 0.9δ ('d', 3H)

1.2δ (sextet, 2H)

2.4δ ('t', 2H)

3.8δ ('s', 3H)

d) Assign the structure

M.F : $C_6H_{12}O$

I.R. : 3120, 2937

NMR : 0.9δ 't' 3H

1.2δ 'sextet', 2H

1.7δ 'quintet' 2H

3.3δ 't', 2H

5.1δ, 'dd' 1H (J = 5 & 8Hz)

5.3δ, 'dd' 1H (J = 8 & 16Hz)

5.7δ, 'dd' 1H (J = 9 & 16Hz)

SECTION - II

Q5) An organic compound was analysed using NMR Techniques. The H^1 and C^{13} NMR along with 2-D ^{1}H-^{1}H COSY and the C-H correlation spectra are given below. Using these spectra assign the structure of the given organic compound. **[11]**

^{13}C NMR Spectrum
(150 MHz, Benzene-D$_6$ solution)

¹H - ¹H COSY Spectrum
(600 MHz, Benzene-D₆ solution)

C-H Correlation Spectrum
(¹H 600 MHz; ¹³C 150 MHz; Benzene-D₆ solution)
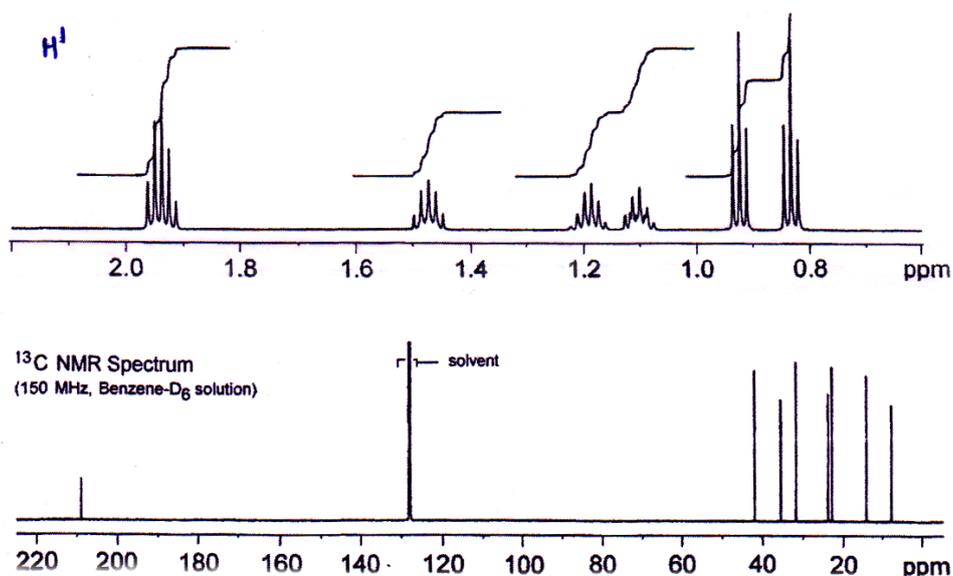
Q6) a) Assign the signals given below to the various protons in the given compound. Use the spin decoupling data for assignmensts and justify your answer. **[12]**
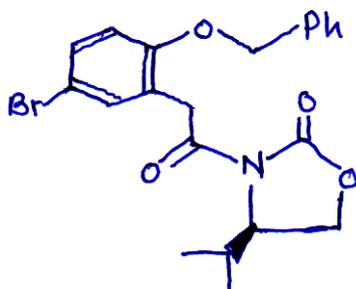
7.35 – 7.38 δ, 'm', 7H

6.79δ, 'd', J = 8.7 Hz, 1H

5.05δ, 'd', J = 11.7 Hz, 1H

5.0δ, 'd', J = 11.7 Hz, 1H

4.21δ, 'd', J = 17.5 Hz, 1H

4.31δ, 'm',   1H

4.18δ, 'd', J = 17.5 Hz, 1H

4.14δ, 'd,d', J = 3 & 9.1 Hz, 1H

4.07δ, 't', J = 9Hz, 1H

2.29δ, 'm',   1H

0.85δ, 'd', J = 7.1Hz, 3H

0.77δ, 'd', J = 7Hz, 3H

Spin decoupling Expt :
Irradiate at   change at
4.31δ   2.29δ (septet.), 4.14δ 'd', J = 9.1 Hz
                                 4.07δ, 'd', 9.1 Hz

b) Assign the signals to the numbered
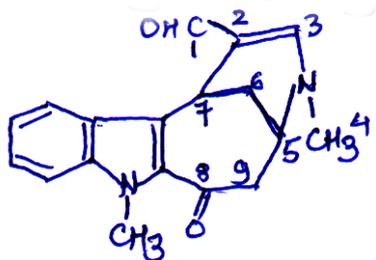
23.9 (d,w)   125.6 (s,w)

30.7 't'   153.1 d

41.5 'q'   184.9 d

48.0 't'   193.6 (s, weak)

Q7) Attempt <u>any four</u> of the following :   **[12]**

a) Differentiate the following by mass spectrometry.

 and

b) Differentiate the following compounds by mass spectrometry.

 and

c) Write the genesis of the ions given below

   85, 84, 70, 56

d) Write the genesis for the ions of ethyl isobutyl ether.
102, 87, 73, 59, 57, 45, 31

e) CH_2Cl_2 shows molecular ion peak at M^+, M+2, M+4 with intensity 3:3:1. Explain.

Q8) Attempt <u>any three</u> of the following :   **[12]**

a) Write short note on Mc-Laferty rearrangement.

b) Three isomeric compounds with mol.for.$C_6H_{14}O$ show base peak at 56, 45 and 59 respectively. Write three isomers and justify your answer.

c) A carboxylic acid with M.F. $C_{10}H_{12}O_2$ exhibit ions at 164 (M^+), 149 (100%), 119, 105, 91, 79 and 71. Deduce the structure.

d) Molecular ion peak is absent in MS for alcohol in EI technique.

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[5830]-311
M.Sc. - II
ORGANIC CHEMISTRY
CCTP-9, CHO-352: Stereochemistry 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 books.*

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

SECTION - I

Q1)   a)   Predict the product and explain stereochemistry involved.   **[5]**
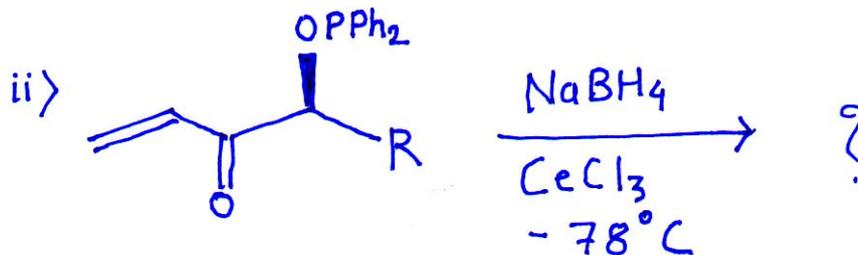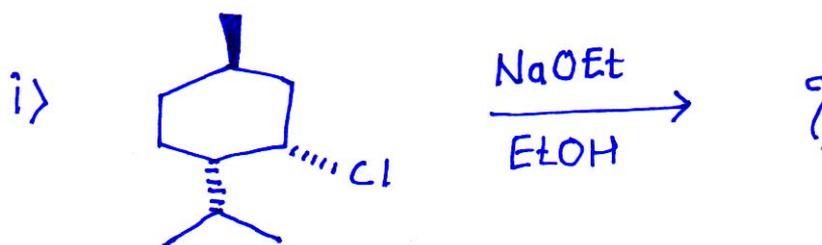
b) Explain racemic modification by formation of diastereoisomers. **[3]**

c) Draw stable conformations or stereostructure of following compounds.**[3]**

    i) 9-Borobicyclo [3.3.1] nonane

    ii) Tricyclo [2.2.1.0^{2,6}] heptane

    iii)

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

a) Write a note on Felkin-Anh rule.

b) Write a note on Von-Auwer Skita rule and Van-Arkel rule.

c) Draw conformations of trans-anti-trans and cis-anti-trans perhydroanthracene. Comment on their stability and optical activity.

d) The relative rate of saponification $K_{\frac{trans}{cis}}$ of the ethyl 4-^{t}butylcyclohexane carboxylates is 8 times higher than that of 4-^{t}butylcyclohexyl p-nitrobenzoates.

Q3) Explain <u>any four</u> of the following : **[12]**

a) Reduction of cyclobutanone by $NaBH_4$ is much easier than cyclooctanone. Explain.

b) Explain IUPAC nomenclature for bridged systems with suitable example.

c) Explain different types of polymer tacticity with example.

d) Explain diastereoselective addition to α-chiral carbonyl compounds.

e) Twistane has four stereocentres but it only exists as two enantiomers. Explain.

Q4) Suggest the mechanism and stereochemical principle involved for following (Any four) : **[12]**
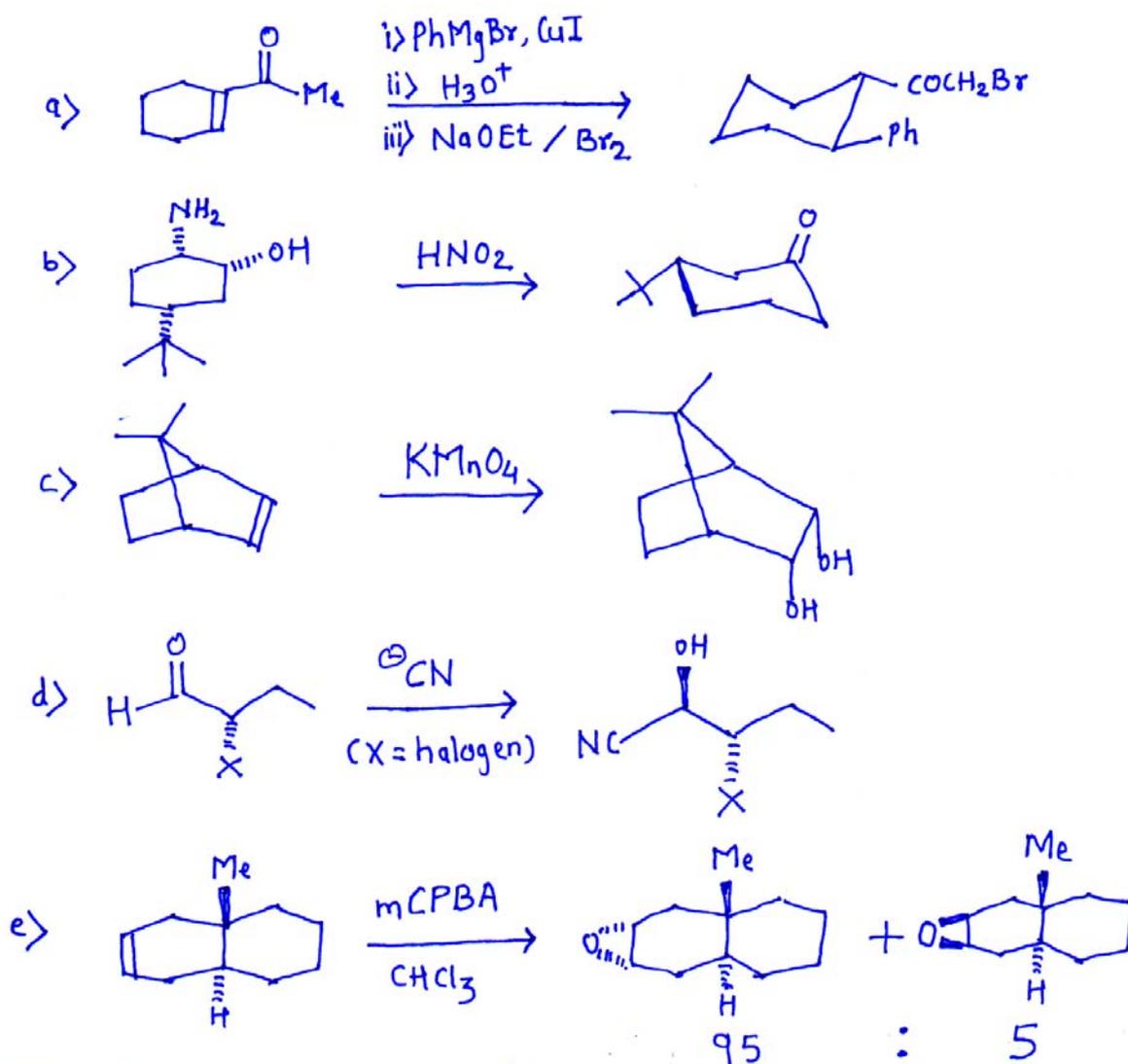
a)

b)

c)

d)

e)

Q5) a) Suggest the mechanism for the following reactions. **[5]**

i)

reactions.

i) LDA, -78°C
ii) H-ethyl ketone

(±) anti

ii)

R-CH=CH-CH(OH)-R₂

^{t}BuOOH
(+) DIPT
Ti(O^{i}Pr)₄
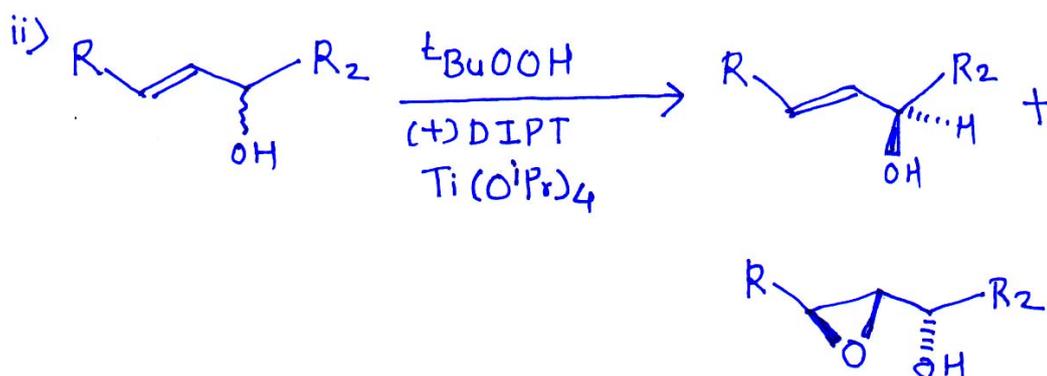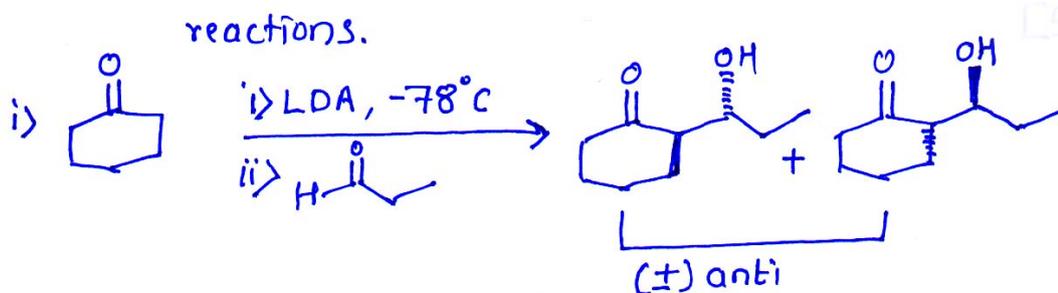
b) Attempt the following : **[6]**

   i) Calculate optical purity and % ee of asymmetric synthesis mixture which exhibits rotation of +32°. The optically pure compound has specific rotation of +40°.

   ii) Give the applications of Chiral pool synthesis.

Q6) Write a short note on <u>any three</u> of the following :　　　　　　　　**[12]**

a) Asymmetric hydrogenation.

b) Proline catalyzed aldol and mannich reactions.

c) Chiral auxilary controlled Diel's Alder reaction.

d) Iminium Based catalysis.

Q7) a) Predict the product.　　　　　　　　**[6]**

i)
$$\text{HN} \xrightarrow[\substack{\text{ii) Cyclopentadiene} \\ \text{AlCl}_3 \\ \text{iii) LiOBn}}]{\text{i)} \overset{O}{\diagup}\text{Cl, Base}} \text{?}$$

ii)
$$\text{Ph}\diagdown\diagup\text{Ph} \xrightarrow[\text{AD mixture}]{(DHQ)_2 PHAL} \text{?}$$

iii)
$$\text{BnO}\diagup\diagdown\diagup\text{OH} \xrightarrow[\text{ii) NaOH, PhSH}]{\text{i) (+)DET}} \text{?}$$

[5830]-311　　　　　　　　5
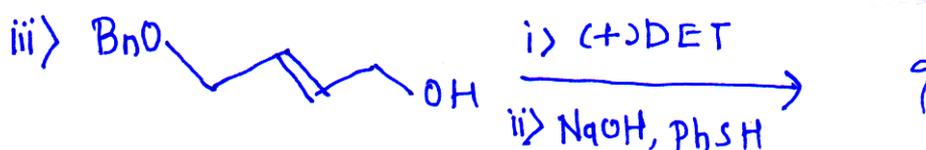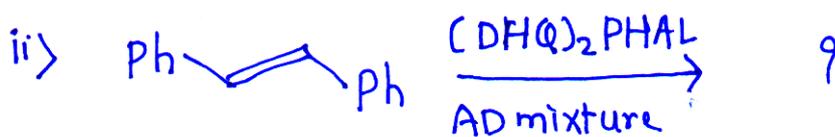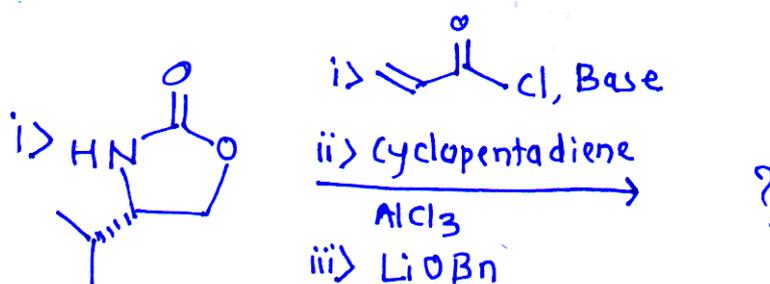
b) Explain any two of the following : [6]

    i)   Explain Corey, Bakshi and Shibata reagent in asymmetric synthesis.

    ii)   Bleach (NaOCl) is used as oxidant in Jacobsen epoxidation. Explain.

    iii) RAMP and SAMP auxilaries are prepared from different starting materials. Explain.

Q8) a) Predict the product with mechanism (Any two) : [6]
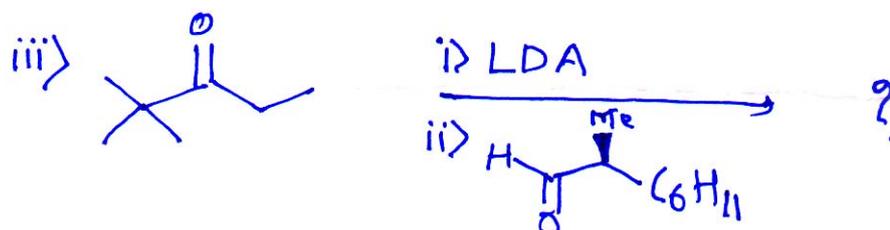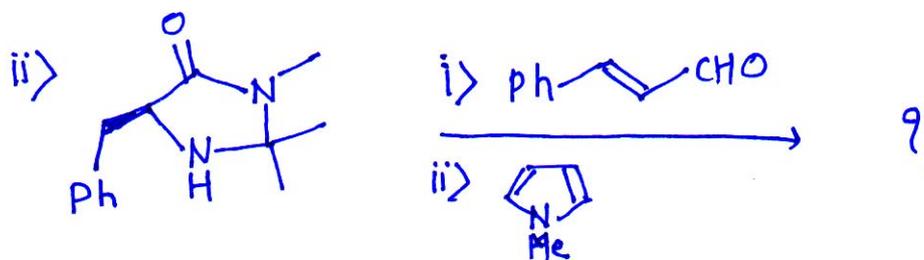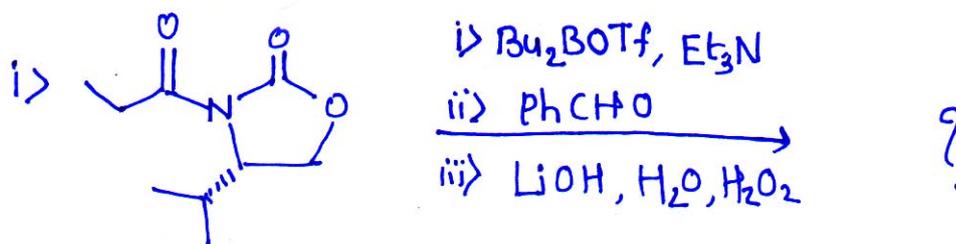
b) Attempt the following :   [6]

    i)   Heathcock and Masamune auxilaries for selective aldol reaction.

    ii)   What is the relationship between $(DHQD)_2$ PHAL and $(DHQ)_2$PHAL. Explain why they preferred over OsO_4 or $KMnO_4$ dihydroxylation.

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[5830]-312
M.Sc. - II
ORGANIC CHEMISTRY
CBOP-3 : CHO-353A: 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 marks each.*
  2)   *Attempt any two questions from Q.2 to Q.4 and two question from Q.6 to Q.8.*
  3)   *Answers to the two sections should be written in separate answer books.*
  4)   *Figures to the right indicate full marks.*

SECTION - I

Q1)   a)   Explain with mechanism, protection of alcohol by using Benzyl chloride and Acetic anhydride in pyridine with suitable examples. Suggest suitable reagents for deprotection.   **[5]**

      b)   Explain with mechanism, protection of carbonyl with suitable examples and suggest suitable reagents for deprotection.   **[6]**

Q2)   Explain in details the synthesis of (-) quinic acid from D-arabinose.   **[12]**

                               OR

Explain in details the synthesis of (-) shikimic acid from D-arabinose.

Q3)   Explain the synthesis of (s)-propanediol from D-mannitol.   **[12]**

                               OR

Write the synthesis of polypeptide in alternate sequence of L-glycine and L-Leucine using solid phase peptide synthesis approach.

Q4) Attempt any three from following : **[12]**

a)
1. NaH/THF
2. BnBr
3. MeOH, Cat CSA
→ A →
1. TBSCl, iPr₂NEt, DCM
2. H₂, Pd-C, EtOH
3. PCC/DCM
B.
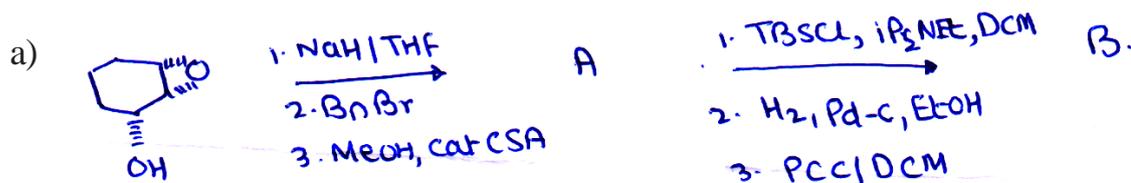
b) Arrange the reagents sequentially with mechanism
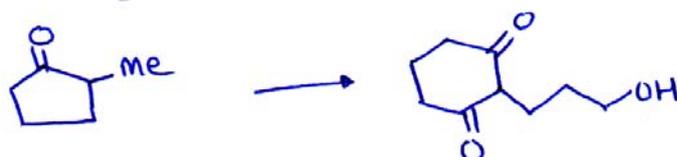
H₃O⁺ ; LiAlH₄ ; TrCl, Py ; mCPBA ; swern oxidation;

Base ; OMe

c)
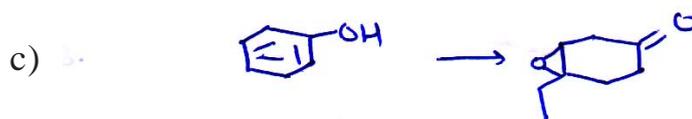
Na/NH₃, tBuOH; H₃O⁺ ; Et Br, AlCl₃; mCPBA; H⁺, HO‿OH ;

CH₃Br .

d)
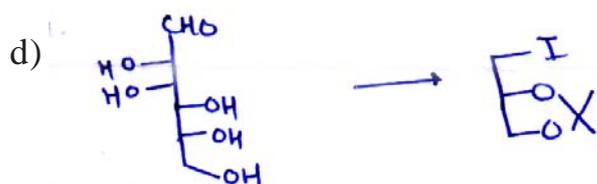
NaI Acetone ; Raney Ni ; Pd(OAc)₄ ; NaBH₄ ; Acetone

2moles : Ts-Cl, Py.

SECTION - II

Q5) a) Draw the $^4C_1$ and $^1C_4$ conformation of D-allose and D-glucose pyranose. **[5]**

b) How will you prepare following glycosides from D-Rahmonse and D-glucose. **[6]**
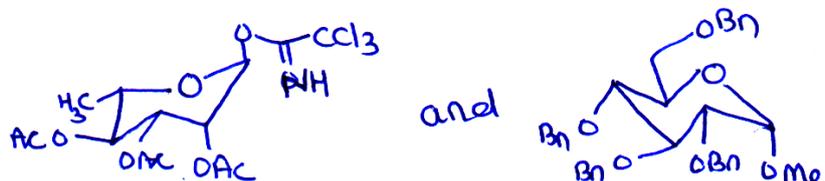
Q6) a) What are glycosyl donor and glycosyl acceptor? Explain the preparation of trichloroacetimidate glycosides and it's use in preparation of β 1, 4 glycosidic linkage. **[12]**

OR

Write the role of BAHA reagent? What do you mean by thioglycosyl acceptor?

Q7) Explain any two of the following: **[12]**

a) Kiliani fischer synthesis of D-hexoses.

b) Reductive and oxidative cleavage of benzylidene acetals.

c) Oligosacharides from D-glucose.

Q8) Write the correct structure of A,B,C,D and E in the following synthesis and justify your answer : **[12]**

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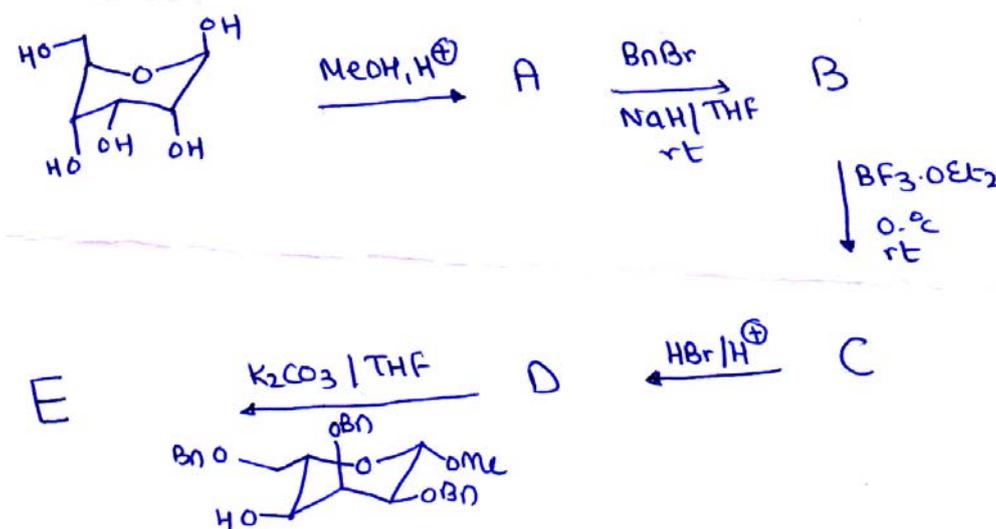
P332

[5830]-312
M.Sc. - II
ORGANIC CHEMISTRY
CBOP-3 : CHO-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 questions from Q.2 to Q.4 and two question from Q.6 to Q.8.*
  3)   *Answers to the two sections should be written in separate answer books.*
  4)   *Figures to the right indicate full marks.*

SECTION - I

Q1) a) Attempt the following :   **[5]**

  i)   Define retrosynthesis and give disadvantages of linear synthesis with examples.

  ii)   How to carry out following transformation.
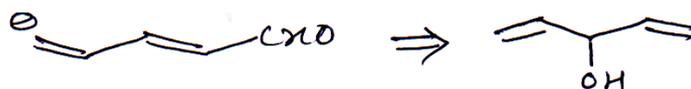
  b) Answer the following :   **[6]**

  i)   What are the advantages of convergent synthesis? Explain with suitable example.

  ii)   Explain the use of 1,3-dithiane in umpolung.

  iii) Predict the product for the following photochemical reaction.
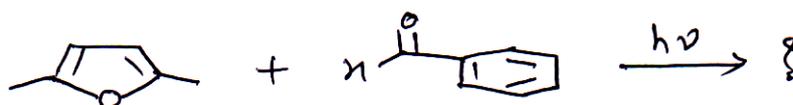
Q2) Using retrosynthetic analysis, suggest suitable method for the synthesis of
following compounds (Any three) : **[12]**

a)

b)

c)

d)
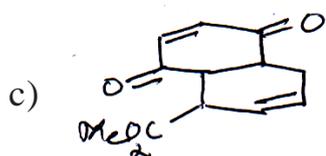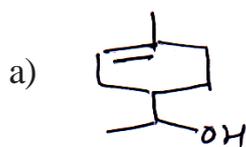
Q3) How would you make these compounds using disconnection approach
(any four) : **[12]**

a)

b)

c)

d)

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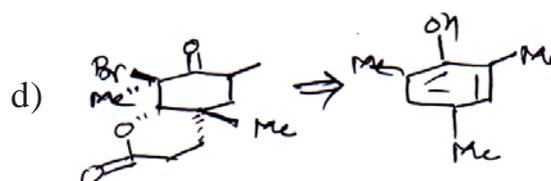
Q4) Answer the following (any three) : **[12]**

a) Explain the disconnection in 1,4-dicarbonyl compounds with suitable
example.

b) Explain the retrosynthetic analysis of quinoline.

c) Write a short note on retrosynthetic analysis of thienamycin molecule.

d) Write a short note on retrosynthetic analysis of Indolizomycin molecule.

SECTION - II

Q5) a) Complete the following reaction sequence and write the structures for A, B and C. **[6]**

i)

ii)
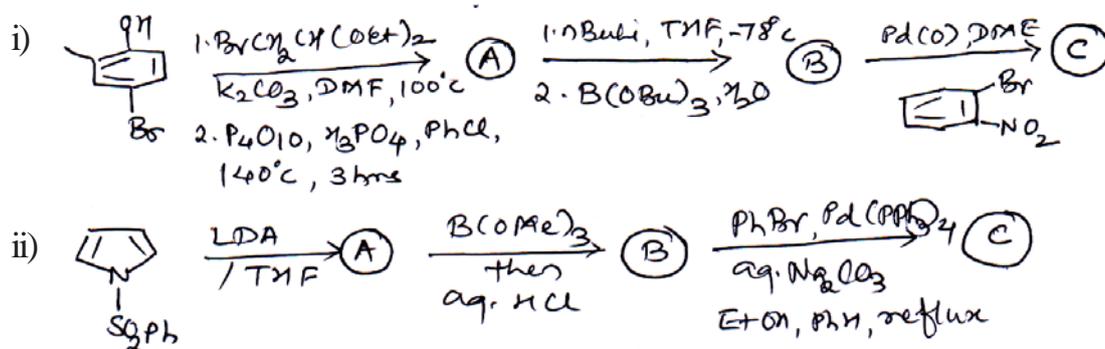
b) Predict the product/s for the following : **[5]**

   i) Reaction of furan with

      I) DMF, $POCl_3$, ag. Na_2CO_3

      II n BuLi/hexane/0°C then iP_rI

      III)
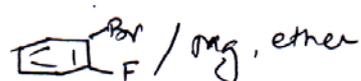
   ii) Reaction of 2,3-dimethyl pyridine with

      I) LDA, then MeI

      II NBS, $(PhCO_2)_2$ then PhSx

      III) BuLi then Ph_2S

Q6) Write short note on any four of the following : **[12]**

   a) Hantzsch Pyridine synthesis.

   b) Paal knorr thiophene synthesis.

   c) Fischer Indo synthesis.

   d) Combis quinoline synthesis.

   e) Feist-Benary synthesis of furan.

Q7) Complete the reaction sequence, write the suitable mechanism and predict the product/s (Any three) : **[12]**

a) $\xrightarrow[\text{/pentane}]{n\text{BuLi}} \xrightarrow{-78°C}$? $\xrightarrow[\text{/THF}]{Ph_2CO}$?

b) $\xrightarrow{\text{/SiO}_2}$? $\xrightarrow[2.\,Ph\text{—I}]{1.\,n\text{BuLi}}$?

c) $\xrightarrow{O_3 \text{/Me}_2S}$? $\xrightarrow[\text{/H}^\oplus]{Ph\,CH_2NH_2}$?

d) $\xrightarrow[\substack{Pd Cl_2(PPh_3)_2 \\ CuI/Et_3N}]{Ph\text{—}\equiv\text{—}H}$? $\xrightarrow[\substack{\text{/EtOH} \\ 90°C}]{NaOH}$?
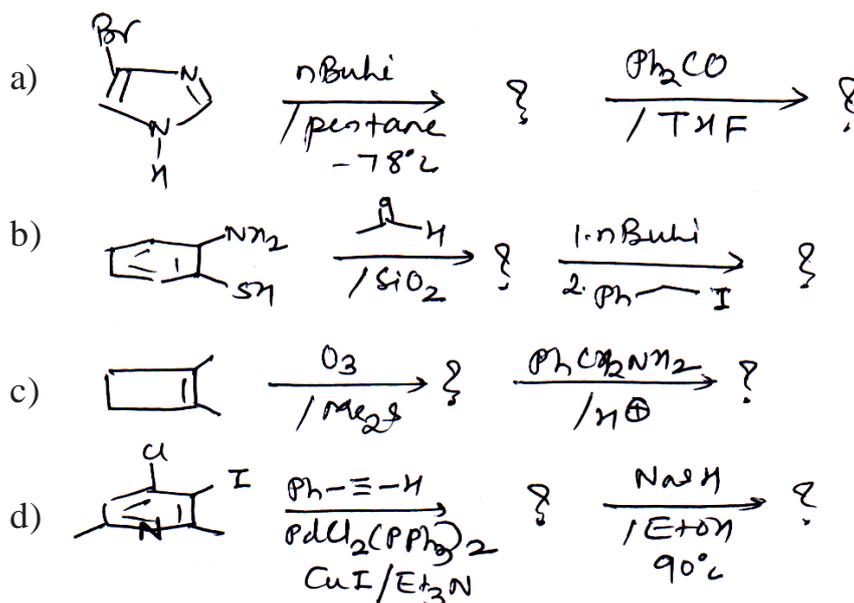
Q8) Answer the following (Any three) : **[12]**

a) Predict the structures of high yield mononitration products :

   i) $C_{16}H_{12}N_2O_2$ from 1-benzyl isoquinoline

   ii) $C_{10}H_8N_2O_3$ from 6-methoxy quinoline

   iii) $C_{10}H_8N_2O_3$ from 7-methoxy isoquinoline

b) Draw the structure for the intermediate and final product $(C_{10}H_{12}O_6)$ formed when 5-ethoxy oxazole is heated with dimethyl acetylene dicarboxylate.

c) Deduce a structure and write out the mechanism for the conversion of 2-formyl indole into a tricyclic compound $C_{11}x_9N$, on treatment with a combination of NaH and $Ph_3\overset{\oplus}{P}\,cn=cn_2\,Pr^\ominus$

d) Arrange the heterocycles : Indole, pyridine, benzofuran and pyrrole in the increasing order as per their reactivity toward electrophilic substitution reaction.

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[5830]-313

M.Sc. (Analytical Chemistry)
390 : Electrochemical and Thermogravimetric Methods of Chemical Analysis
(2019 Pattern) (Semester - III)

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

Instructions to the candidates:

1) *Question 1 and 5 are compulsory.*
2) *Question 2 to 4 and 6 to 8 carry equal marks.*
3) *Solve any 2 questions from 2 to 4 and 6 to 8.*
4) *Figures to the right indicate full marks.*
5) *Use of Logaithmic table calculator is allowed.*
6) *Answers to two section should be written on seprate answer sheet.*

SECTION - I

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

   i)   State first law of electrolysis.

   ii) Give advantages of DME.

   iii) Give use of supporting electrolyte.

   iv) Write Ilkovic equation explain terms involved.

   v)   Sketch and label oxygen sensor.

   b)   Solution of copper ion of concentration 1.0 mm the limiting current is 8.76 µA & capillary constant value found to be 1.9987 calculate diffusion coefficient of Cu^2 t.   **[3]**

Q2) a)   Differentiate between the following :   **[6]**

   i)   Quasireversible and irreversible cyclic rottametry.

   ii) Primary coulometry and secondary coulometry titration.

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

   i)   Draw polarogram and explain factors affecting polarographic Analysis.

   ii) Explain construction & working of rotating ring microelectrode.

P.T.O.

Q3) a) State the principle of square wave polarography. Give its application in Cu & Zn from water. **[6]**

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

   i) What is mediator? Give role of mediator in coulometric titration.

   ii) The fe(II) 0.8202 gm sample was determined by coulometric reduction to zn at platinum cathode. Calculate the % of $Fe_2(SO_4)_3$ Std. mw (399.88) gm/mole in the sample. If 103.277c were required for reduction.

Q4) a) What is hydrodynamic roltametry? Describe in detail application of hydrodynamic roltametry. **[6]**

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

   i) Explain criteria of reversibility of electrochemical reaction.

   ii) In a particular analysis cu $C = 1 \times 10^{-4}$ m $Id_1 = 17.5$ μA. and for unknown solution of copper $Id_2 = 27.9$ μA. What would be the concentrate of unknown solution with other factor constant.

SECTION - II

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

   i) Crystalline phase trasition.

   ii) Explain term polymer blends.

   iii) Give factors affecting thermal analysis.

   iv) Define thermomechanical analysis.

   v) Power compensate DSC.

b) The curve was obtained for 8.80mg of sample. Containg $CuSO_4.5H_2O$ when the monohydrate formation was completed at 200°C. The loss in mass 0.99mg find the percentage of $CuSO_4.5H_2O$ in the sample. [Given A.t.wt Cu = 63.54, S = 32.0, O = 16.0 H = 1.0] **[3]**

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

   i)   Application of dynamic mechanical analysis.

   ii) Explain detection and identification of evolved gas by EGA.

   b) State the principle of TG-DTA. Draw and explain components of TG-DTA Analysis. **[6]**

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

   i)   Explain physical changes and mesurement of application for DSC.

   ii) Write a note on dielectric thermal analysis.

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

   i)   Write a note on heat flux DSC.

   ii) When heating rate changes on DSC or DTA instrument without changing sensitivity what will be the effect on the base live endothermic metting peak and exothermic reaction peak.

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

   i)   Draw and explain the curve of calcuim oxalate monohydrate [$CaC_2O_4.H_2O$]

   ii) Write a note on TA Infrared.

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

   i)   Draw and explain instrumentation of TMA.

   ii) What is mean by thermomicroscopy. Give any two applications.

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[5830]-314

M.Sc. (Part - II)

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 and 5 is compulsory.*

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

3) *Solve any 2 questions from 2 to 4 and solve 2 questions form 6 to 8.*

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

5) *Use of Logarithmic tables and scientific calculator is allowed.*

SECTION - I

Q1) a) Solve <u>any four</u> of the following :   **[8]**

   i) Define LOQ.

   ii) What is meant by ruggedness?

   iii) Define random error.

   iv) What is transfer waiver?

   v) Give 2 features of Dissolution apparatus USP Type 2.

   b) Solve the following :   **[3]**

   In an analysis of a sample of Bronze the expected percentage of Tin is 11%. The values obtained by three analysts are 10.5%, 12% and 12.6%. Estimate the absolute error, relative error and percentage error.

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

   i) Covalidation between two laboratories.

   ii) Factors affecting dissolution process.

P.T.O.

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

    i) Discuss two point calibration approach.

    ii) The following data was collected as a part of quality control study for the analysis of a pharmaceutical formulation with respect to calcium as : 15%, 16%, 18%, 20%, 21%. Estimate the mean, median and range for the above data.

Q3) a) Discuss the European community guidelines as given under ICH. **[6]**

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

    i) Define :

        a) Confidence interval

        b) Variance

    ii) What is slope and intercept? Explain.

Q4) a) Discuss in detail various aspects of ICH. **[6]**

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

    i) Explain the parameters of range and linearity.

    ii) A standard containing 1-8 ppm of nitrate nitrogen was treated with colourizing agents to give an abcorbance of 0.26 at 507 nm. A sample treated in the same manner gave an absorbance of 0.18 at the same wavelength. Determine the concentration of nitrate nitrogen in this sample.

SECTION - II

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

    i) What is headspace SPME.

    ii) Enlist components of Microwave system.

    iii) What are function of the SPME holder.

    iv) What is solvent extraction give classification of liquid-liquid extraction.

    v) Give examples of normal phase sorbent system.

b) Attempt the following : **[3]**

A metal x was found to be extracted to extend of 96% into methylene chloride at pH = 5 when equal volume of aqeous and organic solvent were used y metal was high percentage extracted under the same condition. What is separating coefficient for these two metals at pH = 5 and calculate the distribution ratio for x and y.

[Given : percent extraction for y metal = 4%]

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

i) Explain in detail determination of be as the acetylacetone complex.

ii) Explain in detail SPE formats and apparatus.

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

i) A 20 ml of water containing 0.1 gm of analyte is to undergo liquid-liquid extraction by shaking with 25 ml of an organic phase. It is known that the distribution ratio for the analyte is 1/70 then compare the results of,

a) Two extractions each using 10 ml of organic phase.

b) Three extractions each using 9 ml of organic phase.

ii) Give any one applications of pressurised fluid extractions.

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

i) Explain in detail :

a) Batch extractions

b) Continuous extractions

ii) Give any one applications of Normal phase SPE.

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

i) Describe automation and online SPE with diagram.

ii) Draw schematic diagram of pressurised MAE and explain its working.

Q8) a) Attempt the following : [6]

  i) Give theoretical considerations of SPME.

  ii) Explain in detail determination of copper as diethyl dithiocorbamate complex.

 b) Attempt the following : [6]

  i) Give factors affecting on SPE.

  ii) Explain the process of coupling of SPME with HPLC.

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[5830]-315

M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CCTP-9, CHA - 392
Advanced Chromatographic Methods of Chemical Analysis
(2019 Pattern) (Semseter - III) (4 - Credits)

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

Instructions to the candidates:

1) *Answers to two sections must be written separately.*
2) *Figures to the right indicate full marks.*
3) *Use of logtable and calculators is allowed.*
4) *Neat labelled diagram must be drawn wherever necessary.*

SECTION - I

Note : i) Q. 1 is compulsory.

ii) From Q. 2 to 4 solve any two.

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

i) Give the names of different stationary phases used in gas chromatography.

ii) What is split and splitless injection in gas chromatography?

iii) Give the principle of electron ionization method.

iv) What is HETP? How it is calculated.

v) Give the four factors affecting retention data.

b) Solve the following :   **[3]**

substances A and B have rotation times of 16.40 and 17.63 min. respectively, on a 30.0 cm coloumn. An unretained species passes through the coloumn in 1.30 min. The peak widths (at base) for A and B are 1.11 and 1.21 min. respectively. Calculate (a) the coloumn resolution (b) over age number of plates in the coloumn and (c) the plate height.

P.T.O.

Q2) a) Explain in detail : [6]

   i)   Steps in interpretation of mass spectra.

   ii) Biller - Biemann stripping technique.

b) Solve the following : [6]

   i)   Give the difference between GC and HPLC.

   ii) The following data are for a liquid chromatograph coloumn.

   Length of packing   = 24.7 cm

   Flow rate   = 0.313 nl/min.

   V_m = 0.37 ml

   V_s = 0.164 ml

A chromatogram of a mixture of species A, B, C and D the following data:

	Retention Time (min)	Width of peak Base (w) (min)
Non-retained	3.1	-
A	5.4	0.41
B	13.3	1.07
C	14.1	1.16
D	21.6	1.72

Calculate :

   1) The number of plates from each peak.

   2) The mean and the standard deviation for N.

   3) The plate height for the coloumn.

Q3) a) Discuss the following : [6]

   i)   Interfaces in Gas chromatography-mass spectrometers (GC-MS)

   ii) Solvent effect in gas chromatography.

b) Solve the following : [6]

   i)   What are the different analysis methods in LC - MS.

   ii) Explain coloumn used in GC.

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

     i)   Discuss the nitrogen rule and rings plus double bonds in details.

     ii)   Determination of sucrdse as its trimethylsilyl derivative using gas-liquid chromatography.

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

     i)   Enlist the diffenent mass analysers used in MS. Explain any one in detail.

     ii)   Calculate the resolution of the two compound (A and B)

       if, $tR_A = 13.45$

         $tR_B = 12.4$

         $W_A = 0.5$

         $W_B = 0.5$

SECTION - II

Note : i)   Q. 5 is compulsory.

    ii)   From Q. 6 to 8 solve any two.

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

     i)   When mixture of polar and non plolar substances is passed through column containing non-polar stationary phase, then which component will elute first? Why?

     ii)   What is noice? What are of types of noice?

     iii) What are the functions of precolumn?

     iv)   Give the principle of ion exchange chromatography.

     v)   What is gradient elution in HPLC?

  b)   Caffeine sample was analysed caffeine content by HPLC. The peak area for standard containing 0.02 mg/ml caffeine showed peak area 2050 mV sec. 0.1 g sample was extracted in 25ml mobile phase which showed peak area 2530 mVsec. Calculate perceut caffeine in sample.   **[3]**

Q6) a) Answer the following : [6]

　i) Explain molecular mass determination by size exclusion chromatography.

　ii) Construction and working of fluorescence detector in HPLC.

b) Attempt the following : [6]

　i) What is chemically modified silica? Explain C-18 modified silica as stationary phase in HPLC.

　ii) Explain different criterion in selection of mobile phase in HPLC experiment.

Q7) a) What is interface in LC-MS? What is the function of interface in LC-MS? Explain thermo-spray interface in detail. [6]

b) Answer the following : [6]

　i) Discuss loop-valve for sample injection in HPLC instrument.

　ii) With flow rate of 1 ml min^{-1}, a peak has retention time 2.6 min. on a column with 7900 theoretical plates. What is the maximum length for 5% peak broadeing if either a 0.25 mm i.d. or a 0.18 mm i.d. capillary is used.

Q8) a) Wrtie notes on the following : [6]

　i) Electrophoretic series.

　ii) Qualitative analysis by HPLC.

b) Answer the following : [6]

　i) Explain peak height and peak area determination in HPLC.

　ii) What is supercritical fluid chromatography? Explain advantages of super critical fluid chromatography over GC and HPLC.

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[5830]-316
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) *Answers to two sections should be written on separate answer books.*
2) *Figures to right indicate full marks.*
3) *Use of logtable and calculator is allowed.*

SECTION - I

Instructions to the candidates :

1) *Question 1 is compulsory.*
2) *From Questions 2 to 4 solve any two.*

Q1) a) Solve any four from the following : **[8]**

　　　i) What are the three types of electrophoretic system?

　　　ii) Give any two application of capillary electrophoresis.

　　　iii) Define HPTLC. How it differs from TLC technique.

　　　iv) What is the role of support media in electrophoresis?

　　　v) What is zone electrophoresis?

　　b) Give the effect of support media and pH of buffer on electrophoretic mobility. **[3]**

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

　　　i) Explain in detail isoelectric focus.

　　　ii) Discuss ampherometric detector in electrophoresis.

　　b) Explain in details electrophoretic migration. **[6]**

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

     i)   Write note on UV-Visible absorbance detection in capilliary electrophoresis.

     ii)   What is derivatization? Explain pre and post-column derivatization method.

   b)   Give the principle of electrophoresis. Explain zone electrophoresis with respect to use of support media, density gradient stabilization and free zone electrophoresis.   **[6]**

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

     i)   Write note on electrokinetic injection in capillary electrophoresis.

     ii)   What is the difference between TLC and HPTLC.

   b)   Explain mass-spectrometric detection in TLC with respect to direct plate extraction. Discuss HPTLC method for quantitative analysis.   **[6]**

SECTION - II

Instructions to the candidates :

   1)   *Q.5 is compulsory.*

   2)   *From 6 to 8 solve any two.*

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

     i)   What are anticoagulant? Give two examples.

     ii)   Why 24h urine is collected for clinical analysis?

     iii)   What are water soluble vitamins? Give four examples of water soluble vitamins.

     iv)   What is direct ELISA?

     v)   Give defficiency symptoms of vitamin B-1.

   b)   Blood sample was analysed for Na^+ content by flame photometry. 20 ppm standard sample showed flame intensity 35.5 ml blood sample on treatment diluted to 100 ml. Flame intensity for sample was 25. Calculate mg of Na^+ in 100 ml blood.   **[3]**

Q6) a) Discuss the following : [6]

     i) Oral glucose tolerance test.

     ii) Serum urea determination by urease method.

  b) Answer the following : [6]

     i) Explain colorimetric method for the determination of serum phosphate level.

     ii) 1 ml 25 micromole per litre creatinine standard was treated with protein precipitant and coloring reagent. It displayed absorbance 0.280 at 520 nm. 1 ml serum sample was similarly treated which displayed absorbance 0.250. Calculate blood creatinine in micromole per litre.

Q7) a) Explain the following : [6]

     i) Estimation of vitamin-C by volumetric method.

     ii) Estimation of vitamin B-2 by fluorometric method.

  b) Answer the following : [6]

     i) What are antibodies? Explain two types of antibodies in detail.

     ii) Explain glucose oxidase method for the estimation of blood glucose level.

Q8) a) What is indirect ELISA? What are the differences between direct and indirect ELISA? Explain indirect ELISA method in detail. [6]

  b) Answer the following : [6]

     i) Discuss antibody production in response to infecious agents.

     ii) Blood glucose level was analysed by enzymatic method. 100 microliter 1.8 g/l glucose treated with coloring agent displayed absorbance 0.260. Similarly treated 100 microlitre blood sample displayed absorbance 0.220. Calculate mg of glucose in 100 ml blood sample.

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[5830]-316
M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CBOP-3, CHA-393(B) : Analysis of Food and Controlled Substances
(2019 Pattern) (Semester - III)

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

Instructions to the candidates :
1) *Answers to two sections should be written on separate answer books.*
2) *Figures to right indicate full marks.*
3) *Use of logtables and calculators is allowed.*

SECTION - I

Instructions to the candidates :
1) *Question 1 is compulsory.*
2) *Solve any two form Que. 2 to 4.*

Q1) a)   Attempt any four of the following :   **[8]**
         i)   Write the principal of Karl-Fischer method.
         ii)   Why sampling plan is needed?
         iii)   Write different reagents used in wet digestion method.
         iv)   Write the principal of Bicinchoninic acid method.
         v)   Give the significance of food analysis.

     b)   2.18 gm of Saccharine sample was analyzed for Saccharin content and it required 1.6 ml of 0.11 N NaOH. Calculate the percentage of Saccharin in the sample. (MW of Saccharin = 183.2)   **[3]**

Q2) a)   Attempt the following :   **[6]**
         i)   Describe Nelson-Somyogi method for the determination of total reducing sugars.
         ii)   How is p-hydroxybenzoate estimated from food sample?

     b)   i)   Outline an analytical method for the determination of nitrogen from proteins by Kjeldanle method.   **[3]**
         ii)   A biological sample was analyzed for Net Protein Utilization, Digestibility and Biological value. If nitrogen retained, nitrogen absorbed and nitrogen intake from protein by rat was 1.85 mg, 1.25 mg and 9.37 mg respectively, Calculate NPU, BV and D.   **[3]**

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

    i) Discuss Dumas method for protein analysis.

    ii) What are preservatives? Give their classification with suitable examples.

   b) i) Outline an analytical method for the determination of saponification value of oil. **[3]**

    ii) A 5 gm sample of oil was saponified with excess KOH. The unreacted KOH was then titrated with 0.5 N HCl. The difference between the blank and the sample was 25.8 ml of titrant. Calculate the saponification value of oil. **[3]**

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

    i) Describe the Babcock method for the determination of milk fat.

    ii) 31.8 gm of sulphite containing food sample was subjected to Tanner's method and the titre value obtained with 0.01 M NaOH was 8.9 ml. Calculate the amount of SO_2 in the sample.

   b) i) Describe the specific analysis of mono and digosaccharides by Gas chromatography. **[3]**

    ii) Describe a suitable method for the determination of total starch.**[3]**

SECTION - II

Instructions to the candidates :

   1) **Q.5 is compulsory.**

   2) **Solve any two from Que. 6 to 8.**

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

    i) Define :

       a) Addict

       b) Illicit traffic

    ii) What are barbiturates?

    iii) Explain Mandelin Test.

    iv) What are microcrystal techniques?

    v) Give the origin and sources of cannabis.

b) A sample of drug was analyzed by TLC with distance travelled by solvent was 17.4 cm. The Amobarbital, Pentobarbital and Phenobarbital shows R_f values of 0.226, 0.729 and 0.855 respectively. Calculate the distance travelled by each barbiturate in the sample. **[3]**

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

   i) Write a note on the products of <u>Catha edulis</u>.

   ii) What are benzodiazepines? Write the structures of most commonly abused benzodiazepines.

b) i) Write a note on TLC of LSD. **[3]**

   ii) Discuss the GC-MS identification of Heroin. **[3]**

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

   i) Describe the presumptive tests for amphetamines.

   ii) Explain the quantification of cocaine by UV-spectroscopy.

b) i) Explain the HPLC analysis of mescaline. **[3]**

   ii) Explain the extraction of LSD prior to analysis. **[3]**

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

   i) Explain the identification of cannabis by GC-MS.

   ii) Discuss the manufacturing of diamorphine.

b) i) Discuss the analysis of amphetamines by TLC. **[3]**

   ii) If the concentration of cocaine in the reference standard is 50 mg/ml, peak height of cocaine in the sample and reference standard is 60 min and 70 min respectively. Calculate the concentration of cocaine in the given sample. **[3]**

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[5830]-401

M.Sc. - II (Semester - IV)

PHYSICAL CHEMISTRY

CCTP-10, CHP - 410 : Molecular Structure and Spectroscopy

(2019 Pattern) (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	=	6.023×10^{23} mol^{-1}
2)	Boltzmann Constant	k	=	1.38×10^{-16} erg K^{-1} molecule^{-1}
			=	1.38×10^{-23} J K^{-1} molecule^{-1}
3)	Planck Constant	h	=	6.626×10^{-16} erg s
			=	6.626×10^{-34} J s
4)	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5)	leV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6)	Gas Constant	R	=	8.314×10^7 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	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^8 m s^{-1}
9)	1 cal		=	4.187×10^7 erg
			=	4.187 J
10)	1 amu		=	1.673×10^{-27} kg
11)	Bohr Magneton	β_e	=	-9.274×10^{-24} J T^{-1}
12)	Nuclear Magneton	β_n	=	5.051×10^{-27} J T^{-1}
13)	Mass of an electron	m_e	=	9.11×10^{-31} kg

SECTION - I

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

    i) Define chemical shift in NMR spectroscopy.

    ii) What is spin coupling?

    iii) What is Kramer's degeneracy?

    iv) Explain Principle of ESR.

    v) What is quadrupole moment?

  b) Compare the number of lines in esr of radicals. $\cdot XH_2$ and $\cdot XD_2$

    [$\cdot X$spin state is 5/2]. **[3]**

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

    i) Explain the concept of electric field gradient.

    ii) Explain the factors affecting g-value.

  b) Attempt the following :

    i) Define the term spin Hamiltonian in esr spectroscopy. **[3]**

    ii) Explain the term quadrupole coupling constant. **[3]**

Q3) a) Explain the instrumentation involved in high resolution nmr spectroscopy.
    [6]

  b) Attempt the following :

    i) Write a note on ^{13}C spectroscopy? **[3]**

    ii) Explain the term with respect to nmr spectroscopy. **[3]**

      1) Shielding.

      2) Deshielding.

      3) Coupling constant.

Q4) a) Discuss the advantages of FT-NMR. **[6]**

b) Attempt the following :

i) Explain the term spin density with respect to esr spectroscopy. **[3]**

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} (I = ½ for ^{13}C). **[3]**

SECTION - II

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

i) State and explain Wierl equation.

ii) Explain the term paramagnetic susceptibility.

iii) Which reflection can not be observe for a primitive cubic lattice and why?

iv) State and explain Curie law.

v) Explain the terms nuclear and magnetic scattering.

b) Calculate the typical wavelength of neutron that have reached thermal equilibrium with their surrounding at 373k. (Given mass of neutron = 1.675×10^{-27} kg). **[3]**

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

i) Explain the Faraday method of measuring magnetic susceptibility.

ii) Describe the phase problem in XRD and explain how it may be overcome.

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

i) How electron diffraction method is used for elucidation of structure of simple gas phase molecule?

ii) Calculate the molar susceptibility of benzene given that its volume susceptibility is -7.2×10^{-7} and its density 0.879 gcm^{-3} at 25°C.

Q7) a) Answer the following :   [6]

    i)   Explain neutron diffraction analysis method for a elucidation of structure of magnetically order unit cell with suitable example.

    ii) What is mean by systematic absence? How do they arise for Body Centre Cubic Unit Cell?

   b) Answer the following :   [6]

    i)   Explain low energy electron diffraction technique.

    ii) Explain the terms Ferro, Ferri and Antiferromagnetism.

Q8) a) Answer the following :   [6]

    i)   Explain, how X-ray diffraction can be used to determine the absolute configuration of molecule?

    ii) Write a note on elastic scattering of neutron.

   b) Answer the following :   [6]

    i)   How scattering intensity is related to scattering angle?

    ii) Calculate Structural Factor F(hkl) for the Face-Centred Cubic (FCC) lattice and there from determine which reflection would be absent from diffraction pattern.

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[5830]-402

M.Sc. - II

PHYSICAL CHEMISTRY

CCTP-11, 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 Q2, Q3 and Q4 and any 2 quetions 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	$= 6.626 \times 10^{-16}\,erg\,s$
			$= 6.626 \times 10^{-34}\,J\,s$
4)	Electronic Charge	e	$= 4.803 \times 10^{-10}\,esu$
			$= 1.602 \times 10^{-19}\,C$
5)	leV		$= 23.06\,k\,cal\,mol^{-1}$
			$= 1.602 \times 10^{-12}\,erg$
			$= 1.602 \times 10^{-19}\,J$
			$= 8065.5\,cm^{-1}$
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	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 [35]

Surface Chemistry

Q1) a) Solve any four : [8]

   i) What is differential heat of adsorption?

   ii) Write the relationship between adsorption and surface tension and define the terms in it.

   iii) Give the assumptions of polarization theory for multilayer adsorption.

   iv) What is hysteresis of adsorption?

   v) What is wetting phenomenon?

   b) Solve the following : [3]

   The adsorption of a gas is described by Langmuir isotherm with $K = 0.85$ kPa^{-1} at 25ºC. Find the pressure at which surface coverage is 95%.

Q2) a) Answer the following : [6]

   i) Describe the assumptions of B.E.T. theory for multilayer adsorption.

   ii) Describe mercury porosity meter method of determination of pore size.

   b) Answer the following : [6]

   i) Describe the tracer method for verification of Gibbs adsorption equation.

   ii) Describe with neat labelled diagram, the volumetric method of measurement of adsorption.

Q3) a) Derive the equation for isosteric heat of adsorption. [6]

   b) Answer the following : [6]

   i) Discuss Forth Flotation technique.

   ii) Explain the mechanism of chemisorption of transition metal.

Q4) a) Derive and explain Gibb's adsorption equation. **[6]**

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

i) Explain isothermal method for measurement of heat of adsorption.

ii) The adsorption of butane vapour on a catalyst have been studied and following results are obtained.

P	56.39	89.47	156.61	187.46
V	17.09	20.62	26.09	28.30

Calculate the value of area of cross section by B.E.T.

Given : $P_0 = 774.4$ mmH$_g$

$\sigma = 44.6 \overset{\circ 2}{A}$

weight of catalyst = 1.876 gm

SECTION - II **[35]**

Electrochemistry

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

i) Write Nernst equation and explain the terms in it.

ii) What is diffusion? Explain with suitable example.

iii) What are fuel cells?

iv) What is liquid junction potential? How it is nullified?

v) Write Butler - Volmer equation & explain the terms in it.

b) Calculate the emf of the cell at 25ºC. **[3]**

$\ominus$ Co|Co^{2+} ($a_1 = 0.01$) || Ni $^{2+}$ ($a_2 = 0.001$) | Ni $\oplus$

Given $E^o_{Ni^{2+}/Ni} = -0.257V, E^o_{Co^{2+}/Co} = -0.280V$

Q6) a) Answer the following : [6]

    i)   Discuss the limitations of Debye-Hückel theory.

    ii)   Write a note on Tafel plot.

  b) Solve the following : [6]

    i)   Derive an equation showing the relation between emf of cell and enthalpy.

    ii)   In an experiment, where Pt, HClH$^+$ electrode is involved, the following data was obtained.

η(mV)	50	100	150	200	250
i(mA$_{cm}$)	2.66	8.91	29.9	100	335

    Calculate i_0.

Q7) a) Answer the following : [6]

    i)   Derive an expression showing relation between absolute and conventional mobilities.

    ii)   What is Zeta Potential?

  b) Solve the following : [6]

    i)   Calculate the solubility product of silver iodide from the following cell.

$$\ominus Ag\,|\,AgI_{(s)}\,|\,0.5M\;KI\;||\;0.05M\;AgNO_3|Ag\;\oplus$$

$$E_{cell} = 0.788V.$$

    ii)   Calculate the potential of given fuel cell having reaction

$$C_3H_{2(g)} + 8O_2 \rightleftharpoons 5CO_{2(g)} + 6H_2O_{(l)}$$
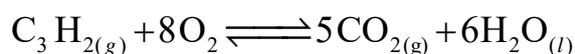
    The standard free energies of formation are – 8.2, –237.2 and –394.2 kJ/Mol for pentane, $H_2O_{(l)}$ and $CO_{2(g)}$ respectively.

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

   i)   What are the types of electrochemical cells?

   ii)   What is electrical double layer?

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

   i)   Discuss lithium batteries in detail.

   ii)   Calculate the electrical work done from the following data

      $E_{cell} = 1.15V$, $n = 3$.

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[5830] - 403
M.Sc.
PHYSICAL CHEMISTRY
CHP - 412 (A) : 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 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
			$= 6.626 \times 10^{-34}$ 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	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) Answer any four of the following : **[8]**

   i) What is transistors? Give its two applications.

   ii) Draw the schematic cross sectional diagram of Rf-Sputtering system.

   iii) What are characteristics of 1-2-3 national?

   iv) What is low critical temperature super conductors?

   v) Define the term MOCVD.

   b) Explain the term photolithography using suitable diagram. **[3]**

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

   i) Describe low dimensional quantum structures of IV-V compounds.

   ii) Explain three types of capacitor on the basis of dieletric material.

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

   i) What is rectifier? Explain half-wave rectifier.

   ii) What are optical photon modes in solids?

Q3) a) Explain in detail reactive sputtering. Give its consequences. **[6]**

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

   i) Discuss N-P-N transitor

   ii) How do perovskites account for defects in crystals.

Q4) a) Explain sol-gel method for preparation of thin film. **[6]**

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

   i) Draw and explain schematic cross sectional diagram of the DC-sputtering system.

   ii) What are the applications of LB films.

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SECTION - II

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

     i) Explain the term calcination

     ii) Define catalytic selectivity.

     iii) Explain the term active sites and inhibition

     iv) Define site and support.

     v) Write the steps involved in Langmuir - Hishelwood mechanism.

  b) Describe in detail the process of catalytic poisoning. **[3]**

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

     i) Write a note on enzyme catalysis

     ii) What are the characteristics of catalytic reactions.

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

     i) Describe the XPS method to determine solid particle size.

     ii) Discuss the hydrolysis and vapour deposition method of catalyst preparation.

Q7) a) Explain adsorption theory of catalysis. **[6]**

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

     i) What are the VOC's? How are various catalysts used to remove them?

     ii) Discuss precipitation method of preparation of catalyst.

Q8) a) Explain the meachanism of photocatalysis in semiconductor. **[6]**

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

     i) How is surface area of a powderd solid measured?

     ii) Explain FTIR method to determine solid particle size.

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[5830] - 403
M.Sc.
PHYSICAL CHEMISTRY
CHP - 412 (B) Biophysical Chemistry and Special Topics in Nuclear and 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 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

<u>Physico - Chemical Constants</u>

1) Avogadro Number $N = 6.023 \times 10^{23}\,\text{mol}^{-1}$
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 $h = 6.626 \times 10^{-16}\,\text{erg s}$
                           $= 6.626 \times 10^{-34}\,\text{J s}$
4) Electronic Charge $e = 4.803 \times 10^{-10}\,\text{esu}$
                           $= 1.602 \times 10^{-19}\,\text{C}$
5) 1 eV $= 23.06\,\text{k cal mol}^{-1}$
                           $= 1.602 \times 10^{-12}\,\text{erg}$
                           $= 1.602 \times 10^{-19}\,\text{J}$
                           $= 8065.5\,\text{cm}^{-1}$
6) Gas Constant $R = 8.314 \times 10^7\,\text{erg K}^{-1}\,\text{mol}^{-1}$
                           $= 8.314\,\text{J K}^{-1}\,\text{mol}^{-1}$
                           $= 1.987\,\text{cal K}^{-1}\,\text{mol}^{-1}$
7) Faraday Constant $F = 96487\,\text{C equivalent}^{-1}$
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 $= 4.187 \times 10^7\,\text{erg}$
                           $= 4.187\,\text{J}$
10) 1 amu $= 1.673 \times 10^{-27}\,\text{kg}$
11) Bohr Magneton $\beta_e = -9.274 \times 10^{-24}\,\text{J T}^{-1}$
12) Nuclear Magneton $\beta_n = 5.051 \times 10^{-27}\,\text{J T}^{-1}$
13) Mass of an electron $m_e = 9.11 \times 10^{-31}\,\text{kg}$

SECTION - I

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

  i) Explain active and passive transport.

  ii) Explain function of cell membrane.

  iii) Application of Biopolymers.

  iv) Explain hydrophobic interaction.

  v) Biological importance of Nucleic acid.

 b) Derive mechalis menten equation for enzyme catalysis. **[3]**

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

  i) Explain problem of protein folding.

  ii) Explain hydrolysis of ATP

 b) Attempt the following.

  i) Discuss the α-helix and β- plated sheet structure of polypeptide.**[3]**

  ii) Calculate Rrms and Rg for a linear polymeric chain containing 350 monomeric unit each being 45A° long. **[3]**

Q3) a) Explain the light seattering method. **[6]**

 b) Attempt the following.

  i) Explain diffusion method **[3]**

  ii) Explain any one diffraction method. **[3]**

Q4) a) Define acid & Base. Derive Handerson Hesselbalch equation. **[6]**

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

  i) Explain the term a) Dialysis b) Isotonic solution c) Hypertonic solution

  ii) A polymer sample contain equal number of molecule with molecular weight 20,000 and 25,000 calculate $\overline{Mn}$ and $\overline{Mw}$.

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

        i) Explain term germinate recombination.

        ii) What are the advantages of radiometric titraction method.

        iii) Define the term radiopharmaceutical and nuclear pharmacy.

        iv) What is advantages of using radical scavenging technique.

        v) Explain term elestic scattering and in elastic scattering.

    b) Calculate geometric cross-section of 125sn. **[3]**

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

        i) Write a note on pulse radiolysis.

        ii) Describe in details various method for disposal of low & intermediate level waste.

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

        i) Write a note on premordial nucleo synthesis.

        ii) Evaluate a value for reaction $^{14}_{7}N + ^{4}_{2}He \rightarrow ^{17}_{8}O + ^{1}_{1}H$

           Given $^{4}_{2}He = 4.00387$ amu $^{14}_{7}N = 14.00753$ amu

           $^{17}_{8}O = 17.00450$ $^{1}_{1}H = 1.00814$ amu

Q7) a) Discuss the chemistry of recoil atoms. **[6]**

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

        i) Give an account on thermonuclear reaction.

        ii) Calculate resolving time if the system in microsecond from following data.

Sample	A	B	C
Count rate	2500	1600	5500
	For 2 min	For 3 min	For 5 min

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Q8) a) Give a brief account on stellar evolution. [6]

b) Attempt the following : [6]

  i) Write a note on types of radioactive Waste.

  ii) Evaluate Q value for reaction.

$$_3^7Li + {}_1^1H \rightarrow {}_2^4He + {}_2^4He$$
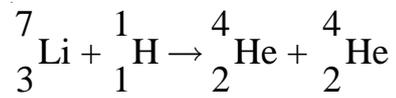
$$\text{Given } {}_3^7Li = 7.01822 \, amu$$

$$_1^1H = 1.00814 \, amu$$

$$_2^4He = 4.00387 \, amu$$

$$\bigcirc\bigcirc\bigcirc\bigcirc$$

[5830]-404
M.Sc.
INORGANIC CHEMISTRY
CHI 430 : Heterogeneous Catalysis and Its Applications
(2019 Pattern) (CBCS) (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 are allowed.*

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

SECTION - I

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

       i)   What are the important properties of heterogeneous catalysts.

       ii)   Describe hydrothermal synthesis of zeolite.

       iii) What is chemical reactor? List out different types of reactors.

       iv) What do you mean by forming of catalyst? What are the advantages of formed catalyst?

   b)   Give the classification of heterogeneous catalyst.   **[3]**

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

       i)   Give an account of factors influencing on zeolite synthesis.

       ii)   Give an account of temperatures programmed techniques for characterisation of heterogeneous catalysts.

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

       i)   Discuss in brief various processes of catalyst deactivation.

       ii)   Discuss in brief about the position of extra framework species in zeolite structure.

       iii) Discuss in brief about nomenclature of zeolites.

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

    i) Give an account of methods for heterogenisation of homogeneous transition metal complexes.

    ii) What is chemical reactor? Explain construction, working merits and demerits of fixed bed reactor.

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

    i) MEL type of zeolite framework structure

    ii) Langmuir Adsorption Isotherm.

    iii) Metal support interactions.

SECTION - II

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

    i) What do you mean by Gas phase reaction? Explain with respect to Fischer- tropsch reaction.

    ii) What is Friedel. Craft alkylation? Explain with example.

    iii) How kaolinite clay is formed?

    iv) What are the advantages of photocatalyst over existing method.

  b) Discuss in short on oxidation of alcohol using heterogeneous catalyst.**[3]**

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

    i) What do you mean by shape selective catalysis? Discuss the use of zeolite as shape selective catalyst.

    ii) Describe the role of HPA as a green catalyst for biomas conversion to useful products.

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

    i) Discuss in brief use of MCM - 41 as a catalyst.

    ii) Discuss in brief the factors affecting electrocatalysis.

    iii) Why Raney-Ni catalyst is used in hydrogenation of hydrocarbons?

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

      i)   Semiconducting oxides are very good photo catalyst. Explain with the help of TiO_2.

      ii)   Give an account of use of heterogeneous catalysis in pollution control.

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

      i)   Catalytic reforming using zeolite

      ii)   MCM-41 as a catalyst

      iii)   Water - Gas - shift reaction.

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[5830]-405

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 diagrams must be drawn wherever necessary.*

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 nanotechnology?

ii)   What is meant by carbon nanotube?

iii) Give the properties of natural nanoparticles.

iv)   What is quantum dot?

b)   Explain the following size dependent properties of nanomaterials.   **[3]**

i)   Melting point

ii)   Colour

P.T.O.

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

   i) Explain the applications of carbon nanotubes.

   ii) Explain in detail thermal properties of nanoparticles.

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

   i) What is nanocomposite? Explain single particle nanomaterials.

   ii) Explain the optical properties of nanomaterials.

   iii) Write short note on polymer nanotechnology.

Q3) a) Answer <u>Any One</u> of the following.   **[6]**

   i) Explain the electronic properties of nanomaterials.

   ii) Explain any one method for synthesis of carbon nanotubes.

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

   i) Explain the Dry nanotechnology with suitable example.

   ii) Explain indetail nanophotonics.

   iii) Explain the MWCNTs.

SECTION - II

(Nanotoxicology and Biosafety)

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

   i) Define nanoetymology.

   ii) How can you reduce the toxicity of nanoparticles.

   iii) What is biodistribution of nanomaterials.

   iv) What is epidemiology?

   b) Explain the following properties of that affecting the nanotoxicology. **[3]**

   i) Size

   ii) Oxidation stress assay.

Q5) a) Answer <u>Any One</u> of the following : [6]

      i) Explain the bio-mimatic technology.

      ii) Explain the challenges of nanotoxicology.

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

      i) Explain the nanoparticle degradability and its disposal.

      ii) Explain the mechanism of nanotoxicity on cell.

      iii) Explain toxic effect of gold nanoparticles.

Q6) a) Answer <u>Any One</u> of the following. [6]

      i) Explain the mechanism of toxicity related to oxidative stress and cytotoxicity of nanoparticles.

      ii) Explain any two physico-chemical properties affecting the nanotoxicity.

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

      i) Explain in vivo toxicity assessment of nanoparticle with the help of suitable example.

      ii) What is meant by invitro toxicity? Explain the apoptosis assay.

      iii) Explain the epidemiological evidences of nanotoxicology.

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M.Sc. (Part - II)
INORGANIC CHEMISTRY
CBOP - 4 (T) CHI - 432 - A) Material Science
(2019 Pattern) (Semester - IV) (4 Credits)

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

Instructions to the candidates :
1) *All questions are compulsory.*
2) *Figures to right indicate full marks.*
3) *Use of logarithm table and calculator is allowed.*
4) *Answer to the two sections should be written in separate answer books.*

SECTION - I
(Crystal defects, Magnetic and Superconducting Materials)

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

i) What is plane defect? Explain its types.

ii) Define :

a) Domain b) Anti ferromagnetic Materials.

iii) What are spinels? Explain their types.

iv) Explain the classification of superconductors.

B) Draw the structure of BCC Crystal structure and calculate the no. of atoms per unit cell in BCC structure. **[3]**

Q2) A) Attempt any <u>One</u> of the following : **[6]**

i) What is diffusion? Explain different types of diffusion in solids.

ii) What is Hysteresis loop? Explain different types of hysteresis loop. Define Retentivity and ferrites.

P.T.O.

B) Attempt any <u>Two</u> of the follwoing : [6]

   i) Define :

      a) Superconductivity   b) Garnet ferrites

      c) Intermetallic Superconductors

   ii) Write a note on Meissner effect.

   iii) What is Kirkendall effect?

Q3) A) Attempt any <u>One</u> of the following : [6]

   i) Derive the expression $x = \dfrac{c}{T - \theta}$.

   ii) The saturation magnetisation of FCC iron is 1700 KA/m². Calculate the net magnetic moment per iron atom in FCC Crystal if lattice parameter is 2.87 °A & 1 BM = 9.273×10^{-2x} A/m².

B) Attempt any <u>Two</u> of the following : [6]

   i) Write a note on Perovskite.

   ii) What is difference between normal and inverse spinels?

   iii) "Effect of temperature on magnetic susceptibility value of paramagnetic materials". Explain.

SECTION - II

(Ceramics, Composite, Cementitious and Biomaterials)

Q4) A) Attempt the following : [8]

   i) What are pyroelectric materials? Explain with example.

   ii) What are cementitious materials? Give examples.

   iii) Explain metallic materials?

   iv) Define : a) Gel   b) Set accelerators

B) What is phosphate cement? Explain with its properties and uses? [3]

5) A) Attempt any <u>One</u> of the following : **[6]**

    i)   What are composite materials? Explain concrete with its types, composition, properties and applications.

    ii)   What are biomaterials? Give the classification of Biomaterials.

  B) Attempt any <u>Two</u> of the following : **[6]**

    i)   Give applications of ceramic materials.

    ii)   What is Laminar and filled composites?

    iii)   Write a note on special concrete.

Q6) A) Attempt the following (any <u>One</u>) : **[6]**

    i)   What is wood? What are different parts of wood? Explain with function of each parts.

    ii)   What is cement? Explain different types of portland cement. Give its applications.

  B) Attempt any <u>Two</u> of the following : **[6]**

    i)   What are the different characteristics of Biomaterials?

    ii)   Give full form of

        a) C_3S

        b)   LLDPE

        c)   CMC

    iii)   Find the percentage moisture content of the wood sample from the following information. Net weight = 215 gm & Dry weight is = 200 gm.

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[5830] - 406
M.Sc. (Part - II)
INORGANIC CHEMISTRY
CBOP - 4 (T) CHI - 432 - B) Inorganic Chemistry
Applications in Industry
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates :
1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Neat diagrams must be drawn wherever necessary.*
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) Discuss the manufacturing process of acetylene gas.

     ii) Define anodic inhibitor. What is corrosion inhibitor?

     iii) How can SO_2 emission can be controlled?

     iv) Why is chemical safety important?

   B) Attempt the following : **[3]**

     i) What is electrodeposition process? Give its principle and working process.

Q2) A) Attempt any <u>One</u> of the following : **[6]**

     i) Explain about green chemistry in day to day life.

     ii) What is chemical propellant? What is the difference between explosive and propellant? What types of explosive is a propellant?

B) Attempt any <u>Two</u> of the following : **[6]**

   i)   What are the effects of industrial gases? What are the major causes of industrial pollution?

   ii) What are semi conductors? Discuss electrodeposition of semiconductors.

   iii) What are chemical explosives? Where should explosive be stored? What are the types of explosive?

Q3) A) Attempt any <u>One</u> of the following : **[6]**

   i)   Define corrosion. What are the factors that affect the rate of corrosion? Explain anion inhibitor properties in neutral electrolytes.

   ii) What are the safety measures followed in chemical industry? Which rules are followed for hazard control to improve plant safety.

   B) Write note on (<u>any Two</u>) : **[6]**

   i)   Corrosion inhibitors for paint coating.

   ii) Electrodeposition of chromium.

   iii) Green chemistry in sustainable development.

SECTION - II
Inorganic Chemistry Applications in Environment

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

   i)   Explain in detail sheardizing and tinning process.

   ii) Explain the working of trickling filter.

   iii) How oil and grease removal takes place from waste water?

   iv) What is the effect of suspended solids and sediments on aquatic life?

   B) Attempt the following : **[3]**

   i)   Mention different disinfection processes useful for purification of water. Explain two methods in detail.

[5830] - 406   5

Q5) A) Attempt <u>any One</u> of the following :   **[6]**

      i)   Explain production of biomass, biofuels and biodiesel.

      ii)   Draw a schematic diagram of polymer electrolyte membrane (PEM) fuel cell. Show overall reaction. Why is the PEM often offer reffered to as a "Proton exchange membrane" fuel cell?

   B)   Attempt <u>any Two</u> of the following :   **[6]**

      i)   Describe how nitrogen can be removed from the waste water by biological treatment.

      ii)   Name the instrumental method for the determination of metal. Such as Hg, Cd, As and Pb. Explain cold-vapour atomic absorption method for the determination of Hg from polluted water.

      iii) List the five provisions of the clean water Act (CWA). which of these are considered to be the most important?

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

      i)   What are the oxygen consuming waste? Name typical sources. Describe how to do BOD test on a water sample. How do you treat water that contains pathogens?

      ii)   Explain how the detergent and pesticides are responsible for water pollution. Compare aerobic treatment process with an anerobic treatment process.

   B)   Write note on (<u>any Two</u>)   **[6]**

      i)   Wind power.

      ii)   Solar thermal power.

      iii) High strength waste.

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[5830]-407

M.Sc. (ORGANIC CHEMISTRY)
CHO-450 : Chemistry of Natural Products
(2019 Pattern) (Semester - IV)

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 separate answer books.*
4) *Figures to the right indicate full marks.*

SECTION - I

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

     i) Write the retrosynthesis of longifolene by E.J. Corey approach.

     ii) Write the role of following reagents in the synthesis.

         a) DBU, THF

         b) nBu_3SnH

     iii) How will you prepare wieland miescher ketone from resorcinol?

     iv) Write a note on Stark-Zhao olefination.

     v) Why the attempts of the synthesis of longifolene given by KuO & Money from the following precursor (A) were failed?

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b) Write the correct sequence of reagents for the following conversion. [3]
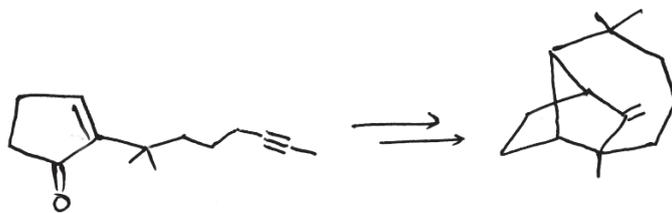

i) LDA, THF, –78°C/CH₃I   ii) RuO₄, IO⁻₄
iii) PTSA   iv) ZnBr₂, NaBH₃CN
v) LAH, H⁺   vi) CH₃Li/SOCl₂

Q2) Predict the products (Any 4) :   [12]

a)

i) ⁻OH
ii) H⁺/H₂O → A Et₃N, 225°C → B

b)

i) NaOAc
ii) H₂, Pd/C → A Ph₃P=CH₂ → B

c)

i) Ag⁺
ii) Cr(vi) → A i) Na, CH₃OH, NH₃ ii) Cr(VI) → B

d)

+ → A i) PhCH₂OĊ–cl, Pyridine ii) hν → B

e)

Et₂AlCl, CH₂Cl₂ → A pBrC₆H₄NCO → B
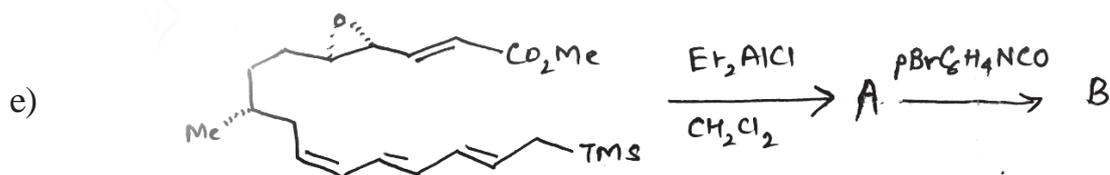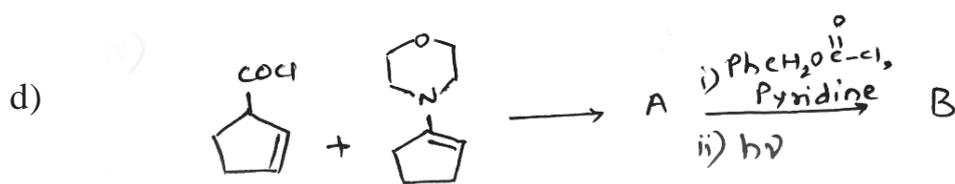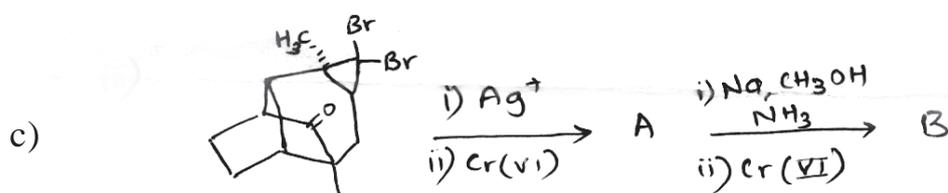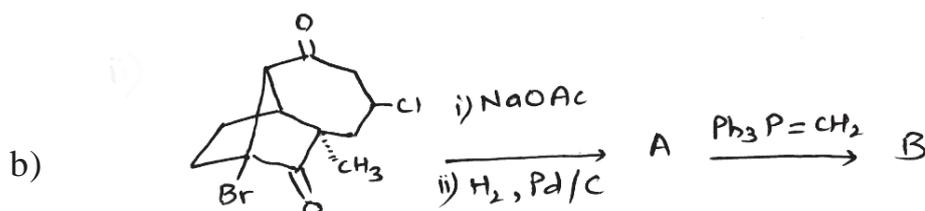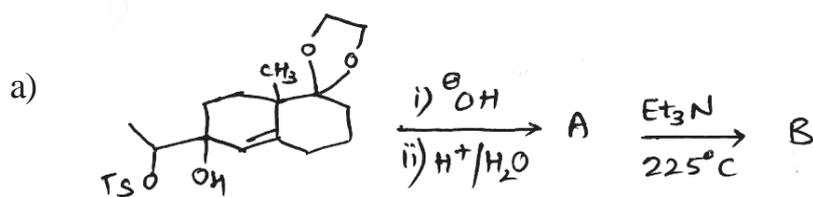
Q3) a) Write the missing reagent and intermediate for the following conversion. Give mechanism for the same (any 2) : **[8]**

i)

ii)

iii)
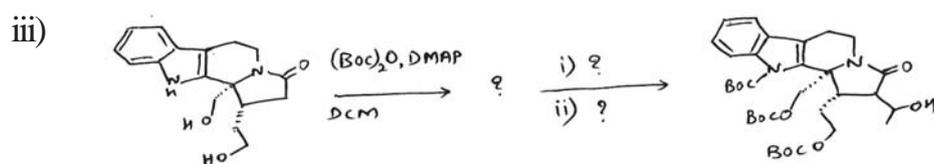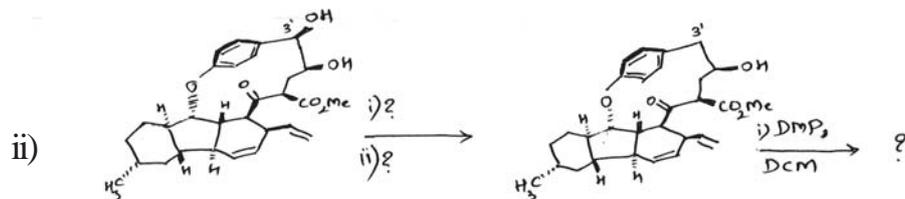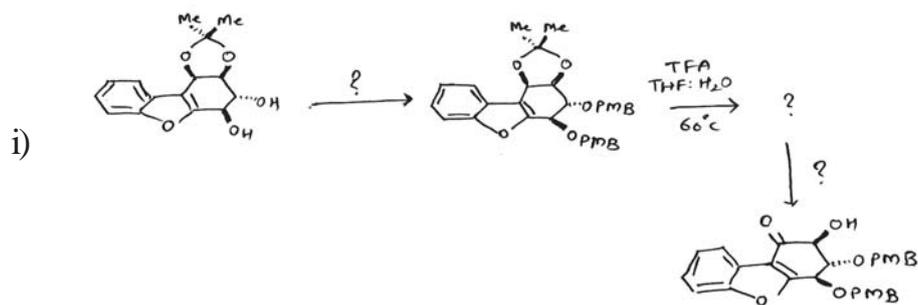
b) Write the steps involved during the construction of tricyclic core from (R)–(+) citronellal in the synthesis of Hirsutellone - B. **[4]**

*Q4)* Outline the steps involved in the following synthetic sequence. **[12]**

a)

b)

(–)Ribisin B

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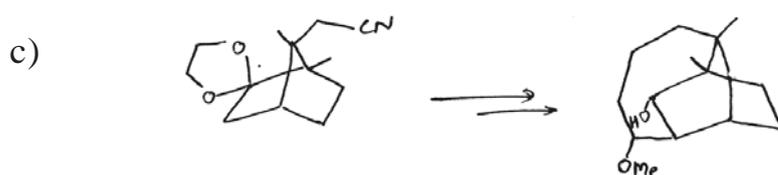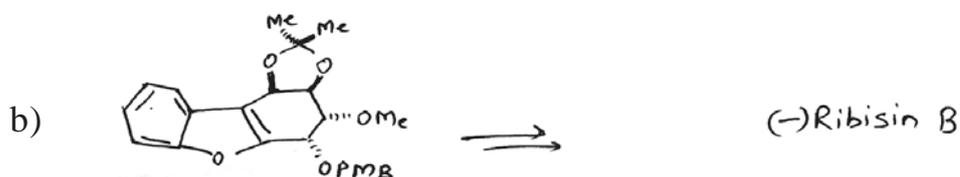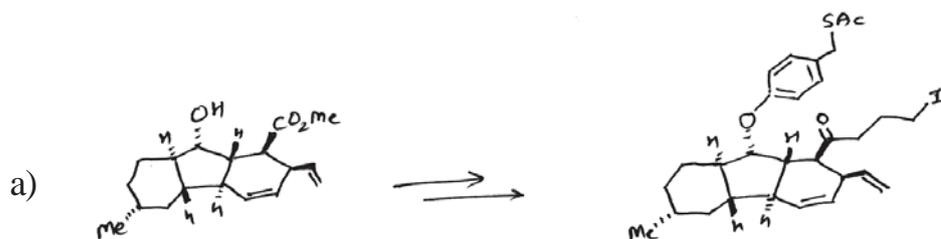
Q5) a) Solve any 4 of the following : [8]

    i) Draw the structure of originally assigned vannusal - B with correct stereochemistry.

    ii) Write a note on Grieco elimination with reference to asymmetric total synthesis of Pinnaic acid.

    iii) Write the correct full form and use of the following.

        a) TPAP   b) LIDBB

    iv) Which is the key cyclisation step involved in the asymmetric total synthesis of pinnaic acid?

    v) Which ^1H NMR coupling constants were exhibited by both originally assigned structure and natural vannusal B?

  b) Why tri-SEM protection was used in the total synthesis of (A) i.e. C_{21} epimer of originally assigned structure? [3]
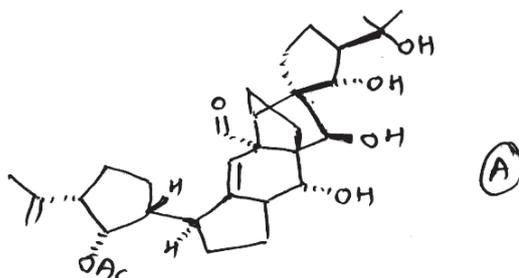
**Q6)** a) Predict the products (any 3) : [9]

    i)

    ii)

    iii)

    iv)
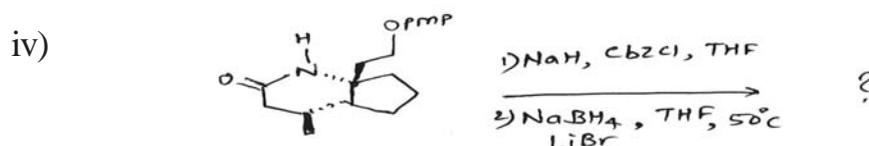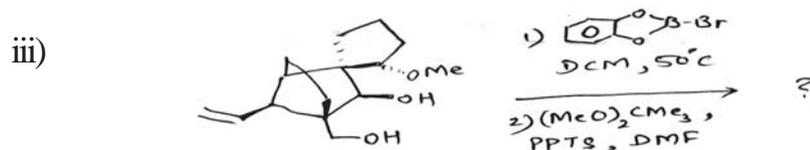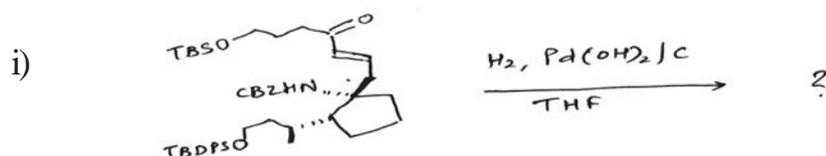
  b) What is Martin's sulfurane? Explain its role with mechanism. [3]

Q7) Write correct reagents and steps involved in the following conversion (any 3) :
[12]

a)

b)

c)

d)
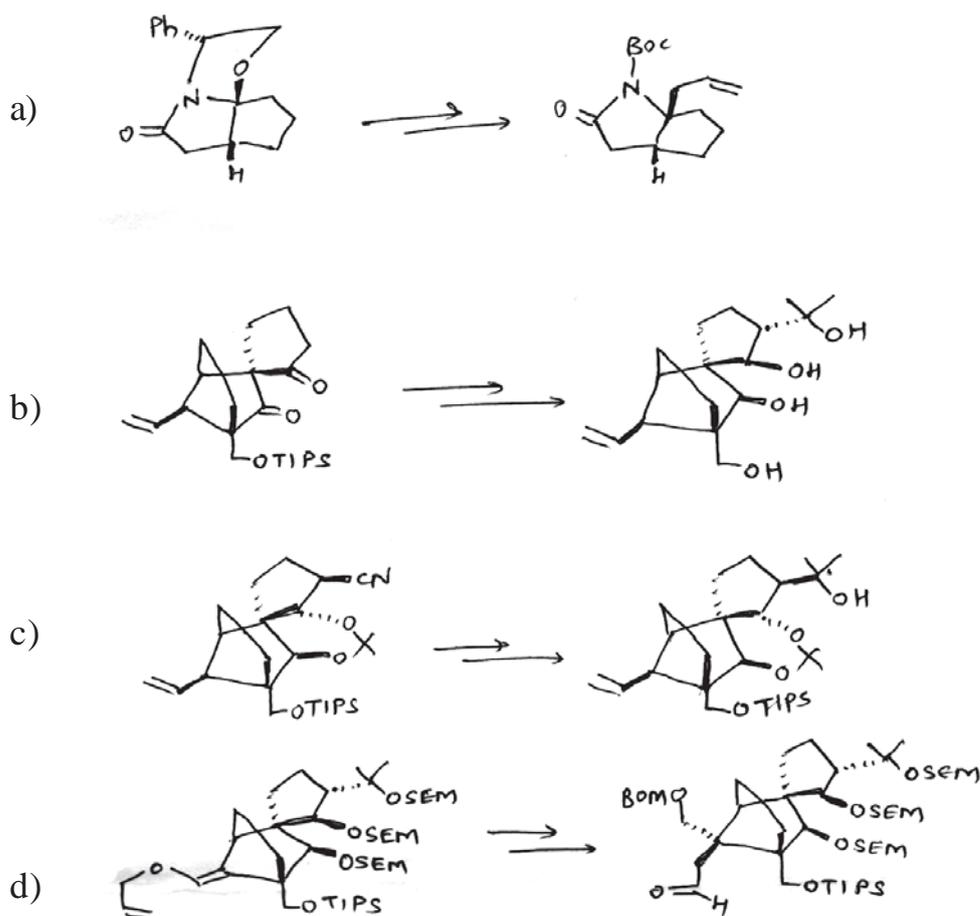
Q8) Answer the following : [12]

a) How the degradation of Pinnaic acid was helpful in determining configuration at C-17?

b) Write down the retrosynthesis of originally assigned vannusal B.

c) Write in detail about the two biosynthetic hypotheses proposed initially for Vannusals A & B.

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[5830]-408
M.Sc. (Part - II)
ORGANIC CHEMISTRY
(CHO-451) : Organomettallic Reagents in Organic Synthesis
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

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

2) Question Nos. 1 & 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 side indicate full marks.

SECTION - I

Q1) A) Explain the following (any four)   **[8]**

    i) Role of cuprous iodide in coupling reactions.

    ii) In Banford-stevens olefination, stereoselective product is obtained with change in solvent polarity.

    iii) Stabilized and non stabilized ylides in wittig reaction.

    iv) Use of $PdCl_2$ in Oxo process.

    v) Chlorobenzene resist to undergo Heck reaction.

    B) Discuss Hiyama Coupling reaction with mechanism.   **[3]**

Q2) A) Predict the product for following reactions.   **[6]**

    i)

P.T.O.

ii) 2 ZnBr^+I—I $\xrightarrow[\text{PPh}_3, \Delta]{\text{Pd(dba)}_3}$?

iii) $\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}$—$\text{CH}_2\text{-CH}_3$ $\xrightarrow[\substack{2) \; \text{H}_3\text{C}\overset{O}{\overset{\|}{C}}\text{Ph} \\ 3) \; \text{Al}/\text{Hg}}]{1) \; n\text{BuLi}}$?
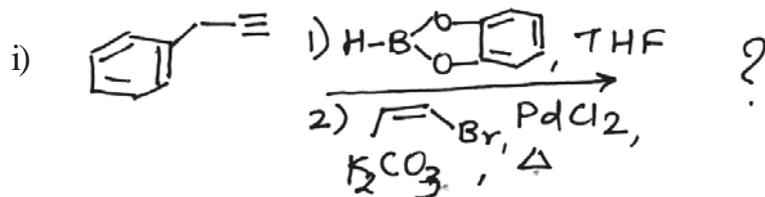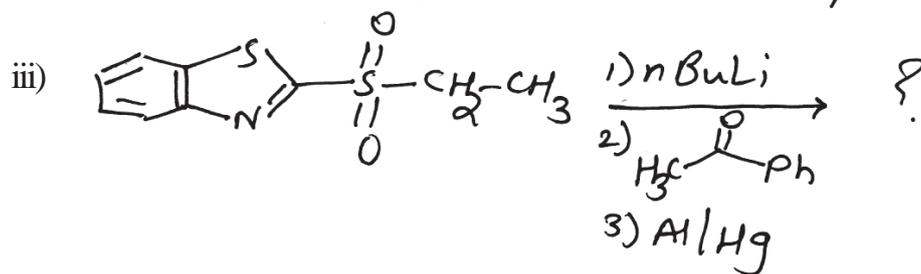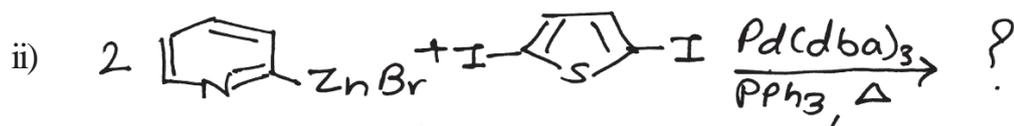
B) Answer the following : [6]

i) Write Buchwald-Hartwig Amination reaction mechanism and it's two examples.

ii) Suggest the mechanism for the following transformation
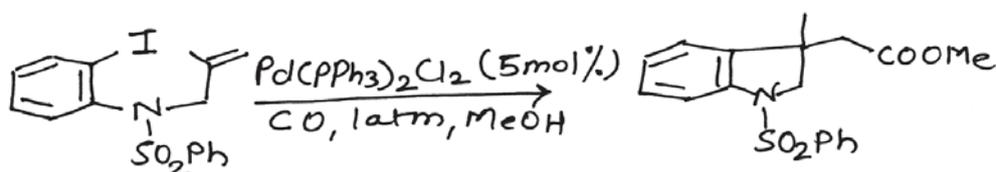
Q3) A) Suggest the Suitable reagents and it's mechanism for the following conversions. [8]

i)

ii)
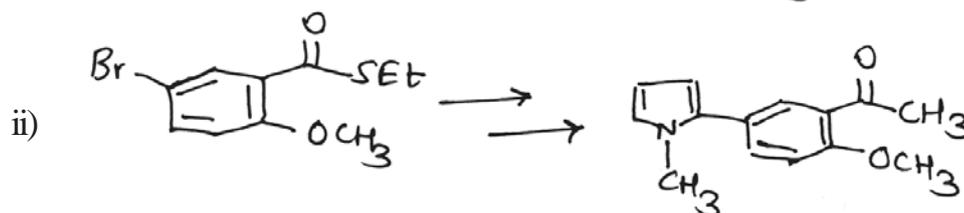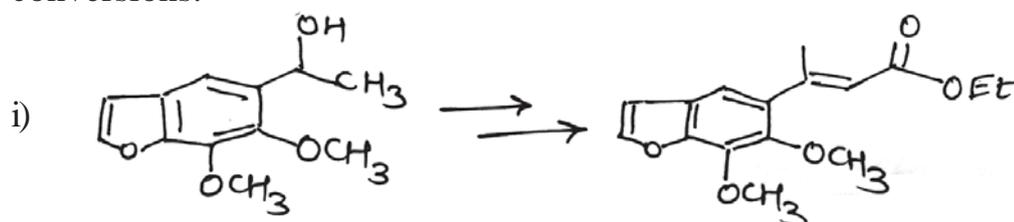
B) Answer the following : [4]

i) Write a mechanism for copper catalyzed oxidation of benzyl alcohol to benzoic acid

ii) Suggest the mechanism for the following reaction
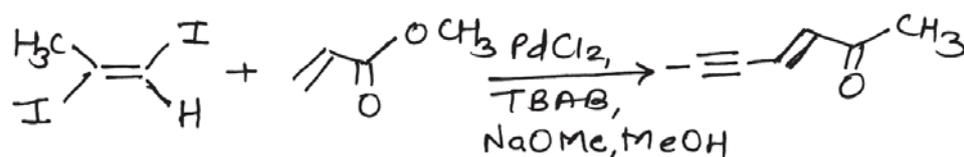
Q4) A) Write a note on : **[6]**

    i)   Suzuki Coupling reaction

    ii)   Ruthenium catalyzed transfer hydrogenation reaction.

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

    i)   Discuss Reppe's process for carbonylation and olefination reaction.

    ii)   For given following reaction, predict the product A and B with mechanism.
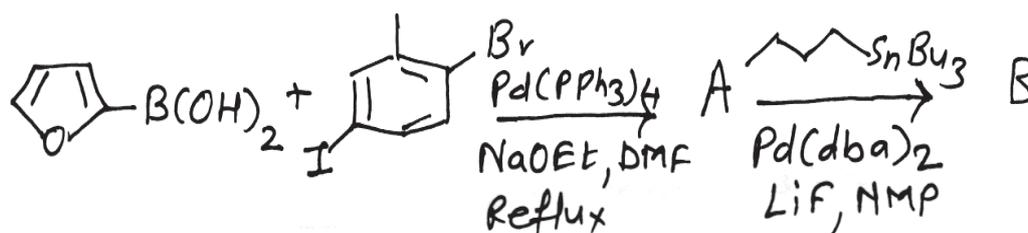
SECTION - II

Q5) A) Answer any four of the following : **[8]**

    i)   Compare the nucleophilic substitution reaction possessed by trimethyl silyl chloride and t-butyl chloride.

    ii)   What is the driving force involved in the ring opening metathesis? Explain with suitable example.

    iii)   Write the characteristics of click reactions.

    iv)   What are optically active boranes? Give the use of optically active borane in the synthesis of organic compound.

    v)   Discuss the isomerization of organoborane write the mechanism involved in it.

   B) Predict the product and suggest the mechanism for the following reaction. **[3]**

Q6) **A)** Suggest the mechanism for the following reactions. [6]

i)

$C_4H_9NH_2$

$\xrightarrow{\text{NC, MeOH}}$

ii)

$\xrightarrow[\text{HCHO, AcOH}]{(CH_3)_2NH}$ Me—⟨ ⟩—CH_2NMe_2
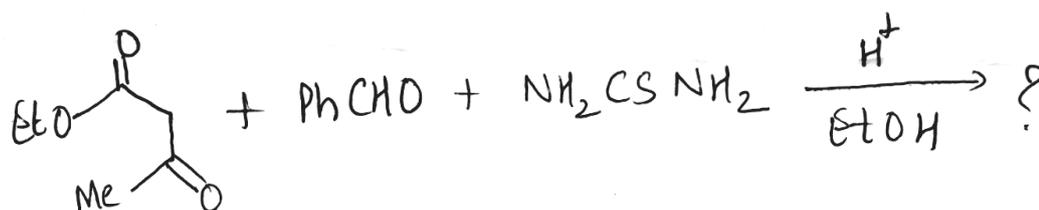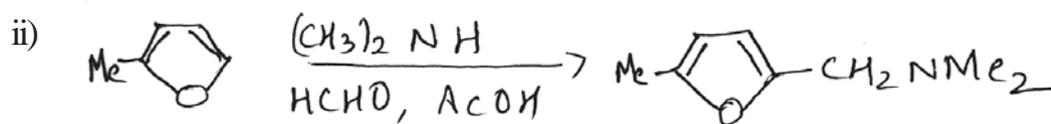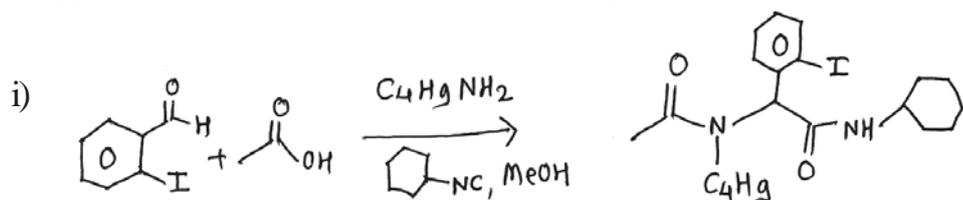
B) Predict the product/s of the following : [6]

i)

$\xrightarrow[CHD]{\Delta}$ A $\xrightarrow[\substack{2)\ H_2SO_4\\80^\circ C}]{1)\ Pd}$ B

ii)

$\xrightarrow{Ru\ Catalyst}$ A $\xrightarrow{OsO_4}$ B

iii) $CH_3-\overset{CH_3}{\underset{}{C}}=CH_2$ $\xrightarrow{B_2H_6}$ A $\xrightarrow[NaOH]{H_2O_2}$ B
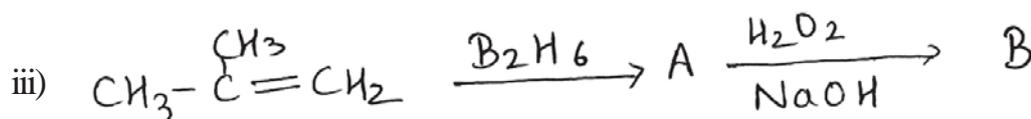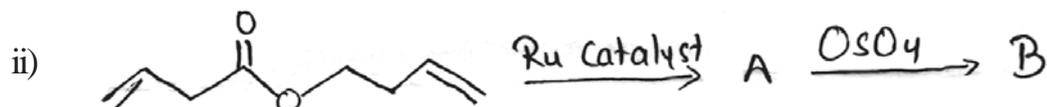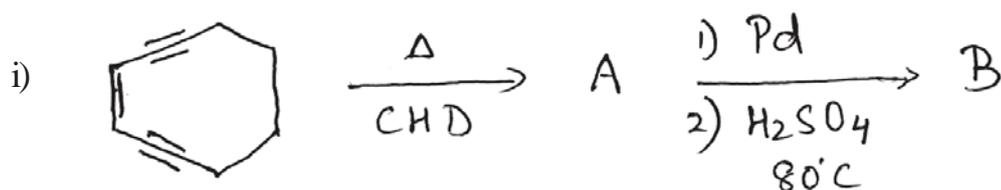
Q7) **A)** Write short notes on - [6]
   i)   Ring closing metathesis
   ii) Passerini reaction

B) Predict the product for the following reactions. [6]

i)

$\xrightarrow[\substack{3)\ CH_3COCl/AlCl_3}]{\substack{1)\ n\ BuLi\\2)\ Me_3SiCl}}$?

ii)

$\xrightarrow[DCM]{AlCl_3}$?

iii) $CH_3-\overset{O}{\overset{\|}{C}}-SH + C_6H_5NH_2 + C_3H_7\overset{O}{\overset{\|}{C}}-C_3H_7 + CN\,CH_2\,CH(OMe)_2$
   $\xrightarrow{H^+}$?
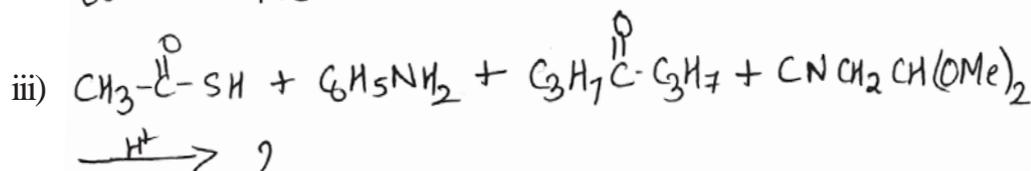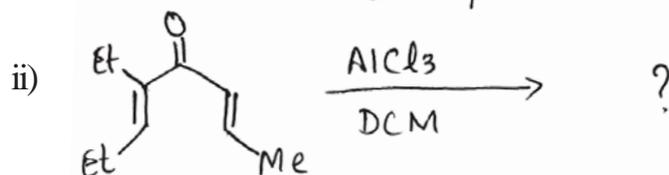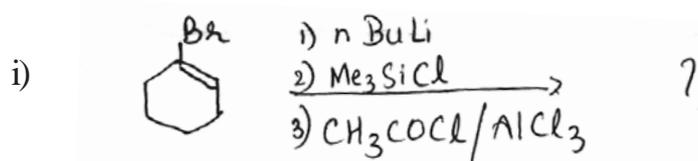
Q8) **A)** Solve the following : **[6]**

  i) Carry out the following conversion using organoborane.
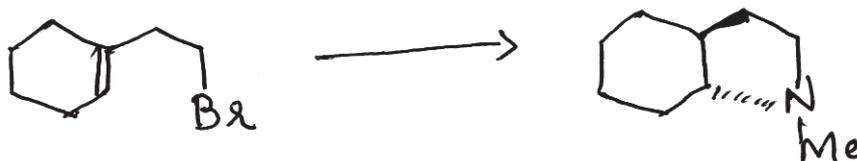
  ii) Predict the product and suggest the mechanism for the following reaction.

$$C_2H_5CHO + CH_2=CHCN \xrightarrow{DABCO} ?$$
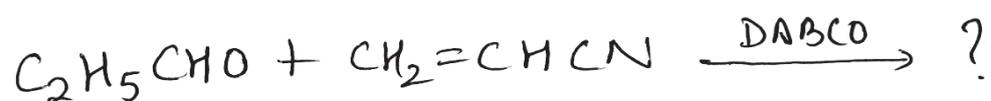
B) Write short notes on - **[6]**

  i) Sharpless azide cycloaddition
  ii) Disimyl borane
  iii) Protection and deprotection of alcohol by trimethyl silyl chloride

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[5830]-409

M.Sc. - II

ORGANIC CHEMISTRY

CBOP-4 : CHO-452(A) : Concept and Applications of Medicinal Chemistry

(2019 Pattern) (Semester - IV)

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 Q2 to Q4 and two questions from Q6 to Q8.*
3) *Answers to 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. **[8]**

   i) Write biological applications of folic acid.

   ii) What is blood brain barrier?

   iii) Explain solid phase peptide synthesis.

   iv) Explain drug absorption process.

   b) Draw structure of oxamniquine and explain it's mechanism of action.**[3]**

Q2) a) Solve any two of the following. **[8]**

   i) Write Hansch equation and explain terms involved in it.

   ii) Write note on proteins as biocatalysts.

   iii) Explain the process of selecting drug target for drug discovery.

   b) Explain modern drug discovery process. **[4]**

Q3) a) Solve any two of the following. **[8]**

   i) Explain drug metabolism process.

   ii) Explain solution phase peptide synthesis.

   iii) Explain applications of peptides.

   b) Explain drug target importance in drug discovery. **[4]**

P.T.O.

Q4) a) Solve any two of the following. **[8]**

      i) Write note on functions of proteins.

      ii) Write note on proton pump inhibitor.

      iii) Explain pharmacodynamics of drug.

  b) Explain drug development process. **[4]**

SECTION - II

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

      i) Explain : SAR of tetracyclines.

      ii) Write note on : Position coefficient.

      iii) What are sulphonamides? Explain their mode of action.

      iv) What is Lipinski rule of 5?

  b) Explain SAR of penicillins and discuss their mode of action. **[3]**

Q6) a) Solve any - 2. **[8]**

      i) Write SAR and mode of action of chloramphenicol.

      ii) Write note on : Macrolides

      iii) Explain Type - I statins.

  b) What is QSAR? Explain its importance in drug design. **[4]**

Q7) a) Solve any - 2. **[8]**

      i) Explain the mode of action of 1) Amphotrecin-B 2) Amantadine

      ii) Write note on : Azoles

      iii) Write is 'SAR' ? Explain it with an example.

  b) Write note on : Physico-chemical parameters in drug design. **[4]**

Q8) a) Solve any - 2. **[8]**

      i) What is prodrug? Explain it with example of acyclovir.

      ii) Write note on : Polyenes.

      iii) Explain effect of pH on solubility of acidic and basic drugs.

  b) Discuss importance of stereochemistry in drug design. **[4]**

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[5830]-409
M.Sc. - II
ORGANIC CHEMISTRY
CBOP-4 : CHO-452(B) : Applied Organic Chemistry
(2019 Pattern) (Semester - IV)

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 Q2 to Q4 and two questions from Q6 to Q8.*
　3) *Answers to the two sections should be written in separate answer books.*
　4) *Figures to the right indicate full marks.*

SECTION - I

Q1) a)　Answer <u>any three</u> of the following. **[6]**

　　　i)　Explain 3D covalent organic frameworks.

　　　ii)　Write a note on chemo-luminescence.

　　　iii)　Write a note on P-Type semiconducting covalent organic frameworks.

　　　iv)　Write the applications of Pd(II) and Pd(O) in covalent organic frameworks.

　　b)　Answer the following. **[5]**

　　　i)　Write any two examples of photo catalyst COF.

　　　ii)　Explain the linkages between 2D polymeric network in covalent organic frameworks.

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

　　a)　Explain the 3D polymeric network in COF.

　　b)　Explain the solvothermal synthesis of COF.

　　c)　Explain the applications of LiF/Al electrode used in OLED.

　　d)　Describe the role of two layers in an OLED system.

Q3) Answer <u>any three</u> of the following :   **[12]**

    a)   Significance of Boroxines and Boronic esters in COF synthesis - explain with suitable example.

    b)   Why organic material preferred over inorganic material for light emitting diodes?

    c)   Explain the ultraviolet photoelectron spectroscopy method for determination of the nature of the metal-organic interface.

    d)   With the help of suitable diagram explain ambipolar semiconducting COF.

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

    a)   Explain Pt-doped hydrazone - linked COF. Discuss any two applications.

    b)   Describe the properties of COF.

    c)   Write a note on organic electroluminescence.

    d)   Describe the applications of covalent organic frameworks.

SECTION - II

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

        i)   Describe Electric field induced switching.

        ii)   Describe pH-dependent switchable catalysts.

        iii)   Describe the Non-covalent synthetic supramolecules.

        iv)   Draw the structure of α-cyclodextrin.

    b)   Answer the following.   **[5]**

        i)   Explain tunneling electron induced switching.

        ii)   Describe the applications of supramolecular chemistry in organic synthesis.

Q6) Answer any <u>three</u> of the following.   **[12]**

    a)   Explain the supramolecular assistance to covalent synthesis.

    b)   Describe the molecular switches on surface and in single molecular junctions.

    c)   Explain the syn-anti conformational switching of pentiptycene - derived DBB analogues.

    d)   Explain 'molecular switches' with suitable example.

Q7) Answer <u>any three</u> of the following :   **[12]**

    a)   Describe the non-ionic and dipolar supramolecular interactions.

    b)   What are Cryptophanes? Describe the structure and applications of Cryptophanes.

    c)   Draw the structure of Cavit and Host - Guest complex. Explain it's applications.

    d)   Describe the properties of covalent organic frameworks.

Q8) Answer <u>any four</u> of the following :   **[12]**

    a)   Explain the structure of Calixarene.

    b)   Describe the synthesis and redox properties of pentiptycene - derived DBB analogous.

    c)   With the help of suitable example explain the different supramolecular interactions.

    d)   Draw the structure of Rotaxane. Explain any two applications.

    e)   Explain 'Electric Field induced switching'.

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[5830]-410

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) *Q.1 & Q.5 are compulsory and solve any two questions from Q.2 to Q.4 and solve two questions from Q.6 to Q.8.*

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

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

4) *Use of logtable & calculators is allowed.*

SECTION - I

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

    i) Give the principle for Atomic fluorescence spectroscopy.

    ii) Enlist the different sources used in AFs.

    iii) How to prepared sample for microwave digestion technique?

    iv) What is the purpose of isotope dilution analysis in ICP-MS?

    v) Draw the schematic representation of the operation of a photomultiplier tube.

b) An aqueous stock solution that contained 0.100 mg/ml of calcium was prepared. Portions of the solution were added to 50 ml volumetric flasks & diluted to the mark with distilled water. A 5.00 ml portion of a natural - water sample was added to a 50 ml volumetric flask & diluted to the mark with distilled water. The absorbances of the solutions were measured. Calculate the concentration of calcium in the natural water.**[3]**

Volume of stock solution	Absorbance
1.00	0.224
2.00	0.447
3.00	0.675
4.00	0.900
5.00	1.124
Diluted natural water	0.475

Q2) a) Explain in detail   [6]

  i) Explain in detail total carbon analysers.

  ii) Explain in detail any two applications of AAS.

 b) Solve the following :   [6]

  i) Enlist the different application of ICP-MS. Explain any two in detail.

  ii) Iron (II) ions catalyze the oxidation of luminol by H_2O_2. The intensity of the resulting Fluroscence has been shown to increase linearly with iron (II) concentration from 10^{-10} to 10^{-8}m. Exactly 1.00 ml of water was added to a 2.00 ml aliquot of an unknown Fe(II) solution., followed by 2.00 ml of a dilute H_2O_2 solution & 1.00 ml of an alkaline solution of luminol. The chemiluminescence from the mixture was integrated over a 10 s period & found to be 14.3. To a second 2.00 ml aliquot of the sample was added 1.00 ml of a 3.58×10^{-5}m Fe(II) solution followed by the same volume of H_2O_2 & luminol. The integrated intensity was 33.3. Find the concentration of Fe-(II) in the sample.

Q3) a) Explain in detail the instrumentation of AAS.   [6]

 b) Solve the following.   [6]

  i) What are the different analysis methods for AFS.

  ii) Explain different types of interferences in AAS.

Q4) a) How to analysed the metal's from waste water sample of ICP-MS method?
                                                                                     [6]

 b) Solve the following.   [6]

  i) How to prepared sample for Liquid-liquid extraction, & enzymatic digestion method.

  ii) Guinine in a 1.264 gm antimalerial tablet was dissolved in sufficient 0.10 M HCl to give 500 ml of solution. A 20.06 ml aliquot was then diluted to 100.0 ml with the acid. The fluorscence intensity for the diluted sample at 347.5 nm provided a reading of 245 on an arbitrary scale. A standard 100 ppm quinine solution registered 125 when measured under conditions identical to those for the diluted sample. Calculate the mass in milligrams of quinine in the tablet.

SECTION - II

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

    i) Define Luminescence.

    ii) What is singlet state.

    iii) Draw hyperfine splitting ESR spectrum of methyl free radical ($\bullet CH_3$).

    iv) Give the equation for energy difference between two state with $M_s = -\frac{1}{2}$ & $M_s = +\frac{1}{2}$ for ESR transitions.

    v) Give the principle of photoelectron spectroscopy.

  b) 1.1 ppm 5 ml 2n (II) solution was extracted three times with 5 ml CCl_4 containing 8-hydroxy quinoline and combined extract was diluted to 25 ml. Similar treatment is given to sample containing Zn(II). Fluorscence intensity for std. is 25 while sample is 20. Calculate mg of Zn(II) in 500 ml sample solution. **[3]**

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

    i) What is deactivation of molecules? Explain any two processes for deactivation of molecules.

    ii) Explain any two parameters affecting fluorscence.

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

    i) Construction and working of electron gun in electron spectroscopy equipment.

    ii) ESR spectrum of free radical containing multiple sets of equivalent proton.

Q7) a) Discuss in detail the principle of X-ray photoelectron and Auger electron spectroscopy. **[6]**

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

    i) Write note on ESR transitions of unpaired electron in ESR spectroscopy.

    ii) What is hyperfine splitting in ESR spectroscopy? How no of lines and their intensities are calculated?

Q8) a) With suitable diagram discuss instrumentation of electron spectrometer for XPS/AES. **[6]**

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

   i) Write note on 'g' factor in ESR spectroscopy.

   ii) Draw ESR spectrum of ethyl free radical ($\bullet CH_2CH_3$). Why each line in triplet is splitted in quartet?

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[5830]-411
M.Sc. (Part - II) (Analytical chemistry)
CHA 491 : CHEMICAL METHODS OF
PHARMACEUTICAL ANALYSIS
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates:

1) *Question 1 and 5 are compulsory.*
2) *Question 2 to 4 and 6 to 8 carry equal Marks.*
3) *Solve any two questions from 2 to 4 and two questions from 6 to 8.*
4) *Figures to right indicate full Marks.*
5) *Use of log table and calculators is allowed.*
6) *Answers to two section should be written on separate answer sheet.*

SECTION - I

Q1) a) Solve any four from following. **[8]**
   i)   Gel

   ii) Nasal Preparation.

   iii) Define capsule. Enlist types of capsule.

   iv) Oral liquid

   v)   Infussion

   b) Solve the following. **[3]**

   A sample of oil weighing 0.3 gm was treated with KI solution after 30 min the iodine is liberated. The liberated with 0.1M $Na_2S_2O_3$ and it required 8.5 ml of titrant, if blank value was 25 ml. Calculate the iodine value of oil.

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

   i)   Limit test for sulphated ash.

   ii) Test for particle size by microscopy.

P.T.O.

b) Differentiate between the following. **[6]**

   i)   Ointments and cream.

   ii) Coated tablet and uncoated tablet.

Q3) a) Define Ester value. Explain indetail method of estimation of ester value.
[6]

   b) Write a note on **[6]**

   i)   Effect of contamination in agar diffusion assay.

   ii) Factors affecting on cell counter.

Q4) a) Explain in brief Tube essay growth inhibiting substance? **[6]**

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

   i)   Explain disintegration test.

   ii) Explain in brief zone of potency.

SECTION - II

Q5) a) Solve any four from following. **[8]**

   i)   What is medicinal product?

   ii) What is related substances?

   iii) Gives typical documents requirement for marketing authorisation.

   iv) Enlist common types of impurities in organic and inorganic chemical ingredient.

   v)   What is active pharmaceutical ingredient?

   b) Solve the following. **[3]**

   Ointment containing 2% (w/w) mupirocin calcium is to be analysed where 2% corresponds to 20mg/gm. Calculate amount of ointment containing 80mg of mupirocin calcium.

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

    i)   What is non-aqueous acid-base titration? Explain assay of lidocaine by non-aqueous acid-base titration.

    ii)   Explain identification of mianserin hydrochloride by UV absorption spectrophotometry.

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

    i)   Explain determination of oxidizing substance in pharmaceutical ingredient.

    ii)   0.0915 gm of sample of hydrocortisone ($C_{12}H_{30}O_5$) is dissolved in ethanol and diluted to 100 ml. Dilute 2.0ml of the solution to 100 ml with ethanol and Measure absorbance at 241nm. The measured absorbance is 0.798. If specific absorbance of hydrocortisone is 440 [lcm,1%]. Calculate purity in given sample.

Q7) a) Explain assay of simvastatin by LC. According to USP with respect to system suitability. Sample and standard preparation, chromato graphic condition, procedure and equation for calculation. **[6]**

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

    i)   Explain assay of Fe^{+2} in ferrous fumarate tablet by titration.

    ii)   What is residual solvent? Explain classification of solvent according to ph. Eur. with example.

Q8) a) Outline procedure for identification of fluoxetine hydrochloride capsule by LC. **[6]**

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

    i)   Explain in detail identification of pharmaceutical ingredient by optical rotation.

    ii)   0.2506 gm sample of metronidazole is dissolved in 50ml glacial acetic acid and titrate against 0.1004M perchloric acid. The titration reading is 9.01ml. The molar mass of metronidazole benzoate is 275.26gm/mol. Calculate percent content in sample.

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

  2)   *Figures to right indicate full marks.*

  3)   *Use of log table and calculators is allowed.*

SECTION - I

Instructions : 1)   *Question 1 is Compulsory.*

          2)   *From question 2 to 4 solve any two.*

Q1) A)   Solve any four :   **[8]**

      i)   What is lab automation?

      ii)   Give uses of chemical sensors.

      iii)   What is batch flow analysis?

      iv)   Give the different types of mass analyser.

      v)   Sate two achievements of biotransduction.

  B)   How would you design an optical biosensor to measure cholesterol?**[3]**

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

      i)   What is Biosensor? Explain its role in Analysis.

      ii)   What is Chemical Sensor? Give it's classification.

  B)   Write a short note on :   **[6]**

      i)   Lab information management system.

      ii)   Optical sensors.

P.T.O.

Q3) A) Discuss the following :   [6]

         i) Flow Injection Analysis.

         ii) Serial and parallel integration.

    B) Explain the following :   [6]

         i) Advantages and disadvantages of Automation.

         ii) Flow Injection Analysis instrumentation.

Q4) A) Attempt the following :   [6]

         i) Define microfabrication. Explain silicon micromatching.

         ii) Explain surface Acoustic Wave Sensors.

    B) Explain the following :   [6]

         i) Construction and working of discrete sample analyser.

         ii) What is miniaturization? Give a theory of miniaturization.

SECTION - II

Instructions : 1) Question No. 5 is Compulsory.

                 2) Question No. 6 to 8 solve any two questions.

Q5) A) Solve <u>any four</u> of the following :   [8]

         i) Mention any two health hazards of SO_2.

         ii) Define COD.

         iii) What is acid digestion?

         iv) Mention any four inorganic pollutants.

         v) What is chlorine demand?

    B) Solve the following :   [3]

    A 25 ml of sewage water sample was refluxed with 10 ml of 0.25N $K_2Cr_2O_7$ solution. The untreated dichromate requires 7.0 ml of 0.1N FAS. 10 ml of dichromate solution and 25 ml distilled water, under same condition as sample required 30.0 ml of 0.1N FAS. Calculate the COD of the Sewage Sample.

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Q6) A) Explain in detail : [6]

i) Explain the harmful effects caused due to radiation and radionuclides in water.

ii) Discuss the effects of particulate matter on our health.

B) Solve the following : [6]

i) Discuss estimation of sulfide by ion selective method.

ii) 100 ml waste water sample is taken and titrated against standard acid having normality 0.1 giving burette reading 20.0 ml. Phenolphthalein is used as indicator. Determine the alkalinity of this sample.

Q7) A) With a suitable diagram explain the estimation of organic nitrogen by the Micro kjeldahl method. [6]

B) Solve the following : [6]

i) Discuss determination of ions by Ion chromatography.

ii) Discuss particle collection by Impactors.

Q8) A) Discuss Direct Spectrophotometric Analysis of gaseous air pollutants.[6]

B) i) How are atmospheric oxidants analysed? [6]

ii) 0.5g of $CaCO_3$ was dissolved in HCl and solution made upto 500 ml with distilled water 50 ml of standard hard water required 48 ml of EDTA solution for titration. 50 ml of hard water sample required 15 ml of same EDTA solution calculate the hardness.

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M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CBOP - 4 CHA - 492 : B) Analytical Chemistry of Agriculture, Polymer and Detergents
(2019 Pattern) (Semester - IV)

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

Instructions to the candidates :
1) *Question 1 and 5 are compulsory.*
2) *Question 2 to 4 and 6 to 8 corry equal marks.*
3) *Solve any two questions from 2 to 4.*
4) *Figures to right indicate full marks.*
5) *Answers to two sections should be written in separate answer sheets.*

SECTION - I

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

    i) Enlist digestion methods used for soil analysis.

    ii) What is mean by exchangeable bases and base saturation.

    iii) What is mean by pesticides and give its types.

    iv) Define term fertilizer and give its various types.

    v) What is mean by pesticide residue.

  B) Solve the following : [3]

    0.555 gm of nitrogen fertilizer was Kjeldhalised and NH_3 produced was absorbed in 50 ml $\frac{N}{10}$ H_2SO_4. The excess of acid required 19 ml $\frac{N}{10}$ NaOH solution for Neutralisation. Find percentage of nitrogen in fertilizer.

Q2) A) Explain in detail. [6]

    i)   Method for analysis of captafol by GC method.

    ii)   Sampling of soil.

  B) Solve the following : [6]

    i)   Write short note on weighing and dispensing errors in sampling of soil.

    ii)   Give the method for estimation of water soluble phosphorus in fertilizer sample.

Q3) A) Solve the following : [6]

    i)   Enlist various methods used for acid digestion of soil & explain in detail.

    ii)   0.190 gm of soil sample subjected to Mg determination by complexometric titration method. Solution containing Mg^{2+} ions was diluted to 100 ml. An aliquot of 10 ml required 17 ml of 0.015 M EDTA solution for complete reaction then calculate percentage of Mg in given sample.

       (Given : At. Wt. Mg = 24.30 g)

  B) Solve the following : [6]

    i)   Outline procedure for determination of ammonium oxalate soluble potassium in fertilizer.

    ii)   Give general scheme for analysis of pesticides.

Q4) A) Solve the following : [6]

    i)   Explain in detail method for analysis of organochlorine and organophosphorus pesticides by GC method.

    ii)   Explain analytical procedure for extractable boron.

  B) Solve the following : [6]

    i)   Give analytical method for determination of Nitrogen.

    ii)   Explain in detail method for analysis of aldicarb by GC method.

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Instructions : 1) *Question 5 is Compulsory.*

2) *From Question 6 to 8 solve any two.*

Q5) A) Solve any four of the following : [8]

i) Explain the term thermosets with suitable example.

ii) Explain the term biomedical polymers with suitable example.

iii) Explain tensile modulus.

iv) What is relaxation time in viscoelasticity?

v) Define surfactant.

B) The data shown below in table were obtained for the molecular weight distribution of a sample of poly (vinyl alcohol). Determine the weight average molecular weight of this material.

Molecular weight distribution of a sample of Poly (vinyl alcohol). [3]

Mean M_i (g mol^{-1})	W_i
7500	0.02
12500	0.10
17500	0.18
22500	0.29
27500	0.26
32500	0.13
37500	0.03

Q6) A) Explain in detail from the following : [6]

i) Explain rate of polymer crystallization monitored by dilatometry.

ii) Explain optical microscopy to study the morphology of polymers.

B) Solve the following : [6]

i) Discuss analysis of quaternary ammonium salts from cationics and amphoterics surfactants by two phase titration with sodium dodecyl sulphate method.

ii) The density and associated percent crystallinity for two poly (ethylene terphthalate) materials as follows :

Density	% crystallinity
1.408	74.3
1.343	31.2

a) Compute the densities of totally crystalline and totally amorphous PETP.

b) Determine the % crystallinity of specimen having density 1.382 gm/cm^2.

Q7) A) Attempt the following : [6]

    i) Describe analysis of ethoxylated alcohols, alkylphenols and fatty acids from non-ionic surfactants by use of cohaltothiocynate colorimetric method.

    ii) Describe isolation of surfactant using liquid-solid extraction technique.

  B) Attempt the following : [6]

    i) Explain the use of NMR spectroscopy for identification of polymers.

    ii) Discuss mass spectrometry for identification of polymers.

Q8) A) Attempt the following : [6]

    i) Describe end group analysis for the determination of molecular weights of polymers.

    ii) Describe the osmometry method for the termination of molecular weights of polymers.

  B) Attempt the following : [6]

    i) Describe construction and performance of surfactant - sensitive electrode.

    ii) Explain Maxwell and Kelvin - Voight models for viscoelastic behaviour.

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