

Total No. of Questions : 8]

SEAT No. :

PD3083

[Total No. of Pages : 4

[6476]-11

M.Sc. - I

PHYSICAL CHEMISTRY

CCTP-1 CHP-110 : Fundamentals of Physical Chemistry-I
(2019 Pattern) (Semester-I) (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) All questions are compulsory.
- 3) Figures to the right indicate full marks.
- 4) Use of logarithmic table, calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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

P.T.O.

SECTION - I

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

- a) State clausius inequality. Give its significance.
- b) Define the term ideal and non-ideal solution.
- c) Sketch and explain the probability curves for the first four energy levels for particle in a box.
- d) Write the Huckel determinant for cyclobutadiene.
- e) State Heisenburg's uncertainty principle.

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

- a) Derive the Gibb's-Dubem equation.
- b) Define chemical potential. Derive the expression for the change in entropy when two ideal gases are mixed.
- c) Discuss the effect of addition of non-volatile solute on the boiling point of liquids.
- d) Explain Raoult's and Henry's law.

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

- a) Write a note on blackbody radiation. What is ultraviolet catastrophe?
- b) Show that the wave functions $\psi_n = \sqrt{\frac{2}{a}} \sin \frac{n\pi}{a} \cdot x$ and $\psi_m = \sqrt{\frac{2}{a}} \sin \frac{m\pi}{a} \cdot x$ are orthogonal wave functions (where $n \neq m$).
- c) Distinguish between valence bond theory and molecular orbital theory.
- d) Apply HMO theory to butadiene and hence calculate the magnitude of the delocalisation energy.

Q4) Attempt any one of the following. **[5]**

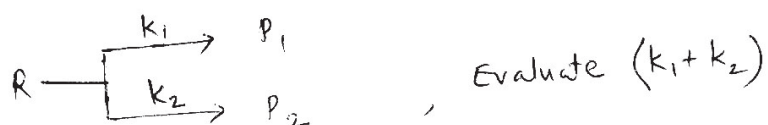
- a) Calculate the osmotic pressure of a solution at 37°C containing 6.0 gm urea, 12.0 gm of glucose and 34.2 gm of canesugar in a 3.1 litre of water.
[At. wt. N = 14, H = 1, O = 16]
- b) Calculate the maximum work performed when 24 gm of oxygen expands isothermally and reversibly at 300k from a volume of 10 dm³ to 25 dm³
[R = 8.314 JK⁻¹ mole⁻¹]

SECTION - II

Q5) Attempt the following :

[10]

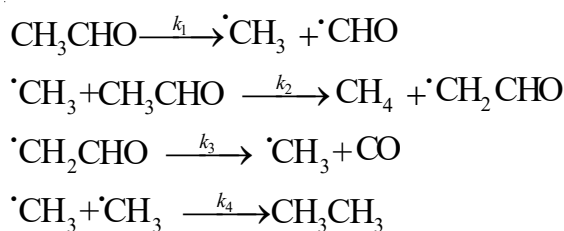
- Define energy of activation and give the exponential form of Arrhenius equation.
- Give the principle of flash photolysis.
- Explain the effect of temperature and pH on enzyme catalysed reactions.
- Give the expression for a vibrational partition function of a diatomic molecule and explain the terms involved in it.
- In the following reactions.



Q6) Attempt any two of the following.

[10]

- Obtain the expression for the rate constant of a reaction using collision theory of bimolecular reaction.
- Explain pre-equilibrium reaction. Derive the expression for enzyme catalysed reaction.
- The thermal decomposition of acetaldehyde ($\text{CH}_3\text{CHO} \rightarrow \text{CH}_4 + [\text{O}]$) follows the mechanism as:



show that
$$\frac{d[\text{CH}_4]}{dt} = k [\text{CH}_3\text{CHO}]^{3/2}$$

where
$$k = k_2 \left(\frac{k_1}{2k_4} \right)^{1/2}$$

- Discuss the kinetics of reversible reaction which follows first order forward and reverse directions.

Q7) Attempt any two of the following.

[10]

- a) Obtain an expression for translational partition function in case of diatomic molecule.
- b) What is inhibition of enzyme action? Explain it for non-competitive inhibition.
- c) Discuss the Lindmann theory of unimolecular reaction.
- d) What are fast reactions? Differentiate between stopped flow technique and continuous flow technique.

Q8) Solve any one of the following.

[5]

- a) Calculate the rotational partition function for F_2 at 25°C , given that, $I = 32.5 \times 10^{-47} \text{ kgm}^2$.
- b) Estimate the diffusion controlled rate constant for recombination of iodine atom in n-hexane solution at 25°C . Given that viscosity coefficient for n-hexane is 0.325 cP.



Total No. of Questions : 6]

SEAT No. :

PD-3084

[Total No. of Pages : 4

[6476]-12

M.Sc. (Part - I)

INORGANIC CHEMISTRY

CCTP-2 CHI-130 : Molecular Symmetry and Chemistry of
P-Block Elements

(CBCS) (2019 Pattern) (Semester -I) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instruction 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 indicates full marks.
- 4) Use of log tables/ character tables and calculator is allowed.

SECTION - I

Q1) a) Answer the following : [8]

- i) Mention the symmetry element, order and classes of C_{2h} point group.
 - ii) Using matrix multiplication method find $\sigma_{xz} \times \sigma_{yz} = ?$
 - iii) Assign the planar H_3BO_3 into appropriate point group, Justify it.
 - iv) Which vibrations are active in I.R.
- b) What is improper axis of rotation? Explain it with the help of example.

[3]

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

- i) Derive the character table for D_{2h} point group using great orthogonality theorem.
- ii) Find out normalized SALC using projection operator A_1' irreducible representation which separates on σ_1 orbital of BF_3 molecule.

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

P.T.O.

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

- Define proper axis of rotation? Find the principle axis in Benzene molecule.
- Give the matrix representation for zC_2 and ${}^y\sigma_{xy}$ symmetry operation. Find out their product by matrix multiplication method.
- Assign the following molecules into appropriate point group.
 - CHFCI Br
 - HOCl
 - HCN

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

- For $[\text{Ni}(\text{CN})_5]^{-2}$ molecule find the reducible representation for which sigma bond form the basis and find out which orbitals are offered for sigma bonding

Given, character table for C_{4v} point group

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$		
A_1	1	1	1	1	1	z	x^2+y^2, z^2
A_2	1	1	1	-1	-1	Rz	
B_1	1	-1	1	1	-1	-----	$x^2 - y^2$
B_2	1	-1	1	-1	1		$x y$
E	2	0	-2	0	0	(x, y)	(x^2, y^2)

- Find out normalized SALC using projection operator of A_g irreducible representation which operates on σ_1 orbital of ethylene molecule.

D_{2h}	E	$C_2(z)$	$C_2(y)$	$C_2(x)$	i	σ_{xy}	σ_{xz}	σ_{yz}
A_g	1	1	1	1	1	1	1	1

- b) Attempt any two of the following: [6]
- i) Explain symmetry criteria for optical activity with the help of example.
 - ii) Identify and draw different types of planes in POCl_3 molecule.
 - iii) Give all associative operation in S_3 axis.

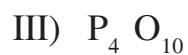
SECTION - II

- Q4)** a) Answer the following: [8]
- i) What are electron rich compounds? Explain with suitable examples.
 - ii) Give the principle of separation of alkali metals using crown ethers.
 - iii) What are the allotropes of carbon? Draw the structure of graphite.
 - iv) Give the preparation of Grignard reagent.
- b) Write a note on intercalation compounds of graphite. [3]

- Q5)** a) Answer ANY ONE of the following: [6]
- i) Write a note on extended Si-o compounds.
 - ii) Give the synthesis, reactions, properties and applications of boron nitrides.
- b) Answer ANY TWO of the following: [6]
- i) Write a note on metallic hydrides.
 - ii) Solutions of alkali metals in ammonia act as reducing agents. Explain.
 - iii) Explain pseudohalogens with examples.

Q6) a) Answer ANY ONE of the following: [6]

i) Draw the structures of the following.



ii) Write a note on metalloboranes and organoboranes.

b) Answer ANY TWO of the following: [6]

i) Write a note on SN compounds.

ii) Give the synthesis and reactions of Xenon-fluorides.

iii) Give the synthesis and reactions of organo silicon compounds.



Total No. of Questions : 8]

SEAT No. :

PD3085

[Total No. of Pages : 5

[6476]-13

M.Sc. - I (Chemistry)

ORGANIC CHEMISTRY

CCTP-3, CHO-150: Basic Organic Chemistry
(2019 Pattern) (Semester - I) (4 Credits)

Time : 3 Hours]

[Max. Marks : 50

Instructions to the candidates:

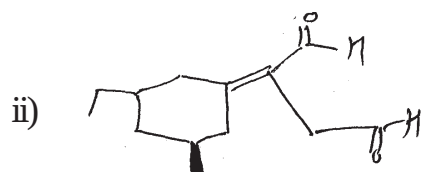
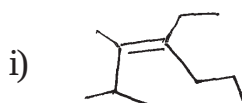
- 1) Section - I and II carry equal marks.
- 2) Q.1 and Q.5 are compulsory.
- 3) Attempt any two questions from Q.2 to Q.4.
- 4) Attempt any two questions from Q.6 to Q.8.
- 5) Answer to the two sections should be written in separate answer books.

SECTION - I

Q1) A) Attempt the following.

[8]

a) Assign E/z configuration to following.

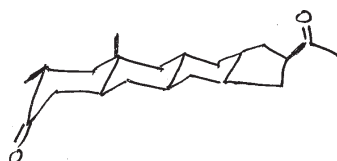


b) Assign P/R or P/S or M/S of labelled hydrogen H_A and H_B .



- c) Why aromatic electrophilic substitution reaction on furan takes place at C-2 position?
- d) Trans - 1, 2 (e,e) dimethyl cyclohexane is more stable than that of Cis isomer. Explain.

B) Label the chiral centres and calculate the number of stereoisomers in the following compound. [3]

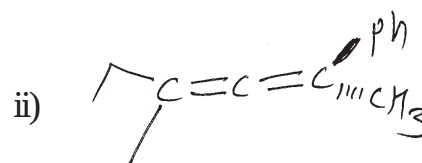


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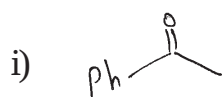
Q2) A) Attempt the following.

[6]

a) Assign R/S configuration.



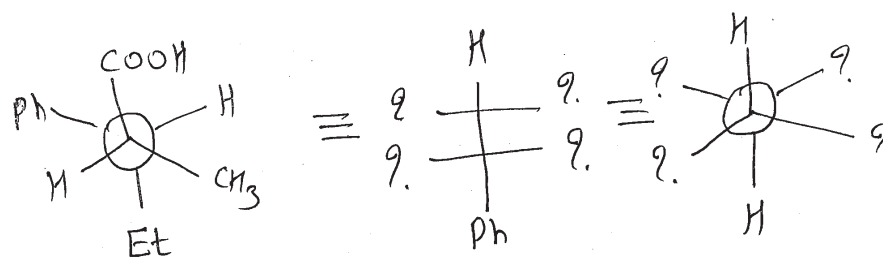
b) Assign Re/Si face.



B) Attempt the following.

[6]

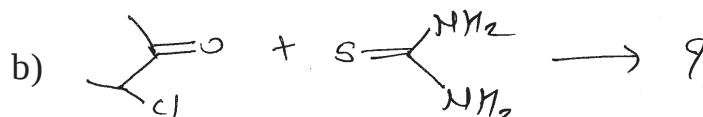
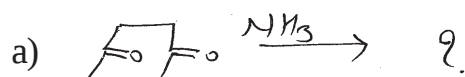
a) Convert the following in perspective formulae.



b) Explain stereo selective reaction with suitable example.

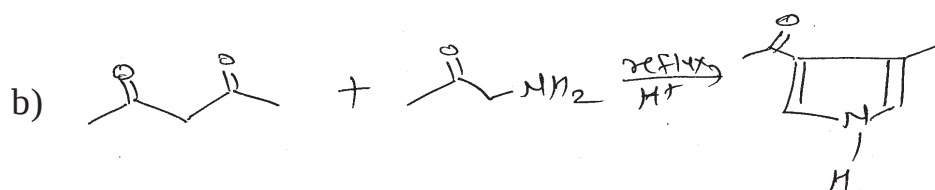
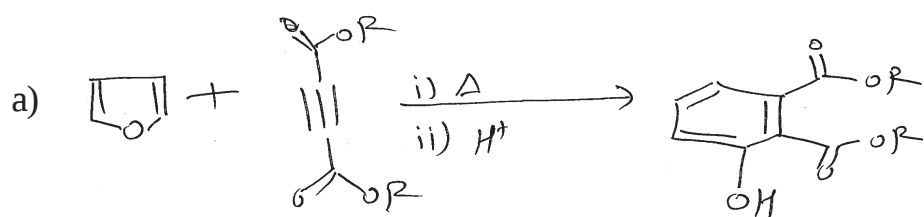
Q3) A) Predict the product with Mechanism.

[6]



B) Suggest mechanism of the following reactions.

[6]



Q4) A) Attempt the following.

[6]

a) Identify aromatic, anti aromatic and non aromatic compound

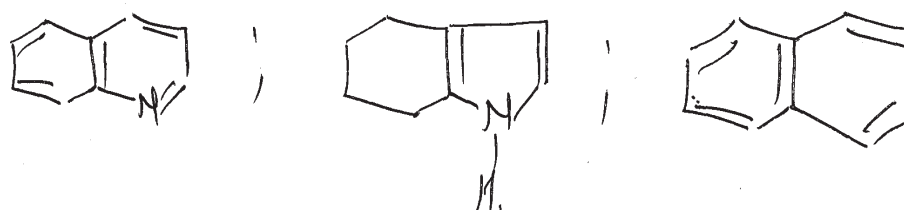


b) Explain the Benzenoid and Non Benzenoid compound with suitable example.

B) Attempt the following.

[6]

a) Identify Benzenoid and Non-Benzenoid aromatic compound.



b) Why thiophene is more aromatic than furan?

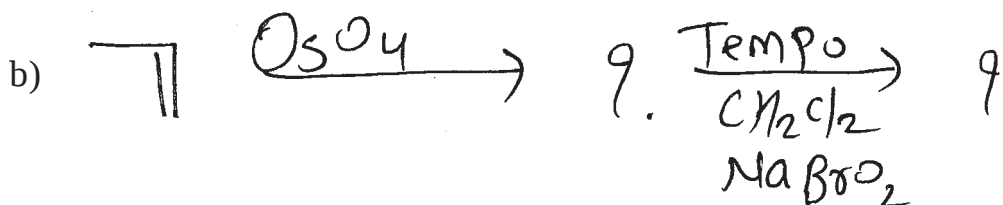
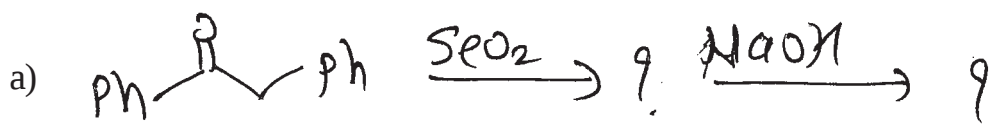
SECTION - II

Q5) A) Attempt the following. [8]

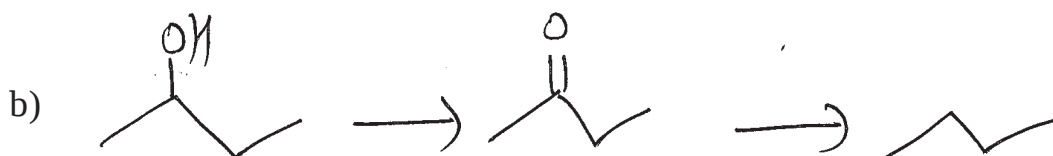
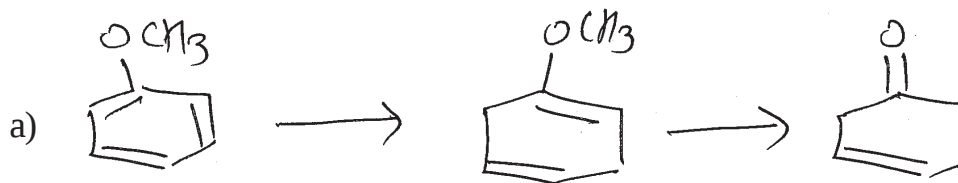
- a) Discuss the stability of carbanion.
- b) Why N-substituted amide can't show Hoffmann rearrangement?
- c) Why phosphorous ylide is more stable than nitrogen ylide?
- d) Uses of KMnO_4 in organic synthesis. Explain.

B) Why MCPBA is most suitable reagent for organic synthesis. [3]

Q6) A) Attempt the following. [6]



B) Suggest the Reagents in the following conversion. [6]



Q7) A) Attempt the following. [6]

a) Pinacol - Pinacolone Rearrangement

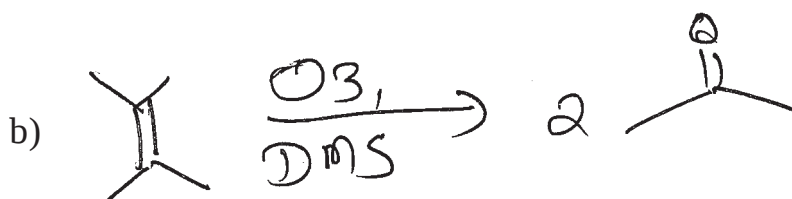
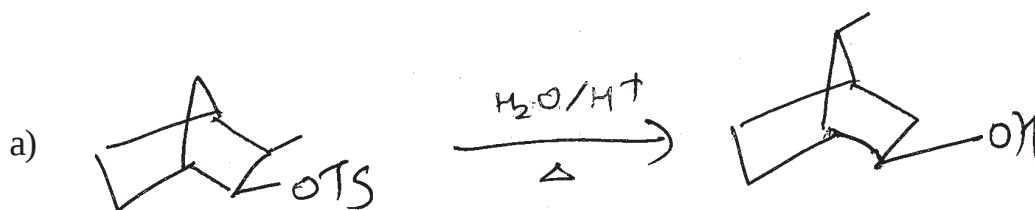
b) Favorskii Rearrangement

B) Attempt the following. [6]

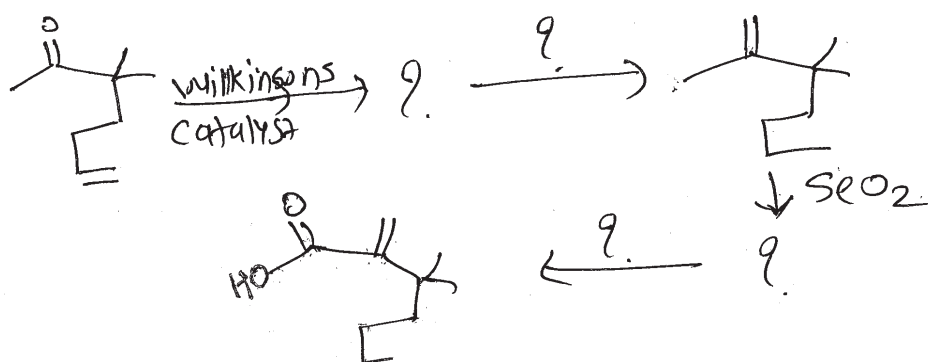
a) Explain the role of sulphur ylide in organic synthesis.

b) Give any two methods for synthesis of epoxide.

Q8) A) Suggest the mechanism of the following reactions. [6]



B) Complete the following reaction sequence. [6]



④④④④

[6476]-14

M.Sc. - I

CHEMISTRY

**CBOP - 1 - CHG - 190 : Introduction to Solid State of Matter
(2019 Pattern) (Semester - I) (2 Credits) (Elective Option - A)***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) Figures to the right indicate full marks.
- 4) Q. 2,3 and 4 carry equal marks.
- 5) Use of logtable and calculators is allowed.

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

- i) Define superconductivity. Give example of high temperature superconductor.
- ii) How n and p type of semiconductor can be obtained from pure silicon?
- iii) What is photoconductivity? Give example of photoconductor.
- iv) Explain vacancy mechanism for solid state ionic conductivity.
- v) What are intrinsic and extrinsic defects?
- b) Band gap of certain semiconductor is given below. Which of them will act as photo conductor? Why? **[3]**

Semiconductor	TiO ₂	cds	siO ₂	
Band gap	3.3	2.7	5.1	eV

$$\text{Given Band gap} = \frac{1240}{\lambda_{\text{max}}} [\lambda_{\text{max}} - \text{wavelength of light absorbed}]$$

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

- i) How density of states can be determined by X-ray emission spectroscopy?
- ii) What are fast ion conductors? Explain why β -alumina act as fast ion conductor.
- b) Answer the following : **[6]**
 - i) What are fuel cells? Explain construction and working of fuelcells?
 - ii) Discuss the synthesis of gold nano particles.

P.T.O.

- Q3)** a) What are metals and semiconductors? Explain band theory of solids. On the basis of band theory explain conductivity in metals and semiconductors. [6]
- b) Write notes on [6]
- i) High temperature superconductors
- ii) Free electron theory of metals.
- Q4)** a) Explain in detail any two methods of synthesis of solids. [6]
- b) Attempt the following : [6]
- i) Give the differences between Frenkel and Schottky defects.
- ii) Discuss construction and working of oxygen sensor.



Total No. of Questions : 4]

PD-3086

[6476]-14

M.Sc. - I

CHEMISTRY

(General Chemistry)

CBOP - 1 - CHG - 190 : Mathematics for Chemistry
(2019 Pattern) (Semester - I) (2 Credits) (Elective Option - B)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

- Q1) a) Solve any four of the following : [8]
- i) Define the term Determinant
 - ii) Write the quotient rule of derivatives

iii) Find the order of the following determinant

$$\begin{vmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 6 & 7 & 8 \\ 9 & 0 & 1 \end{vmatrix}$$

- iv) What is a node and cusp?
- v) What is a horizontal matrix?

- b) Find the value of the following determinant [3]
- $$\begin{vmatrix} 265 & 240 & 219 \\ 240 & 225 & 198 \\ 219 & 198 & 181 \end{vmatrix}$$

- Q2) a) Solve the following : [6]
Find the differential coefficients of the following w.r.t.x.

$$\frac{x}{(x+1)^2}$$

$$\frac{2x+3}{x^2+5}$$

- b) Solve the following : [6]
Find the maximum and minimum values of
- i) $2x^3 - 15x^2 + 36x + 10$
 - ii) $x^3 - 3x^2 - 9$

- Q3) a)** Solve the following : [6]
Evaluate the following integrals

i) $\int \frac{(x+a)^3}{2\sqrt{x}} dx$

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

- b)** Solve the following : [6]
Evaluate the following integrals

i) $\int (x-3)(x+3) dx$

ii) $\int \frac{x^4 + 3x^2 + 1}{x^3} dx$

- Q4) a)** Solve the following : [6]

i) Find the adjoint of the matrix A if $A = \begin{bmatrix} 1 & 1 & 3 \\ 0 & 1 & -1 \\ 2 & 0 & 4 \end{bmatrix}$

ii) Find the inverse of the matrix $A = \begin{bmatrix} 3 & -2 & -1 \\ -4 & 1 & -1 \\ 2 & 0 & 1 \end{bmatrix}$

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

i) What is scalar triple product and vector triple product

ii) If $A = \begin{bmatrix} 2 & 3 & 4 \\ 1 & 2 & 3 \\ -1 & 1 & 2 \end{bmatrix}$ $B = \begin{bmatrix} 1 & 3 & 0 \\ -1 & 2 & 1 \\ 0 & 0 & 2 \end{bmatrix}$ then find AB and BA



Total No. of Questions : 4]

PD-3086

[6476]-14

M.Sc. - I

CHEMISTRY

(General Chemistry)

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

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Question 1 is compulsory.
- 2) Question 2 to 4 Carry equal marks.
- 3) Solve any two questions from 2 to 4.
- 4) Draw diagram wherever necessary.

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

- a)
 - i) Which type of diet is more likely to lead to over consumption and obesity, one rich in sugar or one rich in fat?
 - ii) Which oil has greatest amount of desirable monounsaturated fatty acids?
 - b) Why do some people have curly hair while in others hair grows straight?
 - c) Give the significance of nucleus
 - d) Compare and contrast functional properties of starch and glycogen
 - e) Give characteristics of peptide bond
- B)** Why are most unsaturated fatty acids found in phospholipids are in the cis rather than trans conformation? Draw the structure of 16C, 18C and 20C fatty acid. **[3]**

Q2) a) Attempt the following questions:

- i) Explain in detail LDL receptor is endocytosed and transported to lysosomes **[3]**
- ii) Comment on tertiary structure of proteins. **[3]**
- b) Solve the following.
 - i) What are standard amino acids? Classify them based on their side chains **[3]**
 - ii) Draw the Haworth perspective formulas of α and β forms of galactose. What features distinguishes the two forms **[3]**

- Q3)** a) Describe the important features of prokaryotic and eukaryotic cell. Draw well labelled diagram of prokaryotic and eukaryotic cell. [6]
- b) Solve the following.
- i) Classify lipoproteins based on their density [3]
- ii) Write a note on active transport [3]
- Q4)** a) Discuss protein - ligand interaction using Hemoglobin as an example.[6]
- b) Solve the following.
- i) Comment on Denaturation of proteins [3]
- ii) Comment on Biomolecules as potential drug targets [3]



Total No. of Questions : 8]

SEAT No. :

PD-3087

[Total No. of Pages : 3

[6476]-21

M.Sc. (Part - I)

CHEMISTRY

Physical Chemistry - II

CHP-210 : Molecular Spectroscopy and Nuclear Chemistry
(2019 Pattern) (Semester - II) (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 side indicates full marks.
- 4) Use of logarithmic table / calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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

P.T.O.

SECTION - I

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

- a) Classify the following molecules on the basis of moment of inertia
 H_2O , HCl , C_6H_6 , BF_3
- b) What is hot band?
- c) State the rule of mutual exclusion
- d) What is predissociation spectra?
- e) Give the principle of Mossbauer spectroscopy.

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

- a) How does isotopic substitution reveal the exact isotopic mass and relative isotopic abundance in microwave studies?
- b) Distinguish between simple harmonic oscillator and anharmonic oscillator with respect to energy equation, selection rule and energy curve.
- c) Sketch the polarizability ellipsoid for fundamental vibrational modes of CO_2 molecule and explain its Raman activity.
- d) Explain the rotational Raman spectrum of rigid diatomic molecule.

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

- a) Explain UPES with the help of a spectrum for CO molecule.
- b) Discuss in detail the applications of Mossbauer spectroscopy.
- c) State the Frank-Condon principle. Explain why electronic spectra are very complex.
- d) Explain the Fortrat diagram for $B' < B''$

Q4) Solve any one of the following : **[5]**

- a) The rotational constant for H^{35}Cl is observed to be 10.5909 cm^{-1} . What is the value of B for H^{37}Cl ?
- b) The equilibrium vibrational frequency and anharmonicity constant for HI molecule are 2309.5 cm^{-1} and 0.0172 respectively. Calculate the fundamental and first overtone transition.

SECTION - II

Q5) Attempt the following : **[10]**

- a) Give the general characteristics of radioactive decay.
- b) Define Rad and Rontgen. Give their interrelation.
- c) Explain the term neutron Spallation.
- d) State Fick's first law of diffusion.
- e) Give the principle of radiometric titration

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

- a) Discuss α -decay theory according to classical physics.
- b) Write a note on Compton scattering.
- c) What is Fricke dosimetry? With appropriate reaction obtain the $G_{Fe^{3+}} = 15.6$
- d) Derive the general expression for the activity of a daughter nuclide.

Q7) Attempt any two of the following **[10]**

- a) What is diffusion phenomenon? Discuss zone diffusion technique to determine diffusion coefficient?
- b) Describe how solubility of a sparingly soluble salt can be determined using a radiotracer.
- c) Discuss with the help of a typical fission yield curve, the distribution of fission fragments.
- d) Write a note on gamma radiography.

Q8) Solve any one of the following : **[5]**

- a) Half life of ^{226}Ra is 1500 year. Calculate the activity corresponding to 2.5 gram of ^{226}Ra . Also determine the time required for ^{226}Ra to reduce to 3.5×10^4 dps. If initial activity is 1 curie.
- b) Calculate molecular, mass and linear absorption coefficient of benzene. If density of benzene is 0.879 gm cm^{-3} and $e^u = 0.21$ barn per electron.



Total No. of Questions : 6]

SEAT No. :

[Total No. of Pages : 5

PD3088

[6476]-22

M.Sc. - I

CHEMISTRY

**CHI-230 : Coordination and Bioinorganic Chemistry
(2019 Pattern) (Semester-II) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Answers to the two sections should be written in separate answer book.*
- 3) *Neat labeled diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of calculator is allowed.*

SECTION-I

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

i) Calculate the total degeneracy for the following term and configuration:

1) 5G

2) $3(P^2d^3)$

ii) Assign the J values and work out possible R.S term symbols from the following data:

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

2) $L = 4, S = 2$

iii) Arrange the following terms in increasing order of energy and justify your answer:

1) $^4D \ ^4I \ ^2F \ ^3H \ ^1G$

2) $^3F \ ^1S \ ^2D \ ^1P \ ^4I$

iv) Define : Ferromagnetism and anti ferromagnetism.

b) What is Laporte selection rule for electronic transition? Explain with an example. **[3]**

P.T.O.

- Q2) a)** Answer any one of the following. [6]
- Prepare a table of microstates and obtain allowed R.S term symbols for the excited state $S^1 P^1$ configuration.
 - Classify the following transitions in octahedral complex as orbitally allowed, vibronically allowed and forbidden transitions. Justify your answer.
 - $A_{24} \rightarrow T_{29}$
 - $A_{29} \rightarrow T_{24}$
 - $A_{19} \rightarrow T_{24}$
- b)** Answer any two of the following. [6]
- Determine the ground state term symbol for:
 - $[Mn(H_2O)_6]^{2+}$ ($Z=25$)
 - Ni^{2+} ($Z=28$)
 - Ni^{2+} octahedral complex shows 20% increase in it's observed magnetic moment value. Calculate spin-orbital coupling constant. [Given- $Dq = 850 \text{ cm}^{-1}$]
 - Write a note on : charge transfer spectra.
- Q3) a)** Answer any one of the following. [6]
- Determine the spin multiplicities of states arising from $(t_{2g})^2$ configuration when infinitely strong octahedral field is relaxed to strong field using Bethe's method of descending symmetry, correlation table and direct product table.
 - Give splitting of 2D term in weak cubic field using character table for pure rotational point group (o) and reduction formula.
- b)** Answer any two of the following. [6]
- A complex $[Cr (H_2O)_6]Cl_3$ records three spin allowed transitions at 17300 cm^{-1} , 24500 cm^{-1} and 37700 cm^{-1} . Calculate racah parameter, nephelauxetic ratio and comment on nature of M-L bond. [Given- $B_0 = 918 \text{ cm}^{-1}$]
 - How would you account for the magnetic moment listed against the following complex. $Cs[Ti(SO_4)_2]$ $\mu_{obs} = 1.84 \text{ B.M.}$
 - Write a note on Orgel diagram for P and F R.S. terms.

SECTION-II

Q4) a) Answer the following. [8]

- i) What is two electron transfer metalloenzyme? Write the reaction of it.
- ii) What are the oxidation state of Fe and Co found in biological system?
- iii) What are the function of calcium in biological system?
- iv) What is Chelate effect? What are the donor atoms of EDTA?

b) Explain the communication roles of metals in biology. [3]

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

- i) What is metalloenzyme? Explain how chemical transformation occurs in the substrate upon action of metalloenzyme.
- ii) Explain with the help of scheme ATP-dependent export of 3Na^+ and 2K^+ ion's by Na^+/K^+ ATPase.

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

- i) Write a note on vitamin B_{12} .
- ii) Explain the use of metal's and metal complexes in medicine.
- iii) Explain the role of Ca in blood coagulation.

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

- i) Explain the role of Mn in photosystem-II.
- ii) What is dioxygen transport? Explain the different types of oxygen transport metalloenzyme?

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

- i) How do ligand and stereochemistry can tune the redox potential of the metal? Explain with suitable example.
- ii) With the help of example show metal ion's affect the pK_a of ligand.
- iii) Explain the inner and outer sphere electron transfer reaction in complexes.

Direct Product

1. Group of the form $G \times i$ or $G \times \sigma_h$

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

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

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

For all groups:

$$\text{Letter Symbol: } A \times A = A, B \times B = B, A \times B = B$$

$$\text{Subscript: } 1 \times 1 = 1, 2 \times 2 = 1, 1 \times 2 = 2$$

Except for the B representations of D_2 and D_2 where

$$B \times B = B, \text{ and } 1 \times 2 = 3, 2 \times 3 = 1, 3 \times 1 = 2$$

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

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

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

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

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

(c) For D_{4h} :

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

Irrespective of the suffix on B:

(d) For D_{4d} , S_8 :

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

Irrespective of the suffix on B:

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

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

(a) For O_h , 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} :

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

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

$$E_3 \times E_3 = A_1 + A_2 + B_1 + B_2$$

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

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

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

(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 O_h , O , T_d :

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

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

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

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

6. To Complete result for O are

O	A ₁	A ₂	E	T ₁	T ₂
A ₁	A ₁	A ₂	E	T ₁	T ₂
A ₂	A ₂	A ₁	E	T ₂	T ₁
E	E	E	A ₁ + A ₂ + E	T ₁ + T ₂	T ₁ + T ₂
T ₁	T ₁	T ₂	T ₁ + T ₂	A ₁ + E + T ₁ + T ₂	A ₂ + E + T ₁ + T ₂
T ₂	T ₂	T ₁	T ₁ + T ₂	A ₂ + E + T ₁ + T ₂	A ₁ + E + T ₁ + T ₂

Character Table for O rotational group

O	E	6C ₄	3C ₂ (=C ₄ ²)	8C ₃	6C ₂		
A ₁	1	1	1	1	1		x ² +y ² +z ²
A ₂	1	-1	1	1	-1		(2z ² -x ² -y ² ,
E	2	0	2	-1	0	(R _x ,R _y ,R _z);(x,y,z)	x ² -y ²)
T ₁	3	1	-1	0	-1		(xy,xz,yz)
T ₂	3	-1	-1	0	1		

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



Total No. of Questions : 8]

SEAT No. :

PD3089

[Total No. of Pages : 5

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M.Sc. - I

ORGANIC CHEMISTRY

CCTP-6 : ORGANIC CHEMISTRY - II

CHO-250:Photo Chemistry,Pericyclic and Organic Spectroscopy
(2019 Pattern) (Semester - II) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.1 and Q.5 are compulsory.
- 2) Solve any two from Q.2 to Q.4 and any two from Q.6 to Q.8.
- 3) Write both sections in separate answer sheets.

SECTION - I

(Photochemistry and Pericyclic Reactions)

Q1) a) What do you mean by $\Pi_5^4 + \Pi_5^2$ and Π_5^2 and Π_5^2 reactions? Explain 'Endo-rule' in $\Pi_5^4 + \Pi_5^2$ reaction. [5]

b) Attempt the following. [6]

- i) Explain difference between sensitizer and quencher with suitable examples.
- ii) Explain photoreductive dimerisation of diphenyl methanone.

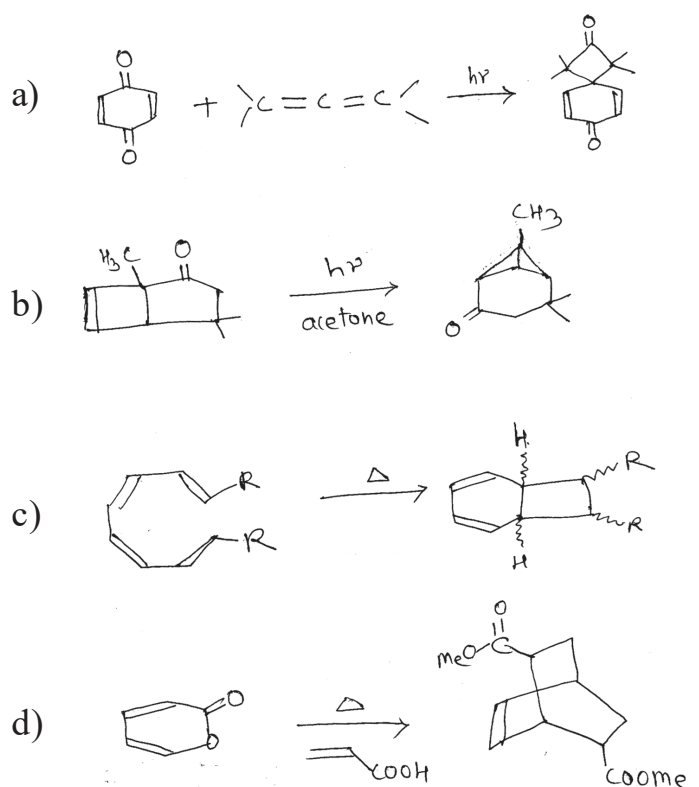
Q2) Answer the following. [12]

- a) Write a note on 'Barton Reaction'.
- b) Explain 'Photochemistry of substituted benzenes'.
- c) [1, 3] sigmatropic shift of Hydrogen is thermally forbidden but photochemically allowed. Explain.
- d) Explain orbital analysis approach for DIS rotation for 1, 3-butadiene to cyclobutene.

P.T.O.

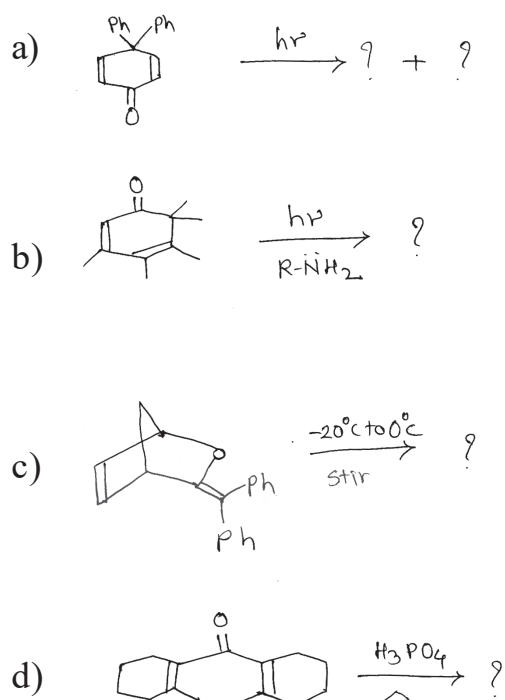
Q3) Suggest the mechanism for the following.

[12]



Q4) Predict the product with mechanism.

[12]



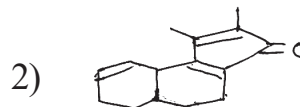
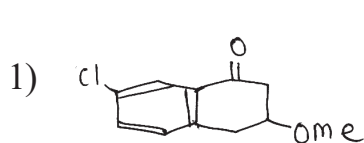
SECTION - II

(Spectroscopic Methods in Structure determination of Organic Compounds)

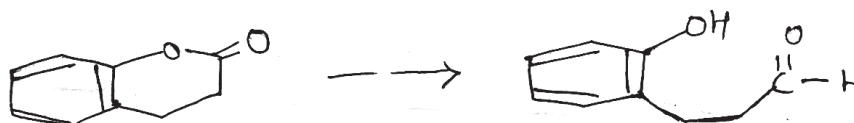
Q5) a) Write a note on 'methods of ionization' in mass spectrometry. [3]

b) Attempt the following. [8]

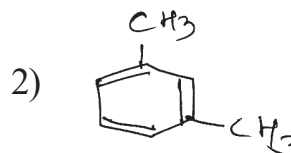
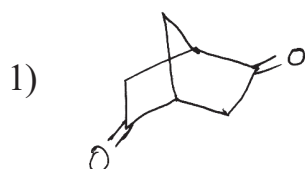
i) Calculate $\lambda_{\max}$ for the following compounds.



ii) How will you monitor the following reaction by IR spectroscopy?



iii) Find total no. of ^{13}C MR signals for the following compounds.



iv) Explain factors affecting chemical shift in PMR spectroscopy.

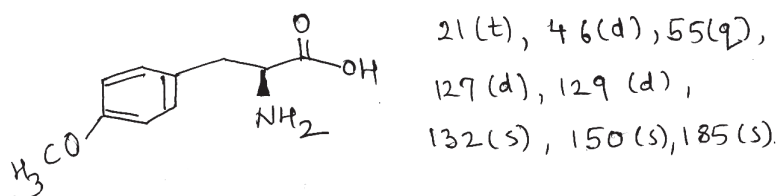
Q6) a) Write short notes on any two. [6]

i) Diamagnetic anisotropy in PMR.

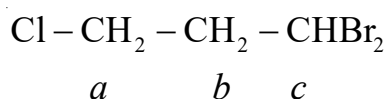
ii) Molecular ion peak and base peak in mass spectrum.

iii) Factors affecting IR frequency of $\text{C}=\text{O}$ group.

b) Assign ^{13}C signals of CMR to the following compound A. [3]



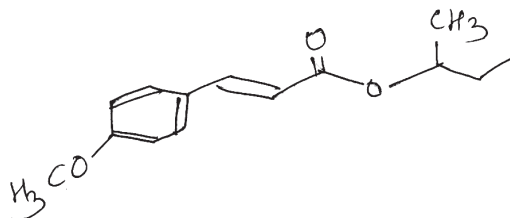
c) Construct a tree diagram of splitting pattern for following marked protons 'b' which shows at 1.6 δ ppm on 300 MHz and the coupling constant $J_{ab} = J_{bc} = 6\text{Hz}$. [3]



Q7) a) Explain the following. (Any two) [6]

- i) TMS is used as internal standard for NMR.
- ii) Coupling constant 'J'.
- iii) Off resonance and proton decoupled in CMR.

b) Assign chemical shifts for the following compounds and justify. [3]



0.91 (t) 3H	5.89 (d) J = 14Hz 1H
1.22 (d) 3H	7.00 (d) J = 8Hz 2H
1.27–1.33 (quintet) 2 H	7.33 (d) J = 14Hz 1H
3.39 (m) 1H	7.42 (d) J = 8Hz 2H
3.53 (s) 3H	

c) Give genesis of ions of the following compounds. [3]



Q8) Deduce the structures of any three of the following using spectral data and justify your answer. [12]

a) M.F. - $C_{10}H_{12}O$

IR - 1685cm^{-1}

PMR 1.00 (t_1 J=7Hz) 3H

1.75 (sex text J = 7Hz) 2H

2.91 (t_1 J = 7Hz) 2H

7.4–7.9(m) 5H

b) M.F. C_5H_{10}

IR - 1775, 1175 cm^{-1} .

Mass - 100, 85, 56

PMR 1.35 (d_1 $J = 6.5Hz$) 18mm

1.52-2.2 (m) 12 mm

2.4 (t) 12 mm

4.5 (sextet, $J = 6.5Hz$) 6mm

c) M.F. $C_4H_9NO_2$; IR - 1350 cm^{-1}

PMR - 0.97 (t_1 $J = 7Hz$) 3H

1.42 (m_1 $J = 7Hz$) 2H

2.00 (quintet, $J = 7Hz$) 2H

4.40 (t_1 $J = 7Hz$) 2H

d) M.F. $C_6H_4O_2$

CMR 136 (d)

187 (s)



Total No. of Questions : 4]

SEAT No. :

PD-3090

[Total No. of Pages : 6

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M.Sc. - I

CHEMISTRY

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

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

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) *Figures to the right 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 HRXRD? Give it's uses.
 - ii) What is the general structure of an electron gun?
 - iii) How biological samples are prepared in SEM?
 - iv) Which detector is used in EDS system? Why it is kept in cryostat?
 - v) What are the selection rules for electron transition between two shells?
- b) Bragg's diffraction of the first order was observed at 25.5° for parallel planes of the crystal under study. If the wavelength of x-rays used is $1.54 \text{ \AA}$. Calculate interplanar spacing for the planes in the crystal. **[3]**

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

- i) Which Factors are responsible for distortion of diffraction spectra? Explain one in detail.
 - ii) Explain topographic contrast in SEM.
- b) Answer the following : **[6]**
- i) Name the electron guns used in TEM? Explain one in brief.
 - ii) Discuss working atmosphere and sample preparation in XRF.

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

- i) Explain Bragg's diffraction by crystal plane with neat labelled diagram.
 - ii) Discuss detector in SEM
- b) Discuss the following : **[6]**
- i) X-ray fluorescence spectrometry
 - ii) Analyzing crystal in XRF

P.T.O.

- Q4)** a) Answer the following : [6]
- i) Give construction and working of X-ray tube.
 - ii) Explain diffraction contrast in TEM.
- b) Answer the following : [6]
- i) Explain applications of XRF.
 - ii) Discuss in brief comparison of K, L and M- series in XRF.



Total No. of Questions : 4]

PD-3090

[6476]-24

M.Sc. - I

CHEMISTRY

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

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

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) Figures to the right indicate full marks.
- 4) Q. 2 to 4 carry equal marks.
- 5) Use of logtable and calculator is allowed.

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

- i) Determine valence shell electron count for the following
 - a) $\text{Re}_2(\text{CO})_{10}$
 - b) $[\text{Pt}(\text{CN})_4]^{2-}$
- ii) Draw the structure of following polynuclear compounds :
 - a) $[\text{Rh}(\text{H})(\text{N}_2)(\text{pph})_3]$
 - b) $[\text{Co}(\text{H})(\text{CO})(\text{pph})_3]$
- iii) Predict the product and give the type of following reaction.
 $[\text{Mn}(\text{CO})_5\text{CH}_3]^+ \text{SO}_2 \rightarrow$
- iv) Give the rate law for associative reaction.
- v) Define ligand dissociation reaction with suitable example

B) Discuss conjugate base mechanism. [3]

Q2) A) Attempt any two of the following : [6]

- i) Explain bonding in carbonyl complexes.
- ii) Explain nucleophilic displacement reaction in organometallic compounds.

B) Discuss the following : [6]

- i) The kinetic chelate effect.
- ii) Ziegler - Natta polymerization of ethylene.

- Q3)** a) Explain in detail hydrogenation by Wilkinson catalyst. [6]
b) Answer the following : [6]
i) Differentiate between coordination and organometallic compounds.
ii) Explain bonding modes in CO.
- Q4)** a) Explain the stereochemistry of substitution reaction in trans octahedral complexes. [6]
b) Write note on the following : [6]
i) Trans effect
ii) π - acid ligands in organometallic chemistry.



Total No. of Questions : 4]

PD-3090

[6476]-24

M.Sc. - I

CHEMISTRY

(General Chemistry)

**CBOP - 2 - 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) Question 2 to 4 carry equal marks.
- 3) Solve any two questions from 2 to 4.
- 4) Draw diagram wherever necessary.

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

- i) What is decarboxylation reaction? Give one example.
- ii) Comment on effect of pH on enzyme activity.
- iii) What are the disadvantages of Gene therapy?
- iv) Explain Lock and Key Hypothesis.
- v) Write the sequence of mRNA molecule synthesized from a DNA template strand having the sequence
5' – ATGC ACCTTA – 3'

b) Explain the principle and working of Native - polyacrylamide Gel electrophoresis. [3]

Q2) Attempt the following questions:

- a) Explain in detail principle, working and application of paper chromatography. [6]
- b) Explain in brief
 - i) Features of Genetic code [3]
 - ii) Applications (any two) of Biotechnology [3]

Q3) Solve the following questions :

- a) Discuss in detail process of RNA synthesis. [6]
- b)
 - i) How will you determine molecular weight by Gel filtration chromatography. [3]
 - ii) Urea cycle [3]

Q4) Attempt the following questions.

- a) Describe Tricarboxylic acid cycle. [6]
- b) i) Comment on central dogma of molecular Biology [3]
ii) Give the salient features of active site. [3]



Total No. of Questions : 8]

SEAT No. :

PD3091

[Total No. of Pages : 3

[6476]-31

M.Sc. - II

PHYSICAL CHEMISTRY

**CCPT-7 CHP-310 : Quantum and Solid State Chemistry
(2019 Pattern) (Semester-III) (4 Credits)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Answer to the two sections should be written in separate answer books.*
- 2) *Questions 1 and 5 are compulsory.*
- 3) *Answer any 2 questions out of 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 indicate full marks.*
- 5) *Use of logarithmic table, calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Physico - Chemical Constants

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

P.T.O.

SECTION - I

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

- i) Find the term symbol for $L = 1, S = 3/2$.
- ii) State any two postulates of quantum mechanics.
- iii) What is Pauli's exclusion principle?
- iv) Define eigen function and eigen value.
- v) Give the importance of Ladder operator.

b) Construct the Hamiltonian operator for H_2^- ion and H_2 molecule. [3]

Q2) a) Attempt the following. [6]

- i) Derive variation theorem.
- ii) Define symmetric and antisymmetric wave function.

b) Attempt the following. [6]

i) Which of the following are eigen functions of $\frac{d^2}{dx^2}$? Give eigen value.

- 1) $\cos x$ and
- 2) $6e^x$

ii) Formulate the Hamiltonian operators for H_2 molecule.

Q3) a) Derive the expression for first order correction to wave function of non-degenerate unperturbed level. [6]

b) Attempt the following. [6]

- i) Show that Hermitian operators have real eigen values.
- ii) Verify the commutator identity $[\hat{A}, \hat{B}] = -[\hat{B}, \hat{A}]$

Q4) a) What is Slater determinant? Give the properties of Slater determinant. [6]

b) Attempt the following. [6]

i) If $\hat{A} = 3x^2$ and $\hat{B} = \frac{d}{dx}$ then, show that $\hat{A}$ and $\hat{B}$ do not commute.

ii) Classify with justification whether the following operators are linear or non linear.

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

SECTION - II

- Q5) a)** Attempt any four of the following : **[8]**
- i) What are point defects? Give their classification.
 - ii) Enlist the various types of crystal growth techniques.
 - iii) Define nucleation and induction period.
 - iv) Explain the formation of colour centres in a crystals.
 - v) Explain how p-n junction is created.
- b) Write the equation for Schottky defects and explain the terms involved in it. **[3]**
-
- Q6) a)** Attempt the following. **[6]**
- i) Explain floating zone method to grow crystal from melts.
 - ii) Explain the parabolic rate law used to explain the mechanism of gas-solid reactions.
- b) Attempt the following. **[6]**
- i) Explain the mechanism of following solid gas reaction
$$\text{MgO}_{(s)} + \text{Al}_2\text{O}_{3(s)} \rightarrow \text{MgAl}_2\text{O}_{4(s)}$$
 - ii) Write a note on Kirkendall effect.
-
- Q7) a)** State and explain the various method of electrical breakdown in insulators. **[6]**
- b) Attempt the following. **[6]**
- i) Write note on intrinsic semiconductor.
 - ii) Calculate the specific heat capacity for Na at 4.0k [Given : $\theta_D = 159\text{k}$].
-
- Q8) a)** Deduce $E_o = \frac{E_v + E_c}{2}$ for intrinsic semiconductor. **[6]**
- b) Attempt the following. **[6]**
- i) The average energy required to create a Frankel defect in an ionic crystal $A^{+2}B^{2-}$ is 1.4 ev. Calculate the ratio of the number of Frankel defect at 300°C in 1g of the crystal.
 - ii) State the advantages of growing crystals by Pulling method.



Total No. of Questions : 8]

SEAT No. :

PD-3092

[Total No. of Pages : 3

[6476]-32

M.Sc. - II

PHYSICAL CHEMISTRY

CHP - 311 : CCTP - 8 : Nuclear, Radiation and Polymer
Chemistry

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

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answer to the two sections should be written in SEPARATE answer books.
- 2) Questions 1 and 5 are compulsory.
- 3) Answer any 2 questions out of 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 diagram must be drawn wherever necessary.

Physico - Chemical Constants

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		$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
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		$= 4.187 \times 10^3 \text{ erg}$ $= 4.187 \text{ J}$
10.	1 amu		$= 1.673 \times 10^{-22} \text{ kg}$
11.	Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

- Q1) a)** Attempt any four of the following : **[8]**
- i) State Bethe's notation.
 - ii) Explain role of moderator and coolant in reactor.
 - iii) What is the principle of RBS?
 - iv) Draw the schematic diagram of Li-drifted detector.
 - v) State the principle of breeder reactor.
- b) Explain conservation of momentum in nuclear reaction. **[3]**
-
- Q2) a)** Attempt the following : **[6]**
- i) Explain general aspects of reactor design.
 - ii) Discuss ionization and x-ray emission detection in PIXE.
- b) Attempt the following : **[6]**
- i) Describe surface analysis in RBS.
 - ii) Write a note on thermonuclear reactions.
-
- Q3) a)** Give the comparative account of Nuclear shell model, liquid drop model and collective model. **[6]**
- b) Attempt the following : **[6]**
- i) Discuss the theory of solid state semiconductor detector.
 - ii) On the basis of semi empirical mass equation, predict the stable nuclide of isobaric series $A = 140$.
-
- Q4) a)** Describe in detail the working of breeder reactor. **[6]**
- b) Attempt the following : **[6]**
- i) Explain photonuclear reactions.
 - ii) Discuss Li-drifted detector.

SECTION - II

- Q5) a)** Attempt any four of the following : **[8]**
- i) State the Mark-Houwink equation.
 - ii) Define polydispersity index.
 - iii) Describe monomer reactivity ratio.
 - iv) Explain colligative properties.
 - v) Define osmotic pressure.
- b) The degree of polymerisation of polyethylene is 3000. Calculate the molecular weight. **[3]**
-
- Q6) a)** Answer the following : **[6]**
- i) Derive Co-polymer equation.
 - ii) Describe molecular forces and chemical bonding in polymers.
- b) Answer the following : **[6]**
- i) Discuss heat of mixing of polymer solutions.
 - ii) Explain weight average molecular weight of polymer.
-
- Q7) a)** Explain membrane osmometry technique to determine molecular weight of polymer. **[6]**
- b) Answer the following : **[6]**
- i) Calculate $\bar{X}_n$, $\bar{X}_w$ and weight fraction of $\bar{X}_n$ – mers when 95% step polymerisation is complete.
 - ii) Explain biological and non-biological polymers.
-
- Q8) a)** Discuss light scattering technique to determine molecular weight of polymer. **[6]**
- b) Answer the following : **[6]**
- i) Give the classification of polymers on the basis of structure.
 - ii) Explain addition & condensation polymer with examples.



Total No. of Questions : 8]

SEAT No. :

PD3093

[Total No. of Pages : 3

[6476]-33

S.Y.M.Sc.

PHYSICAL CHEMISTRY

CHP-312: Physicochemical Methods of Analysis
(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer the two sections should be written in separate answer book.
- 2) Question 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 indicate full marks.
- 5) Use of logarithmic table, calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Physico - Chemical Constants

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

P.T.O.

SECTION - I

- Q1) a)** Attempt any four of the following. **[8]**
- i) Define absorptive edge and state its use.
 - ii) Define the terms short-wavelength cut-off and Brems strahlung.
 - iii) What is meant by dynamic and isothermal thermogravimetry?
 - iv) What are X-rays? Which is useful region of X-ray for chemical analysis?
 - v) Define the terms fermi energy and Binding energy.
- b)** Explain electron probe X-ray microanalysis technique. **[3]**
-
- Q2) a)** Answer the following. **[6]**
- i) What is X-ray fluorescence? Draw a neat labelled diagram of energy dispersive instrument.
 - ii) Explain chemical shift observed in ESCA technique.
- b)** Answer the following. **[6]**
- i) Explain the factors affecting DTA.
 - ii) Estimate the thickness of foil of the alloy having absorption coefficient $450.55 \text{ cm}^2/\text{gm}$ at 0.430 nm . The detector recorder 9586 counts per two mixture of transmitted x-ray when foil was not in path of x-ray and 856 counts per minute when foil was placed in the path. The density of alloy is 8.01 gm/cm^3 .
-
- Q3) a)** Describe electrostatic field analyser used in ESCA. **[6]**
- b)** Answer the following. **[6]**
- i) Explain spectral splitting observed in ESCA technique.
 - ii) Write application of DTA technique.
-
- Q4) a)** Describe heat flux DSC instrument. **[6]**
- b)** Answer the following. **[6]**
- i) What is meant by EXAFS? Give two applications of x-ray absorption.
 - ii) Gypsum showed mass loss of about 15% of original sample mass due to complete dehydration at 170°C . Determine the number of water molecules present in gypsum.
[Given:- At wt of Ca = 40, S = 32, O = 16, H = 1]

SECTION - II

- Q5) a)** Attempt any four of the following. **[8]**
- i) Define plasma and its advantages.
 - ii) State the advantages of constant current coulometry.
 - iii) Give the difference between normal pulse and differential pulse.
 - iv) What is controlled potential coulometry?
 - v) Write the advantages of amperometric titration.
- b) Explain liquid phase chemiluminescence. **[3]**
- Q6) a)** Answer the following. **[6]**
- i) Describe hydrodynamic voltametry.
 - ii) Give factors affecting the photoluminescence.
- b) Answer the following. **[6]**
- i) Discuss the application of ICP atomic emission spectroscopy.
 - ii) Draw a neat labelled diagram of typical cyclic voltagram.
- Q7) a)** Explain the application of coulometry to perform neutralization titrations. **[6]**
- b) Answer the following. **[6]**
- i) What are the different techniques of amperometric titration.
 - ii) Define the terms
 - 1) Voltagram
 - 2) Potentiostat
- Q8) a)** Compare ICP technique with conventional atomic emission technique. **[6]**
- b) Answer the following. **[6]**
- i) Explain the 'S' route mechanism for electro chemiluminescence.
 - ii) A sample of Ni weighing 1.59g is dissolved in acid and Ni is electrolysed using constant current of $1.25\mu\text{A}$ for 5 minutes. Calculate the percentage of Ni in ore.



Total No. of Questions : 8]

SEAT No. :

PD-3094

[Total No. of Pages : 7

[6476]-34

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-313(A) : CBOP-3 : Photochemistry and Techniques in
Polymer Chemistry
(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answers to the Two sections should be written in SEPARATE answer books.
- 2) Question 1 and 5 are COMPULSORY.
- 3) Answer any 2 questions out of Q2, Q3 & Q4 and any 2 questions out of Q6, Q7 & 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	= $6.023 \times 10^{23} \text{ mol}^{-1}$
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	= $6.626 \times 10^{-16} \text{ erg s}$ = $6.626 \times 10^{-34} \text{ Js}$
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 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 J
10.	1 amu		= $1.673 \times 10^{-27} \text{ kg}$
11.	Bohr magneton	β_e	= $-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear magneton	β_n	= $5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	= $9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

- Q1) a)** Solve any 4 of the following : **[8]**
- i) What are the characteristics of triplet state?
 - ii) Define dark term dark reaction. Give an example.
 - iii) What is Flash photolysis?
 - iv) What is self phase modulation?
 - v) What are the application of photosynthesis.
- b) Explain photochemical kinetics of biomolecular process. **[3]**
-
- Q2) a)** Explain in details. **[6]**
- i) Explain geneal features of photophysical process.
 - ii) Discuss Nanosecond laser Flash photolysis.
- b) i) Write a note on theory of photoluminescence.
- ii) What is stem-volmer equation. **[6]**
-
- Q3) a)** What is actinometry? Enlist the various types of chemical actinometer. **[6]**
- b) i) Explain the mechanism of delayed fluorensence. **[3]**
- ii) State the importance of quenching. **[3]**
-
- Q4) a)** Deduce the stem-volmer equation for the kinetic of collision quanching. **[6]**
- b) Solve the following :
- i) A certain system absorb 2.8×10^{16} quanta of eight per second. At the end of 14 min. It is observed that 0.14 mole of the irradiated substance was reacted. **[3]**
 - ii) For photochemical reaction $A \rightarrow B$ 1×10^{-5} moles of B were formed on absorption of 6.62×10^7 erg at $3600\text{\AA}$ calculate the quantum efficiency. **[3]**

SECTION - II

- Q5) a)** Solve any four of the following : **[8]**
- i) Distinguish between homochain polymer and heterochain polymers.
 - ii) State the principle of ultracentrifugation process.
 - iii) What is glass transition temperature?
 - iv) What is meant by thermoplastic polymer?
 - v) What is Vulcanization?
- b) Describe the compression molding. **[3]**
-
- Q6) a)** Explain in detail : **[6]**
- i) Describe the principle of membrane osmometry.
 - ii) Why do the IR spectra of crystalline and amorphous polymer differ?
- b) i) Derive copolymer equation. **[3]**
- ii) Explain the conduction mechanism in conducting polymers. **[3]**
-
- Q7) a)** What are the techniques used for the production of reinforced plastics. Explain any one technique with neat diagram. **[6]**
- b) i) Distinguish between addition and condensation polymerization. **[3]**
- ii) Explain - it is almost impossible to obtain an 100% crystalline polymer. **[3]**
-
- Q8) a)** Write a note on X-ray diffraction in analysis of polymer. **[6]**
- b) i) Describe cross linking of the polymer. **[3]**
- ii) Write a note on step polymerization. **[3]**



Total No. of Questions : 8]

PD-3094

[6476]-34

M.Sc. - II

PHYSICAL CHEMISTRY

CHP-313(A) : CBOP-3 Special Topics in Physical Chemistry
(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answers to the Two sections should be written in SEPARATE answer books.
- 2) Question 1 and 5 are COMPULSORY.
- 3) Answer any 2 questions out of Q2, Q3 & Q4 and any 2 questions out of Q6, Q7 & 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

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6.	Gas Constant	R	= $8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$ = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ = $1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$
7.	Faraday Constant	F	= $96487 \text{ C equivalent}^{-1}$
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 J
10.	1 amu		= $1.673 \times 10^{-27} \text{ kg}$
11.	Bohr Magneton	β_e	= $-9.274 \times 10^{-24} \text{ J T}^{-1}$
12.	Nuclear Magneton	β_n	= $5.051 \times 10^{-27} \text{ J T}^{-1}$
13.	Mass of an electron	m_e	= $9.11 \times 10^{-31} \text{ kg}$

SECTION - I

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

- i) Define the terms : Precision and accuracy.
- ii) Explain the difference between random and systematic error.
- iii) What do you understand by pH of solution? What is the range of pH scale?
- iv) What are the mass balance and charge balance equations?
- v) State and explain the principle of nephelometry.

b) Calculate the mean, standard deviation and relative standard deviation for the following data : **[3]**

Sr No.	Mass (g)
1	3.080
2	3.094
3	3.107
4	3.056
5	3.112
6	3.174
7	3.198

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

- i) Discuss in brief the steps involved in systematic treatment of equilibrium.
- ii) Define the term significant figures. State the rules for determining the number of significant figures.

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

- i) What is regression analysis? Give it's significances.
- ii) Calculate the pH, the hydrogen and hydroxyl ion concentrations of a 4.2×10^{-3} M solution of calcium hydroxide in water at 25°C. [Given : $K_w = 1 \times 10^{-14}$]

- Q3) a)** Answer the following : **[6]**
- i) State and explain the principle of turbidimetry. How this technique is similar to colorimetric technique?
 - ii) What is logarithmic concentration diagram? How does a logarithmic concentration diagram change when the dissociation constants of acid changes?
- b)** Answer the following : **[6]**
- i) Explain the choice between nephelometry and turbidimetry for analysis of sample.
 - ii) What is correlation coefficient? State the difference between correlation coefficient and coefficient of determination?
- Q4) a)** Write mass balance expressions for a 0.01 M solution of hydrochloric acid is in equilibrium with an excess of solid barium sulphate. **[6]**
- b)** Answer the following : **[6]**
- i) What is probability? Explain with suitable example for calculating probability.
 - ii) State the applications of nephelometric method of analysis.
- SECTION - II**
- Q5) a)** Attempt any four of the following : **[8]**
- i) What is quantum well?
 - ii) Define the term carbon nanotube. Give an example.
 - iii) What is meant by physisorption?
 - iv) Enlist the factors that affect the hydrogen storage value of carbon nanotubes.
 - v) Explain sharp memory effect.
- b)** Discuss the sol-gel method for the preparation of nanoparticles. **[3]**

- Q6) a)** Answer the following : **[6]**
- i) Describe in brief vapour condensation method for synthesis of nanosized particles of ceramic materials.
 - ii) Explain the influence of temperature and pressure on hydrogen uptake.
- b)** Answer the following : **[6]**
- i) Write a short note on piezoelectric materials.
 - ii) Discuss the method for synthesis of cadmium telluride nanocrystals.
- Q7) a)** Answer the following : **[6]**
- i) Define smart materials. Give it's classification.
 - ii) Explain the electrochemical charging and discharging of hydrogen gas at a carbon nanotube.
- b)** Answer the following : **[6]**
- i) Explain the types of smart materials.
 - ii) State the applications of nanoparticles in the field of drug delivery.
- Q8) a)** What is adsorption energy? Explain it's role in hydrogen storage. **[6]**
- b)** Answer the following : **[6]**
- i) Describe the preparation method of rubber like ceramics.
 - ii) Write a note on lithography.



Total No. of Questions : 6]

SEAT No. :

PD3095

[Total No. of Pages : 3

[6476]-35

M.S.c. - II

INORGANIC CHEMISTRY

CHI - 330 - CCTP - 7 : Organometallic and Homogenous Catalysis
(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) Neat diagram must be drawn 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) State $[\text{Ir}(\text{CO})\text{Cl}(\text{PPh}_3)_2]$ complex obey's $18e^-$ rule or not. (Atomic No. of Ir = 77).
- ii) Why do transition metals acts as catalyst? Give an example.
- iii) Give reactions for the synthesis of metal carbene.
- iv) Arrange following M-CO in decreasing order of back donation.



b) Explain the role of IR spectroscopy in characterisation of organometallic compounds. [3]

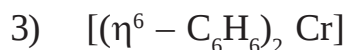
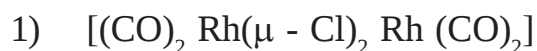
Q2) a) Answer any one of the following. [6]

- i) Give preparation method and electrophilic substitution reactions of ferrocene.
- ii) Give an account of applications of organometallic compounds.

P.T.O.

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

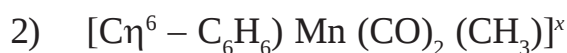
i) Determine number of M-M bonds and identify whether 18e⁻ rule is obeyed or not justify.



(Atomic no. of Rh = 45 Mn = 25 Cr = 24)

ii) What is metallocene? Explain synthesis, properties and give reactions of ferrocene.

iii) 18e⁻ rule as a guide determine x in the following complexes.



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

i) Explain Dewar - chatt - dyncanson model for bonding in metal - olefin complex.

ii) Explain in detail synthesis of metal carbonyl complexes.

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

i) Describe the use of organometallic compounds as a protecting agent, Electrophile and Nucleophile.

ii) Discuss the reactions of organometallic compounds.

iii) What are phosphines? Give it's types.

SECTION - II
(Homogenous Catalysis)

- Q4) a)** Answer the following. [8]
- i) Define oxidative addition reaction.
 - ii) What is Zeiglar - Natta polymerisation?
 - iii) Give General features of homogenous catalysis.
 - iv) What are similarities between suzuki and Heck coupling reaction.
- b)** Write a note on olefin metathesis. [3]
-
- Q5) a)** Answer any one of the following. [6]
- i) What do you mean by Heck reaction? Explain the steps involved in reaction.
 - ii) Give importance of chiral ligands in Assymetric catalysis.
- b)** Answer any two of the following. [6]
- i) What do you mean by cross coupling reaction?
 - ii) Write the favourable factors for the oxidative addition reaction.
 - iii) Write a short note on Polymerization in organometallic compounds.
-
- Q6) a)** Answer any one of the following. [6]
- i) Give catalytic cycle of suzuki coupling reaction.
 - ii) Explain the catalytic role of alkyl Mo (VI) compounds in epoxidation reaction.
- b)** Answer any two of the following. [6]
- i) Explain with an example oxidative addition and reductive elimination reaction.
 - ii) What is cativa process? Discuss it's mechanism?
 - iii) Write Note on metal complexes in Asymetric catalysis.



Total No. of Questions : 6]

SEAT No. :

PD3096

[Total No. of Pages : 3

[6476]-36

M.Sc. - II

INORGANIC CHEMISTRY

CCTP-8-CHI-331 : Inorganic Reaction Mechanism

(2019 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

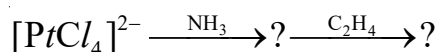
Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Neat diagram must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.
- 4) Use of logarithmic table and calculator are allowed.
- 5) Answer to the two sections should be written in separate answer books.

SECTION-I

Q1) a) Answer the following. [8]

- i) Thermodynamically stable complex could be kinetically inert or labile? Illustrate with suitable example.
- ii) Complete the following reaction sequence



- iii) Explain linkage isomerization with suitable example.
- iv) $\text{Cis} - [\text{Co}(\text{en})_2 \text{Cl}_2]^+$ aquates 100 times faster than $\text{Cis} - [\text{Co}(\text{en})_3]^{3+}$. Why?

b) List out the characteristics of inner sphere reaction. [3]

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

- i) Discuss relationship between d-electron configuration of the metal and lability of metal complexes.
- ii) Compare SN^1 and SN^2 mechanism in octahedral substitutions.

P.T.O.

- b) Answer any two of the following. [6]
- i) Describe Franck-Condon criterion in order to happen electron transfer.
 - ii) What is anation reaction? Explain with suitable example.
 - iii) Discuss the effect of nature of leaving group in octahedral substitution reaction.

- Q3)** a) Attempt any one of the following. [6]
- i) What is SN^1CB mechanism. Explain with suitable example.
 - ii) Discuss the steps involved in mechanism of outer sphere electron transfer reaction with suitable example.
- b) Write a note on (Any two). [6]
- i) Complementary and Non-complimentary reactions.
 - ii) Pi-bond theory of trans effect.
 - iii) Racemization in trischelate metal complexes.

SECTION-II

- Q4)** a) Answer the following. [8]
- i) Describe the mechanism for halogenation of coordinated nitrogen atom with example.
 - ii) What are the types of photochemical reactions.
 - iii) What is reductive elimination reaction? Give example.
 - iv) Compare thermal and photochemical reactions.
- b) Describe the phenomenon of fluorescence. [3]

- Q5)** a) Answer any one of the following. [6]
- i) Explain the electrophilic behaviour of coordinated ligands.
 - ii) Give an account of oxidative addition reaction.
- b) Answer any two of the following. [6]
- i) What do you mean by one electron oxidative addition. Explain with suitable example.
 - ii) State laws of photochemistry. How are they significant.
 - iii) Discuss in brief kinetic template effect involving reaction between two non-donor atoms.

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

- i) Give an account of photochemical reaction of Cr (III) complexes.
- ii) Discuss in detail alkylation of coordinated sulphur and nitrogen atoms.

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

- i) Photoisomerisation reaction.
- ii) CO insertion reactions.
- iii) Solvolysis of coordinated phosphorous atom.



Total No. of Questions : 6]

SEAT No. :

PD3097

[Total No. of Pages : 3

[6476]-37

M.Sc. - II (Inorganic Chemistry)

CCTP-9 CHI-332: BIOINORGANIC AND MEDICINAL

INORGANIC CHEMISTRY

(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Draw neat diagram wherever necessary.
- 4) Answer to the two sections should be written in separate answer books.

SECTION - I

(Bioinorganic Chemistry)

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

- i) Discuss the chemistry of cobalamine.
- ii) What is the difference between blue and non-blue copper oxidase?
- iii) Which metal is present at the active site of plastocyanin? What is the geometry around the metal?
- iv) Explain the active site structure of enzymes containing copper.

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

What do you understand by type-1, type-2, type-3 copper proteins? Explain giving structure of these proteins.

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

- i) Name two enzymes of each of the following metals and explain their role, reactions for any one of the enzyme of each metal. (zinc, copper, cobalt, Molybdenum).
- ii) Explain how oxygen transfer occurs through molybdenum containing enzymes?

b) Attempt any Two of the following. **[6]**

- i) Explain the active site, structure and function of carboxy peptidase.
- ii) Explain the model of pathway for reduction and accumulation of Vanadium.
- iii) Explain catalytic activity of Cu-Zn superoxide dismutase.

P.T.O.

- Q3) a)** Attempt any ONE of the following. [6]
- i) Draw the structure-
 - 1) Zn-finger
 - 2) Fe_4S_4 protein
 - 3) Azurin
 - 4) GAL 4 (yeast transcription factor)
 - 5) Model complex of M_o
 - 6) Rubredoxin
 - ii) Explain the following action of alkyl cobalamin
 - 1) One-electron redox reaction
 - 2) Co-C bond cleavage
- b)** Write note on (any two) [6]
- i) High potential Iron-Sulphur proteins.
 - ii) Galactose oxidase.
 - iii) Metalloenzymes in biological nitrogen cycle.

SECTION - II

- Q4) a)** Answer the following. [8]
- i) What are radiopharmaceuticals? Give two examples of metal complexes used in radiopharmaceuticals.
 - ii) Name of gold complexes used for treating HIV and draw their structure.
 - iii) Explain the process of decay of ^{131}In .
 - iv) Which metal complexes are mostly used for heart and brain imaging?
- b)** Attempt the following. [3]
- Write a note on non-Tc based renal imaging.
- Q5) a)** Attempt any one of the following. [6]
- i) Draw the structure of cis-platin and trans-platin which is the better anti-cancer drug? Why? What is the mechanism by which cis-platin blocks cell proliferation?
 - ii) Explain the role of lithium isotopes in precise localization of lithium on cells and in the treatment of manic depression.
- b)** Attempt any Two of the following. [6]
- i) What is meant by “intercalation” of complexes in DNA? Explain with suitable examples and diagram.
 - ii) Justify the statement “Radio-pharmaceuticals have revolutionised the field of medicine”.
 - iii) Give details about 2nd and 3rd generation platinum anticancer drugs.

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

- i) Explain with the help of suitable diagram, the nuclease activity of $[\text{Cu}(\text{Phen})_2]^+$ complex.
- ii) Discuss the binding of Bismuth with thiolate ligand.

b) Write note on any Two **[6]**

- i) Bone imaging agent
- ii) Antitumor agent
- iii) Hypoxia imaging agent



Total No. of Questions : 6]

SEAT No. :

PD-3098

[Total No. of Pages : 6

[6476]-38

M.Sc. - II

INORGANIC CHEMISTRY

CBOP-3 CHI-333 (A) : 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 must 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 calculator is allowed.

SECTION - I

(Thermal & Spectroscopic Techniques)

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

- i) What is principle of TGA?
- ii) What is TPD?
- iii) What is Chemical Shift?
- iv) What is FTIR? Explain Beam Splitter?
- v) What is Auger? Explain electron gun.

b) Explain ESR spectrum of Hydrogen and Anthracene. [3]

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

- i) What is DSC? What are its types? Explain construction, working and applications of DSC.
- ii) Derive the Bragg's equation. What are applications of XRD.

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

- i) What is thermocouple? Explain the examples of thermocouple.
- ii) What are α -rays? How they are prepared?
- iii) What are the components of TPD?

P.T.O.

- Q3) a)** Attempt any one of the following : [6]
- i) What is NMR? Explain construction working and applications of NMR spectroscopy.
 - ii) I) What is G.M. Counter.
II) What is Luminescence, Fluorescence & Phosphorance?
- b) Attempt any two of the following : [6]
- i) Explain types of IR Spectroscopy.
 - ii) What is Scintillation & Proportional Counter?
 - iii) Explain working of TGA.

SECTION - II

(Imaging & Analytical Techniques)

- Q4) a)** Attempt any four of the following : [8]
- i) What is principle of TEM?
 - ii) Explain principle of UV spectroscopy?
 - iii) What is photodegradation? Explain with example.
 - iv) What is hyperchromic shift? Explain with example.
 - v) Explain working of SEM.
- b) Distinguish between SEM & TEM. [3]
- Q5) a)** Attempt any one of the following : [6]
- i) What is XPS? Explain construction working and application of XPS?
 - ii) What is magnetic materials? Explain ferrimagnetic and ferromagnetic materials. Explain hard & Soft ferrites.
- b) Attempt any two of the following : [6]
- i) Explain factor affecting Chemical shift.
 - ii) Give applications of Cyclic voltametry.
 - iii) Explain Currie law.

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

i) What is principle of Flame photometer? Explain construction, working & applications of flame photometer.

ii) I) Define :

a) Aspiration

b) Nebulisation

c) Saturation magnetisation

II) Explain ferrites with suitable examples.

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

i) What is red shift? Explain with suitable example.

ii) What is Hysteresis loop? Explain different types of Hysteresis loop.

iii) What are the different possible electronic transitions in UV spectroscopy.



Total No. of Questions : 6]

PD-3098

[6476]-38

M.Sc. - II

INORGANIC CHEMISTRY

CBOP-3 CHI-333(B) : Inorganic Magneto and Polymer
Chemistry

(2019 Pattern) (Semester - III)

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 logarithmic table and calculator are allowed.
- 5) Neat diagrams must be drawn wherever necessary.

SECTION - I

(Magneto Chemistry)

Q1) a) Answer the following : [8]

- i) Define magnetic susceptibility and give its Unit.
 - ii) What are magnetic domains?
 - iii) Explain the term canting.
 - iv) What is Currie temperature?
- b) Account for the difference in magnetic moment of copper (II) acetate dihydrate (1.4 B.M.) and cupric acetylacetonate (1.84 B.M.) at room temperature. [3]

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

- i) Explain magnetic properties of mixed-valence compounds.
 - ii) Discuss in details temperature independent Paramagnetism.
- b) Answer any two of the following : [6]
- i) What are hard and soft ferrites?
 - ii) Write a note on photoinduced magnetism.
 - iii) Explain the terms :
 - I) Spin - pairing.
 - II) Ferromagnetic material.

- Q3) a)** Attempt any one of the following : [6]
- i) Explain the difference between antiferromagnetic spin-spin exchange and spin-pairing.
 - ii) Discuss in brief magnetically dilute and magnetically concentrated system.
- b)** Attempt any two of the following : [6]
- i) Write a note on magnetic anisotropy.
 - ii) Explain hexagonal ferrites with Examples.
 - iii) Write a note on magnetic behaviour of lanthanides and actinides.

SECTION - II

(Inorganic Polymer)

- Q4) a)** Answer the following : [8]
- i) Define hetero polymer with suitable example.
 - ii) What are polysiloxanes?
 - iii) What is boron nitride?
 - iv) Explain the term depolymerization.
- b)** 250 gm of vinyl chloride and 86 gm of methyl acrylate copolymerize. Find the polymer composition. [3]
- (Given : Monomer reactivity ratio : 0.23 and 1.68 respectively;
Atomic wts : C = 12, H = 1, Cl = 35.5, O = 16)
- Q5) a)** Answer any one of the following : [6]
- i) Explain the role of Inorganic polymer as a catalyst.
 - ii) Give in detail classification of polymer.
- b)** Attempt any two of the following : [6]
- i) Explain metal containing polymer for medical purpose.
 - ii) Discuss phosphorous based polymer.
 - iii) Differentiate between natural and synthetic polymers.

- Q6)** a) Attempt any one of the following : [6]
- i) Explain in details the steps involved in polymerization process.
 - ii) What are phosphazenes? Give any two chemical properties of phosphazenes.
- b) Attempt any two of the following : [6]
- i) Give the structure and bonding in silicates.
 - ii) Write a note on luminescent inorganic polymer.
 - iii) Draw the structure of borazine and give any two chemical properties of it.



Total No. of Questions : 8]

SEAT No. :

PD3099

[Total No. of Pages : 5

[6476]-39

M.Sc. - II

ORGANIC CHEMISTRY

CCTP-7-CHO-350 : Organic Reaction Mechanism and Biogenesis
(2019 Pattern) (Semester-III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

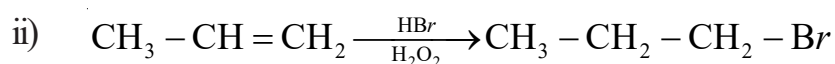
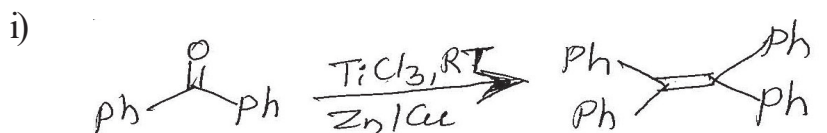
- 1) Question No. 1 and 5 are compulsory and carry 11 marks each.
- 2) Attempt any 2 questions from Q.2 to Q.4 and 2 questions from Q.6 to Q.8.
- 3) Answer to the two sections should be written in separate answer books.
- 4) Figures to the right indicates full marks.

SECTION-I

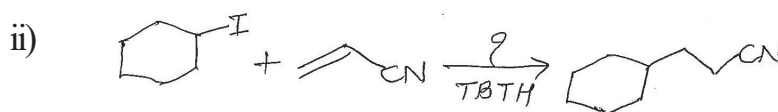
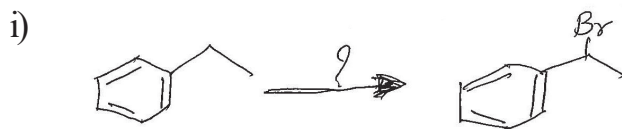
Q1) Attempt the following.

[5]

- a) Suggest the mechanism for the following reaction.



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



P.T.O.

Q2) Write short notes on any three of the following.

[12]

- a) Barton reaction
- b) Trapping of intermediates
- c) Free radical arylation of aromatic ring
- d) Hunsdiecker Reaction

Q3) Attempt any four of the following.

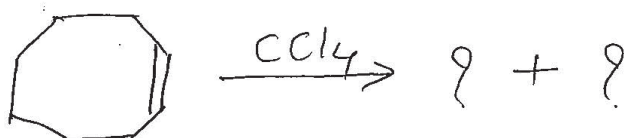
[12]

- a) Predict the sign of Hammett σ (sigma) constant for the following substituents.
 - i) P-OMe
 - ii) M-Br
 - iii) P-NO₂
- b) What are antioxidant? Explain their mode of action with suitable example.
- c) Explain 'non-Linear Hammett plot' with suitable example.
- d) How crossover experiment helps to decide the reaction mechanism? Explain with suitable example.
- e) Explain the use of AIBN in organic synthesis.

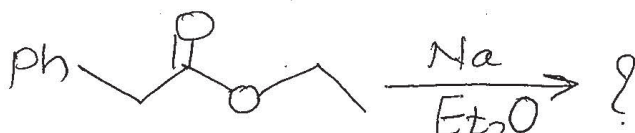
Q4) Attempt any four of the following.

[12]

- a) Derive the 'Hammett equation'.
- b) Predict the product with mechanism.



- c) Predict the product with mechanism.



- d) Predict the product and explain the mechanism.



- e) Discuss the use of isotopes in determination of reaction mechanism.

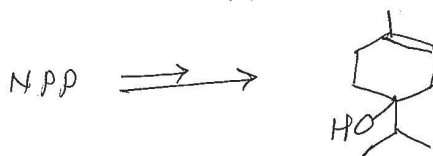
SECTION-II

Q5) Attempt the following.

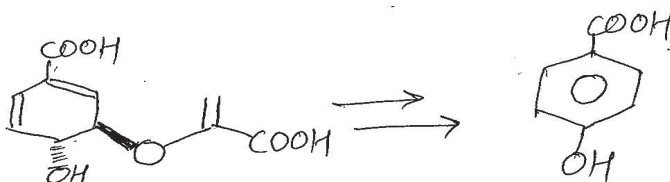
[5]

a) Suggest the biogenetic steps.

i)



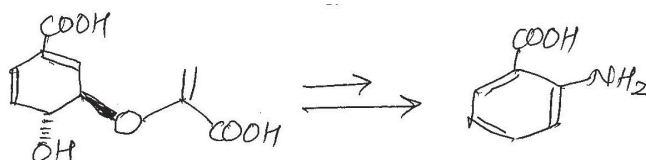
ii)



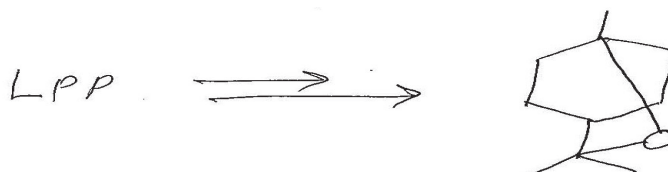
b) Complete the following biogenetic conversions.

[6]

i)



ii)



Q6) Write short note on any three of the following.

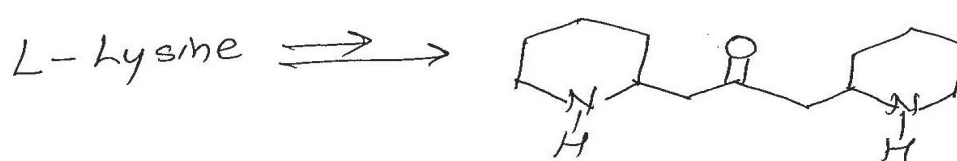
[12]

- Irregular monoterpenes.
- Metabolites in mixed biogenesis.
- Role of pyridoxal phosphates in oxidative determination in biogenesis of alkaloids.
- Classification of terpenoides.

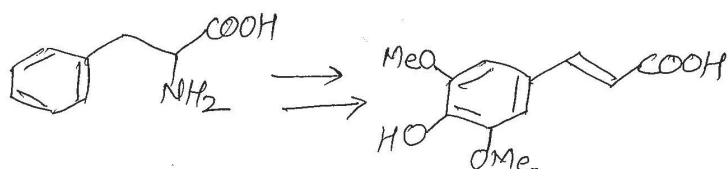
Q7) Complete the following biogenesis (any four).

[12]

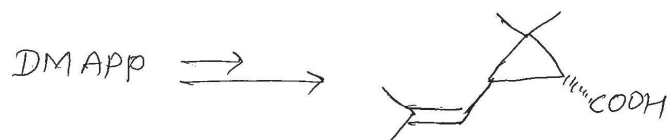
a)



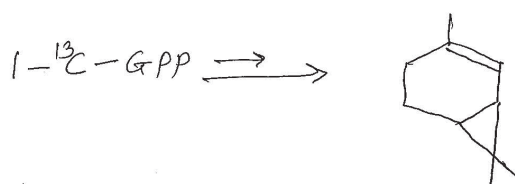
b)



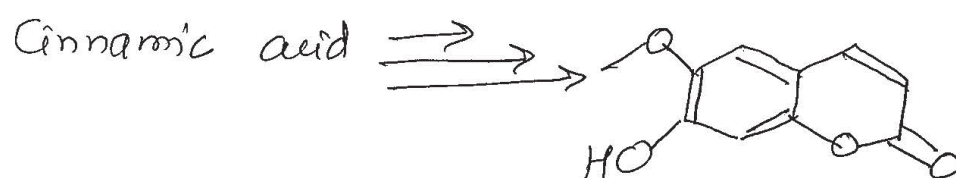
c)



d)



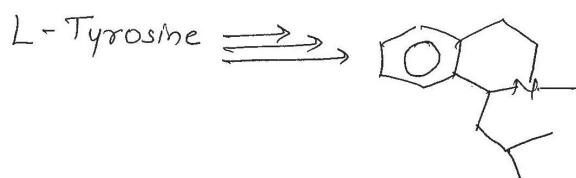
e)



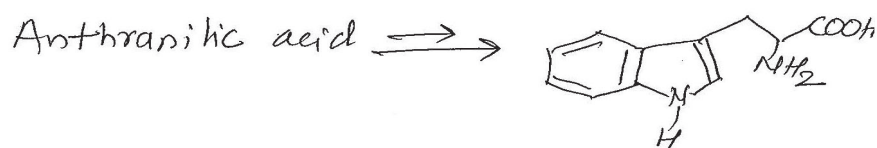
Q8) Attempt any four of the following.

[12]

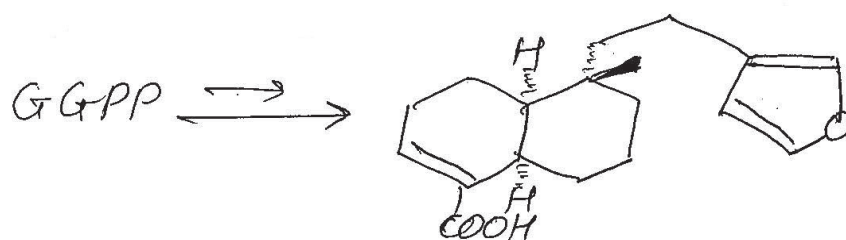
a) Complete the given biogenesis.



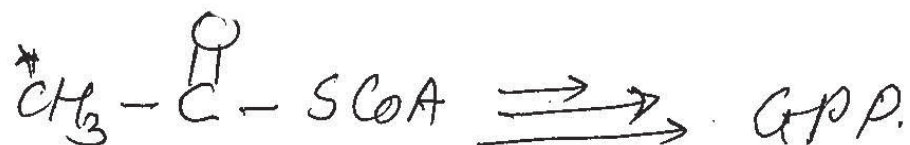
b) Complete the following biogenesis.



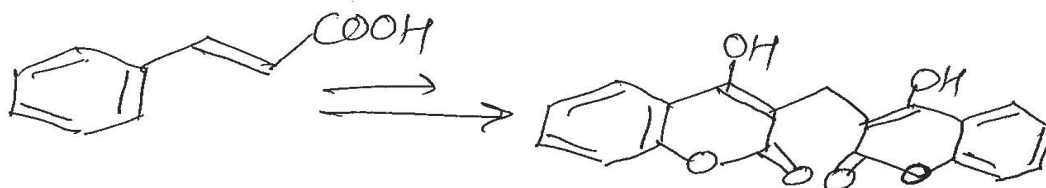
c) Outline the step involved in the given biogenesis.



- d) Complete the given biogenesis and depict the distribution of label in GPP.



- e) Complete the given biogenesis.



Total No. of Questions : 8]

SEAT No. :

PD3100

[Total No. of Pages : 11

[6476]-40

M.Sc. (Part-II)

ORGANIC CHEMISTRY

**CCTP-8-CHO-351 : Structure Determination of Organic
Compounds by Spectroscopic Methods
(2019 Pattern) (Semester-III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No. 1 and Q.5 are compulsory and carry 11 marks each.*
- 2) *Attempt any 2 questions from Q.2 to Q.4 and 2 questions from Q.6 to Q.8.*
- 3) *Answer to the two sections should be written in separate books.*
- 4) *Figures to the right indicate full marks.*

SECTION-I

Q1) a) Discuss various factors affecting vicinal coupling constant with appropriate examples. [3]

b) Two isomeric compounds A & B having molecular formula $C_5H_8O_2$ show peak at 1780cm^{-1} in IR spectra. Draw the structure of A & B from the data given. [4]

i) ^1H NMR: Two singlets at 1.1 & 2.2 δ ppm with peak area 3:1 ratio.

ii) ^1H NMR: Two singlets at 1.2 & 4.00 δ ppm with peak area 3:1 ratio.

c) Deduce the structure from given spectral data. [4]

M.F. : $C_8H_{12}O$

IR : 2730, 1680, 1620 cm^{-1}

CMR : 188(d), 153(s), 152.5(d), 43.6(s), 40.6(t), 30(t), 29.5(Q)

PMR : 1.25(s)6H, 1.83(t)7Hz 2H, 2.5(dt) 7, 2.6Hz 2H,

6.78(t) 2.6Hz 1H, 9.82 (s) 1H.

P.T.O.

Q2) Write a short notes (any three).

[12]

- a) Compare APT and DEPT
- b) Applications of double irradiation technique in NMR
- c) Types of spin-spin coupling
- d) Correlation spectroscopy technique

Q3) Solve any four of the following from given data.

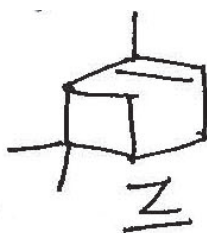
[12]

- a) A nitro compound containing seven carbons shows molecular ion peak at 182. It shows peak at 1600, 1531, 1350, 910 & 840 cm^{-1} in its IR.
PMR: 2.75(d) 0.5Hz 3H, 7.7(dQ)8, 0.5Hz 1H, 8.4(dd) 8, 2Hz 1H 8.8 (d) 2Hz 1H.
- b) M.F: $\text{C}_{11}\text{H}_{12}\text{O}_2\text{Br}_2$
I.R. : 1738, 1190 cm^{-1}
PMR : 1.3(t) 7Hz 9mm, 4.3(Q) 7Hz 6mm, 4.8(d) 12Hz 3mm 5.3(d) 12Hz 3mm, 7.3 (bs) 15mm.
- c) M.F: $\text{C}_8\text{H}_9\text{NO}_3$
I.R. : 2500-3000, 3300, 1600, 1510, 1200 cm^{-1}
PMR : 3.8(s) 3H, 6.84(d) 8Hz 1H, 7.24(d) 3Hz 1H
7.22(d,d) 8, 3Hz 1H, 5.0(bs) Exchangeable 2H 11.2 (bs) 1H Exchangeable.
- d) 1,4-butanediol $\xrightarrow{(0)}$ product (x)
The product shows following spectral data, Deduce the structure of (X)
IR : 1770 cm^{-1} Mass : 86,42
PMR : 1.2(m)2H, 2.5 (m) 2H, 4.0 (m) 2H.
- e) M.F : $\text{C}_{12}\text{H}_{18}\text{O}_2$
IR : No peak above 1200 cm^{-1}
PMR : 1.2(t)7Hz 6H, 3.50 (Q) 7Hz 4H
4.40(s) 4H, 7.10(s) 4H

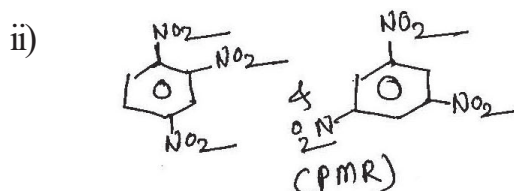
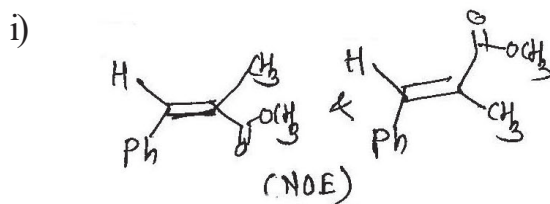
Q4) Attempt any four of the following.

[12]

- a) The PMR of compound Z shows three singlets due to methyls at 1.63, 1.27 and 0.85 δppm . Assign these signals with justification.



- b) How will you distinguish between following pairs by using the given spectral method.



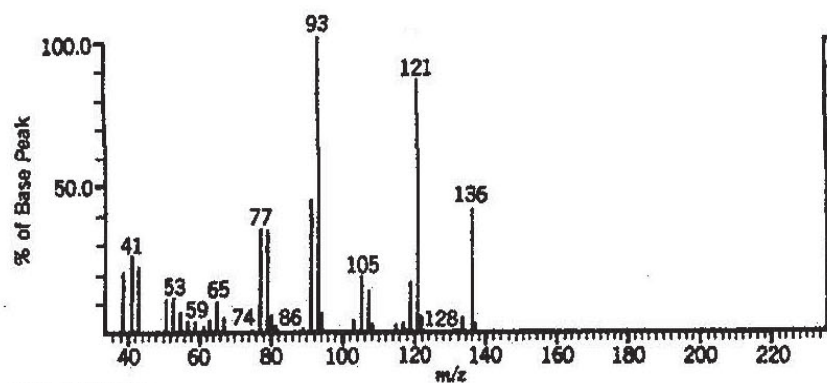
- c) Why does geminal coupling constant is designated by negative sign? Explain with the help of mechanism of coupling constant.
- d) Identify each of the isomeric compounds from the CMR data.
- M.F. : $C_4H_{10}O$
- A: 18.9(Q) z carbons, 30.9(d), 69.4(t)
- B: 10.1 (Q), 22.7 (a), 32(t), 69.2 (d)
- C: 31.3 (Q), 69.0 (s)
- e) Explain : N, N dimethyl formamide shows two signals for methyl groups at room temperature, where as only one signal due to methyl group is observed above 130°C.

SECTION-II

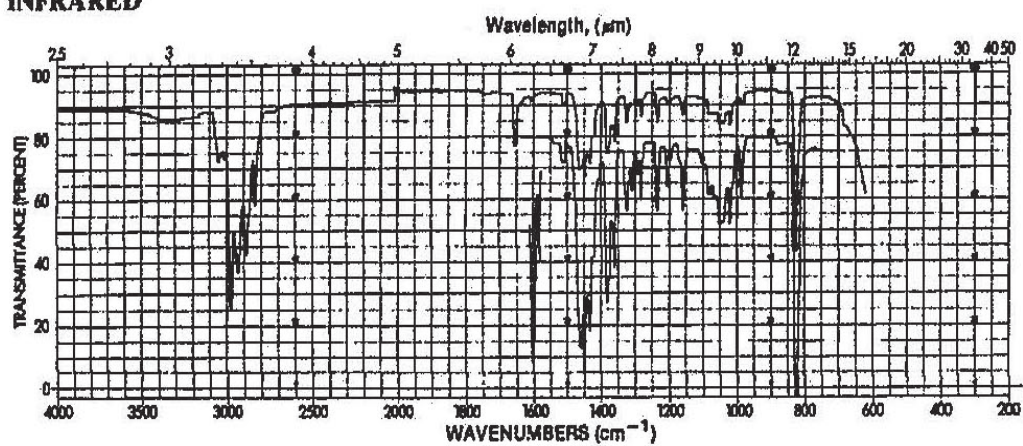
- Q5)** The spectra of unknown compound are given below. Analyse the spectra and use the data to arrive at a structure. [11]

Note: Students are instructed to interpret and attach the extra copy of spectra to answer sheet as provided with question paper.

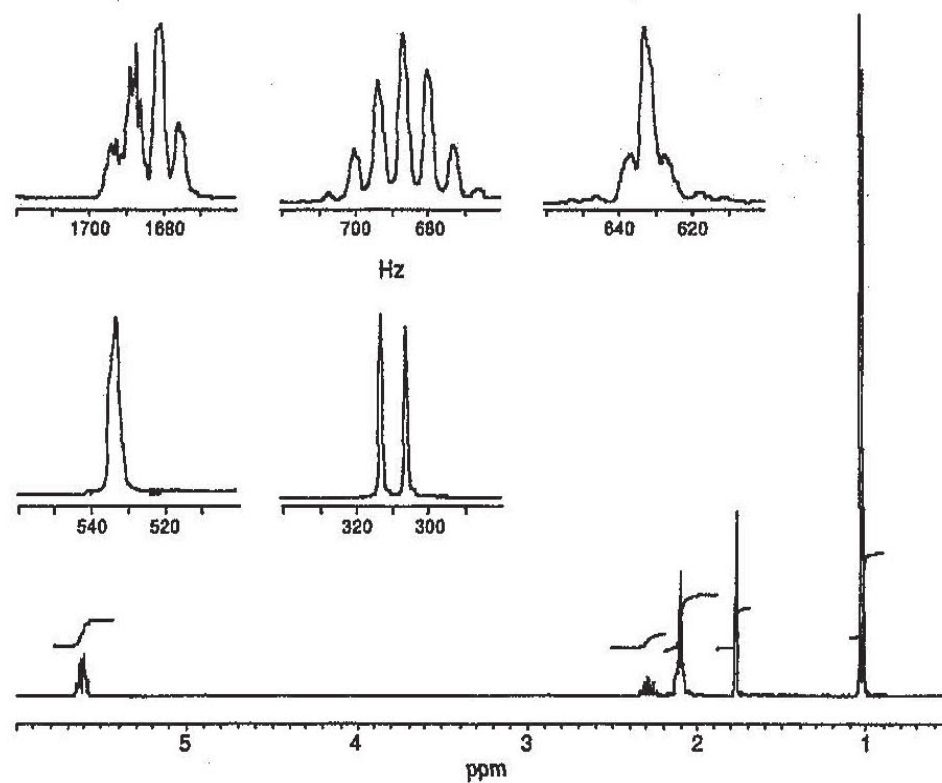
MASS



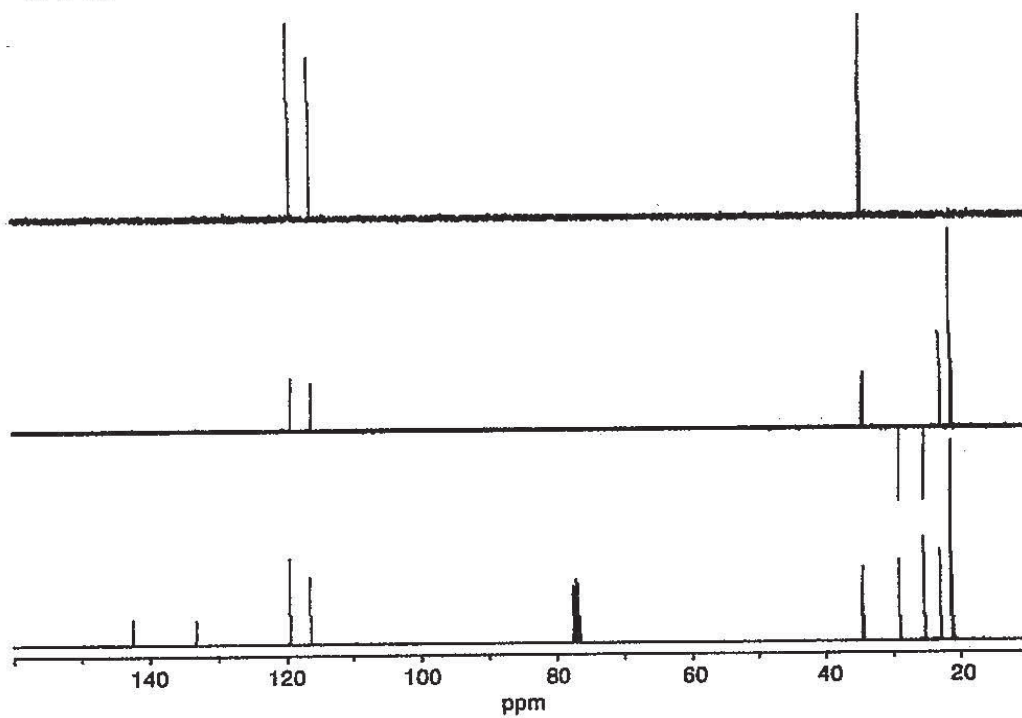
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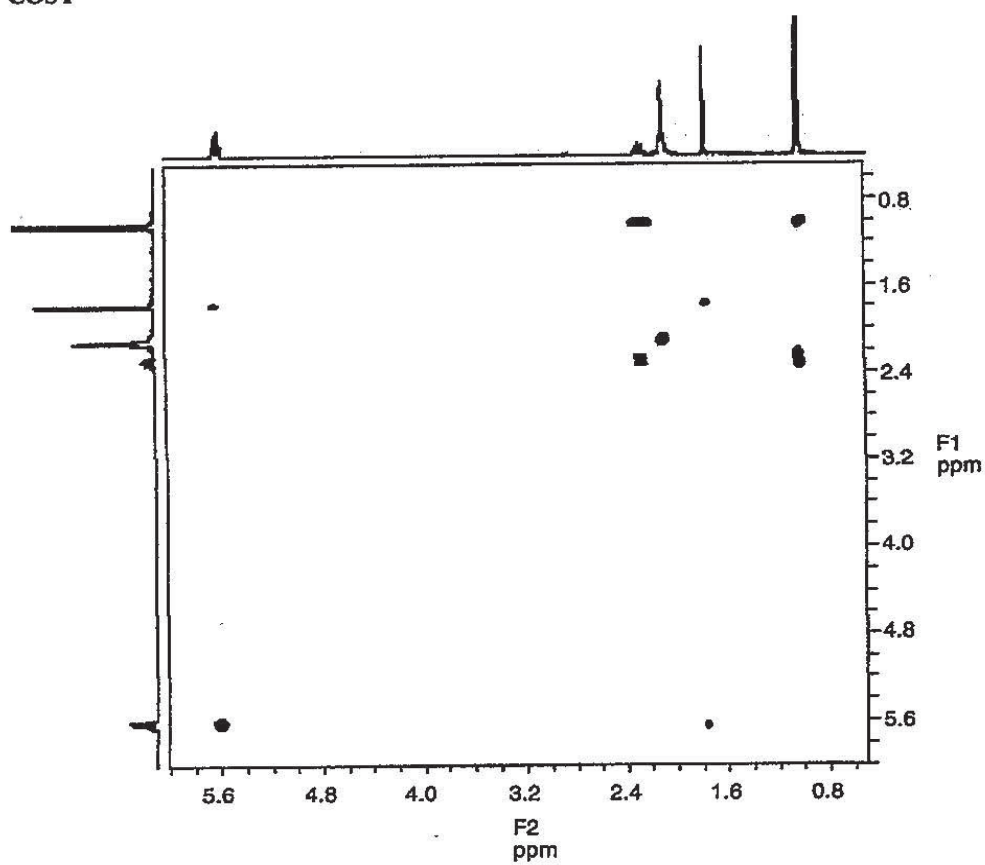
¹H NMR



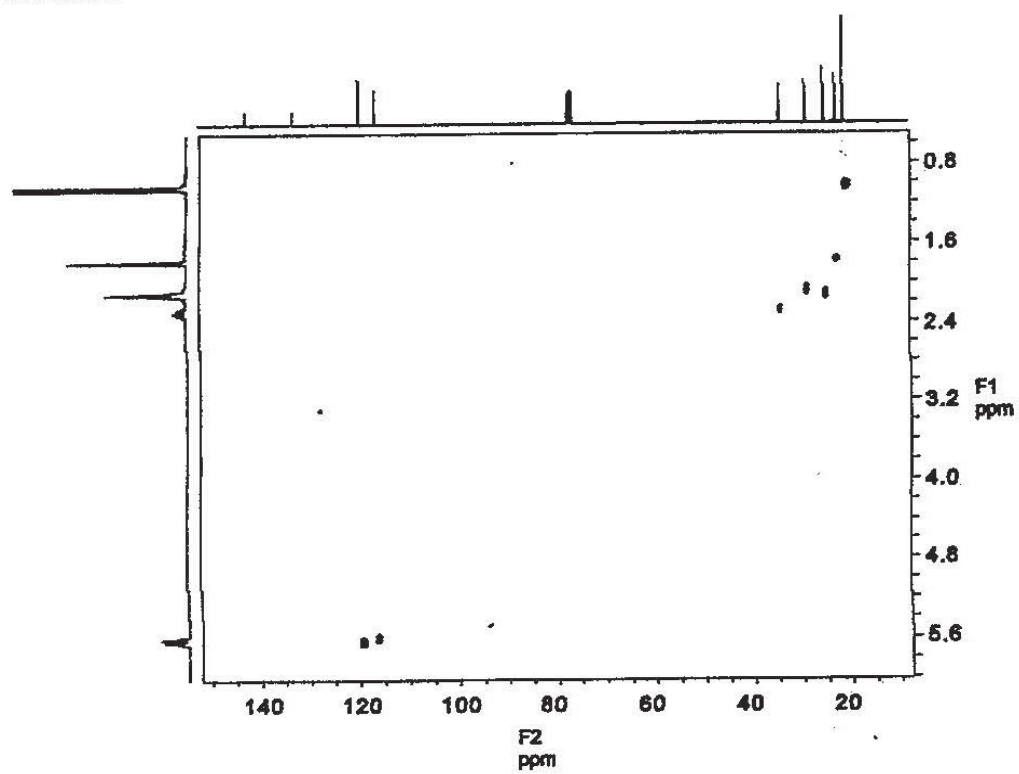
¹³C/DEPT



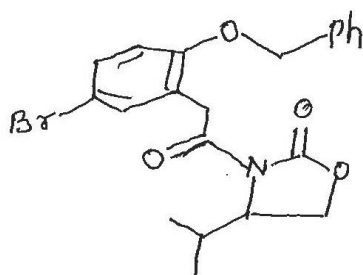
COSY



HETCOR



- Q6) a)** The PMR of compound A shows following signals. Assign signals to different protons using decoupling experiment. Justify your answer. [6]



0.77 (3H, d, 7 Hz) , 0.85 (3H, d, 7.1 Hz)
 2.29 (m, 1H) , 4.07 (1H, t, 9 Hz)
 4.14 (1H, dd, 3 and 9.1 Hz)
 4.18 (1H, d, 17.5 Hz) , 4.21 (1H, d, 17.5 Hz)
 4.30 (1H, m) , 5.00 (1H, d, 11.7 Hz)
 5.05 (1H, d, 11.7 Hz)
 6.79 (1H, d, 8.7 Hz) , 7.28-7.35 (7H, m)

Spin decoupling experiment -

Irradiation at

i) 4.30

change at

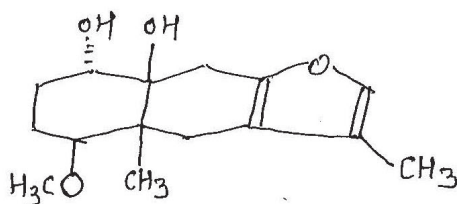
0.77 (s)

0.85 (s)

4.07 (d)

4.14 (d)

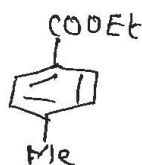
- b)** Assign the given chemical shift to various carbon of the following structure. [6]



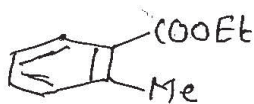
8.0(q), 17.0(q), 28.0 (t), 29.0 (t), 34.01 (t)
 35.0(t), 49.0 (s), 51.2 (q), 72.0 (d), 82.02 (d)
 85.0 (s), 125.0 (s), 128.0 (s), 135.0 (d), 148.0 (s)

- Q7)** Attempt any four of the following. [12]

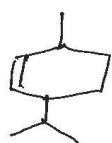
- a) Differentiate the following by mass spectrometry.



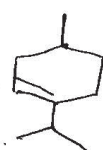
and



- b) Differentiate the following by mass spectrometry.



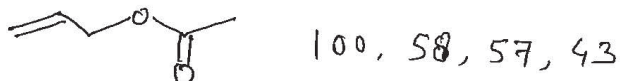
and



- c) Write the genesis of the ions given below.



- d) Write the genesis of the ions given below.



- e) Mass spectrum of O-nitrotoluene shows substantial peak at $m/z = 120$. Justify.

Q8) Attempt any three of the following.

[12]

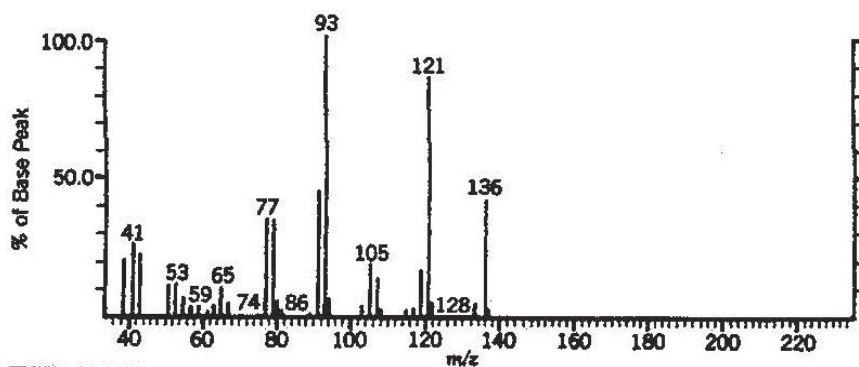
- Explain the technique used to arrive at molecular formula in MS.
- Discuss various ionization techniques used in mass spectrometry.
- Write short note on various analyzers used in MS.
- An amine $C_7H_{15}N$ shows following ions in mass spectrometry. Deduce probable structure.

$m/z = 84(100\%), 70, 56$

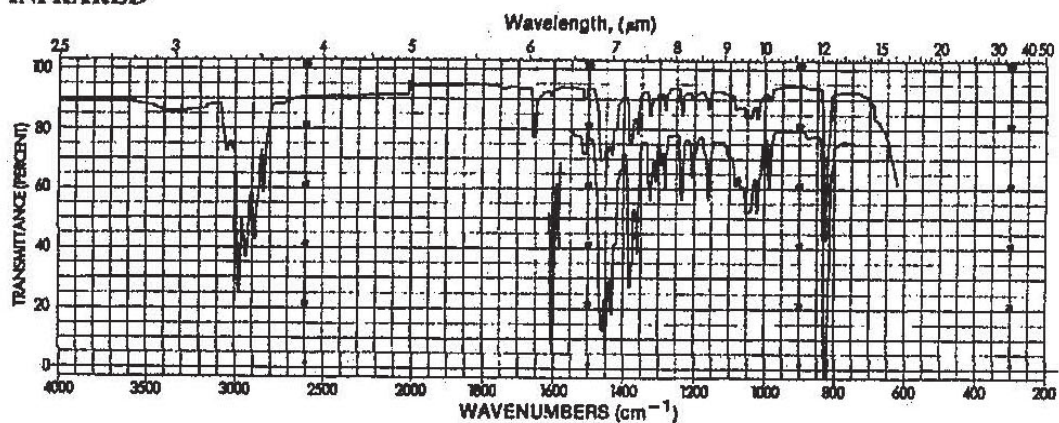
113 (M^+), 98, 85

Student should interpret the spectras and attach with answer sheet.

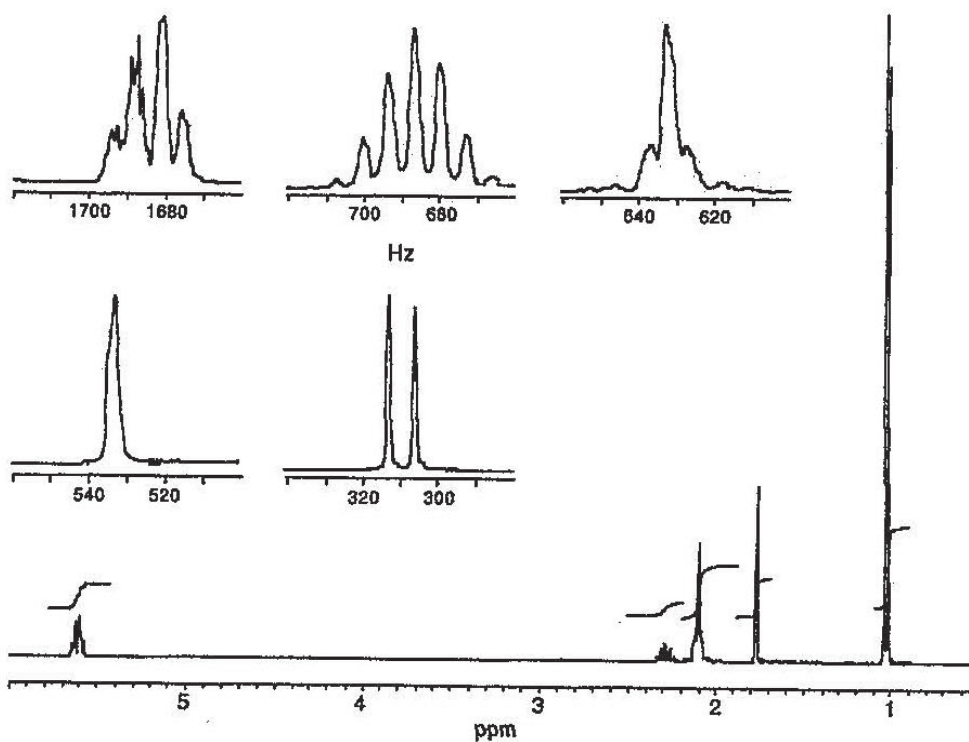
MASS



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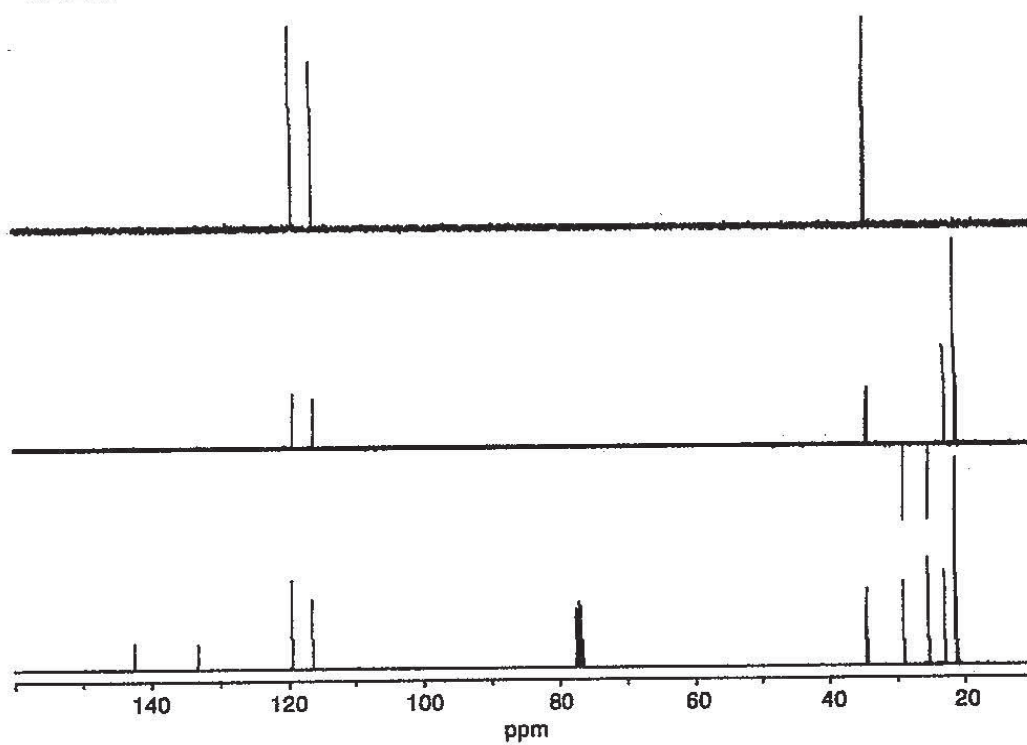


^1H NMR

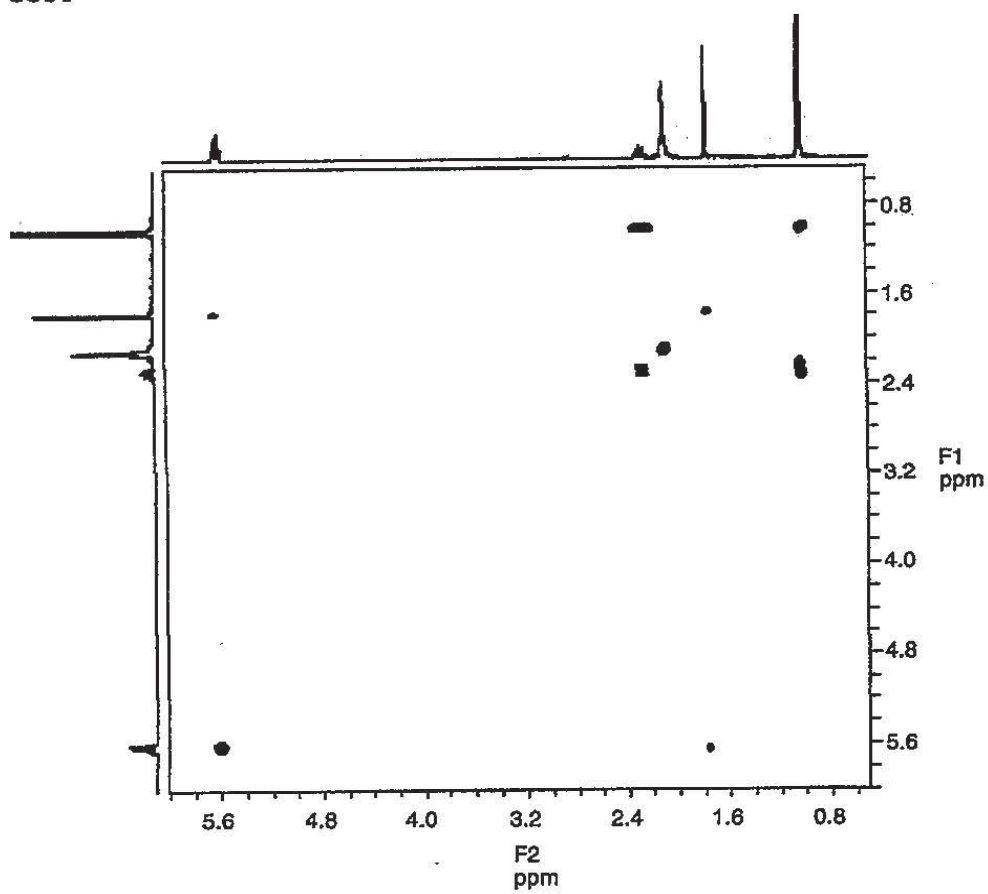


To be attached with answer sheet

¹³C/DEPT

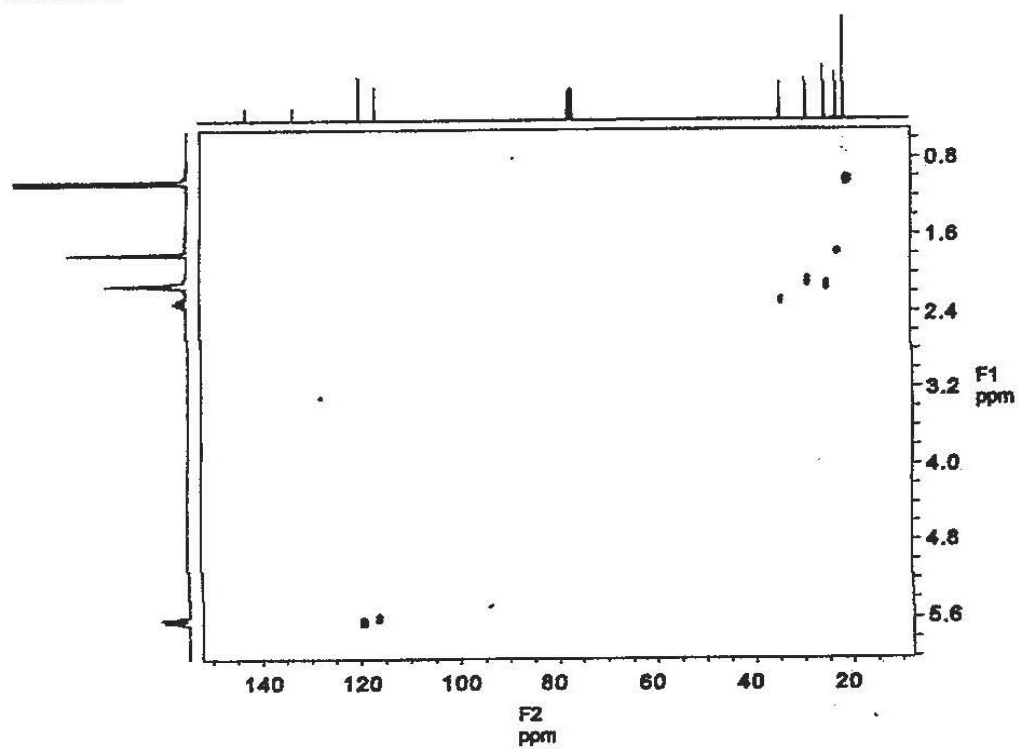


COSY



To be attached with answer sheet

HETCOR



Total No. of Questions : 8]

SEAT No. :

PD3101

[Total No. of Pages : 5

[6476]-41

M.Sc. - II

ORGANIC CHEMISTRY

**CCTP9-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 book.*
- 5) *Figures to the right indicate full marks.*

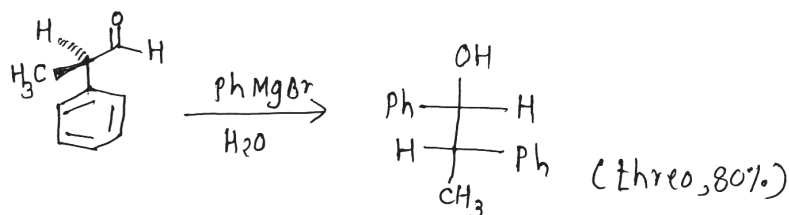
SECTION - I

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

- i) Write a note on stereochemistry of polymer chain.
- ii) What is anomeric effect. Explain it's with suitable examples.
- b) Give an account of resolution of racemic modification by kinetic asymmetric transformation. **[3]**
- c) Draw the stable conformation of Cis and Trans 1,4 di-*t*-butyl cyclohexanes justify your answer. **[3]**

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

- a) Draw the stable conformation of trans-syn-trans and Cis-anti-trans perhydroanthracene comment on its stability and optical activity.
- b) Write a short notes on Cram's dipolar model.
- c) State the following rules :
 - i) Von Auwer Skita Rule
 - ii) Von Arkel Rule
- d) Suggest the mechanism for the following :

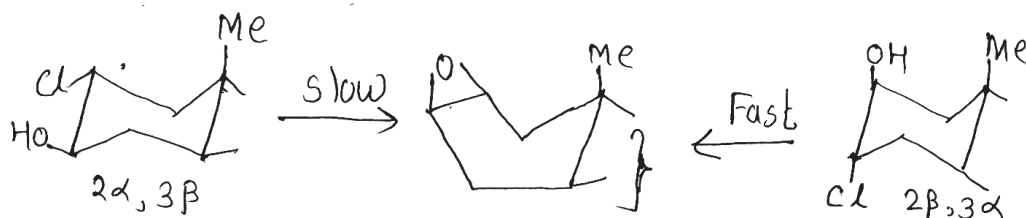


P.T.O.

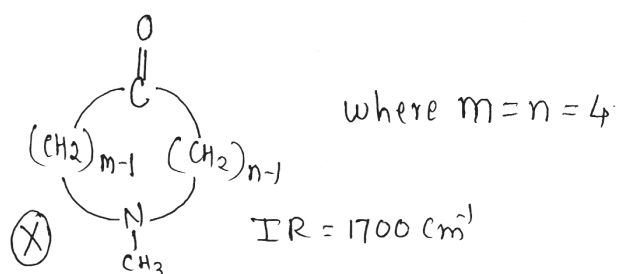
Q3) Give reasons (any 4)

[12]

- Cis-anti-Cis perhydroanthracene forms inseparable all pair while trans-anti-trans perhydroanthracene form separable all pairs.
- Explain the observed rate of following epoxidation of Chloro cholesterol.

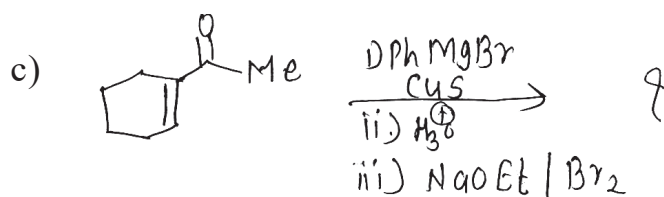
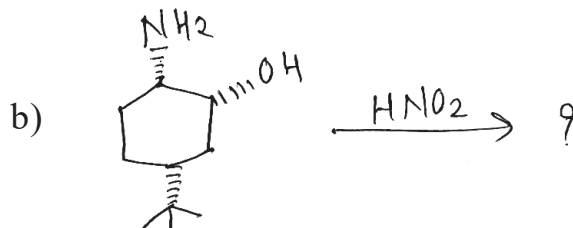
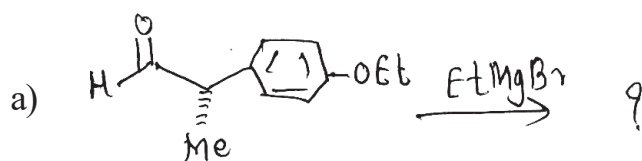


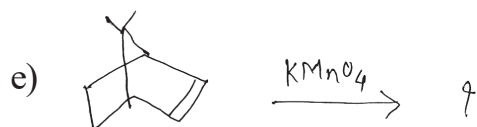
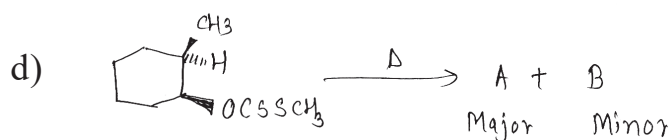
- Twistane has four stereocentres but it only exists as two enantiomers explain.
- Asolvent sensitive UV absorption band is observed in trans-but not in Cis-5 cyclodecenone.
- IR band at 1700cm^{-1} disappear when compound $\otimes$ is protonated.



Q4) Predict the product justify your answer by giving mechanism and stereochemical principles involved in it (any four).

[12]



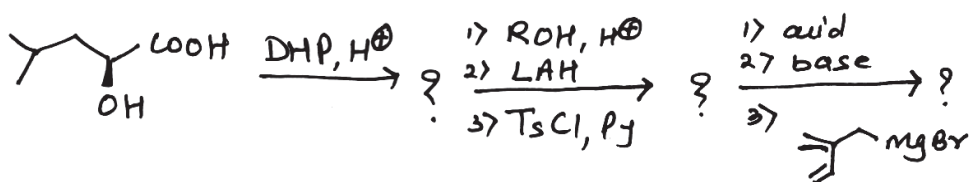


SECTION - II

Q5) a) Answer the following : [8]

- i) With the help of suitable example, explain the term Enantioselectivity.
- ii) Explain the disadvantages of 'Chiral Auxiliaries in asymmetric synthesis.
- iii) With the help of suitable example, explain the condition for formation of Z-enolate.
- iv) Draw the structure of CBS reagent.

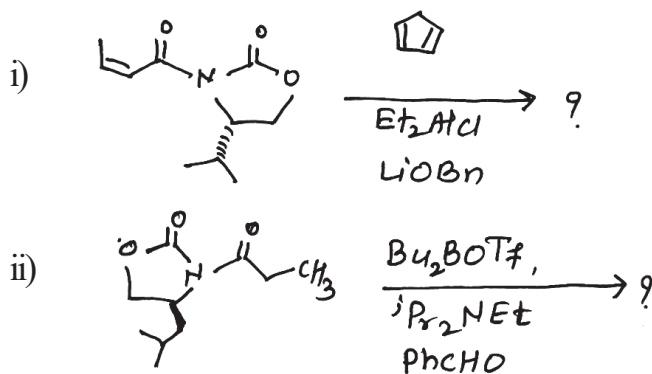
b) Complete the following conversion : [3]



Q6) a) Answer the following (Any two) [6]

- i) Explain the selectivity of (+)-DET and (-)-DET in Sharpless asymmetric epoxidation.
- ii) Explain the different conditions required for asymmetric synthesis.
- iii) Explain Noyori asymmetric hydrogenation with suitable example.

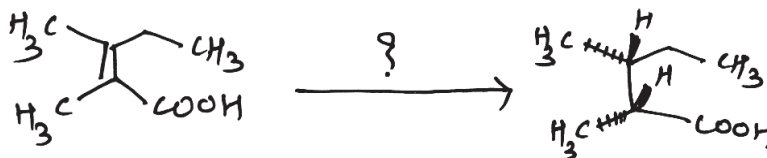
b) Predict the product(s) and justify the mechanism. [6]



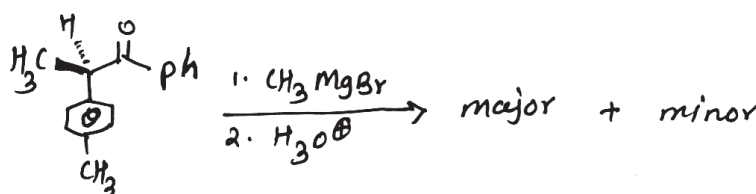
Q7) a) Answer the following (Any two).

[6]

- Explain the term diastereotopic ligands and diastereotopic faces.
- Name the suitable reagent for the following transformation and justify the answer.

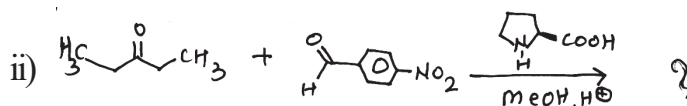
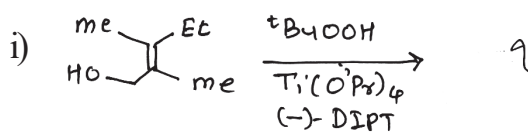


- With the help of Felkin-anti rule, explain the major and minor product in the following reaction.



b) Predict the product(s) and justify the mechanism.

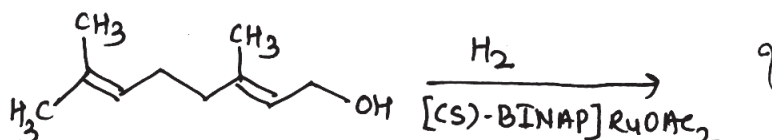
[6]



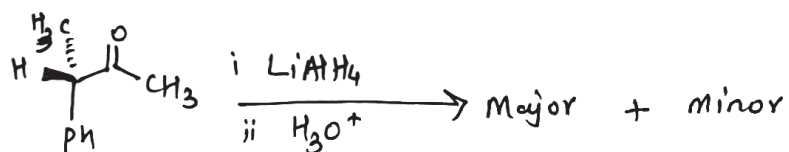
Q8) a) Answer the following (Any two).

[6]

- In Aldol reaction Z-enolate gives mainly syn product while E-enolate gives anti product. Explain with suitable example.
- Predict the product in the following conversion and explain the stereochemistry.

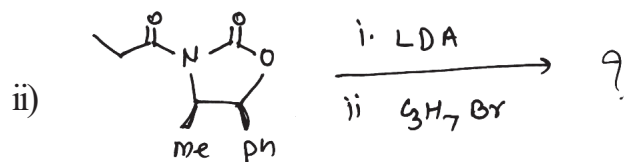
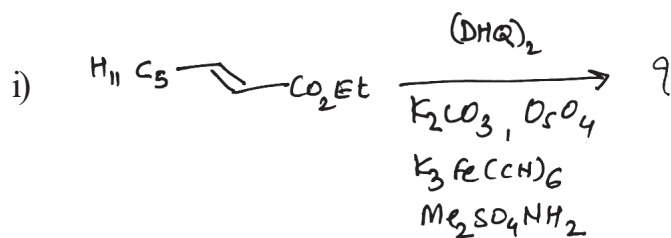


- iii) According to Cram's rule, explain the major and minor product formed in the following reaction.



- b) Predict the product(s) and justify the mechanism.

[6]



[6476]-42

M.Sc. (Part - II)

ORGANIC CHEMISTRY

**CHO - 353A : Protection - Deprotection Chiron Approach and
Carbohydrate Chemistry
(2019 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70]

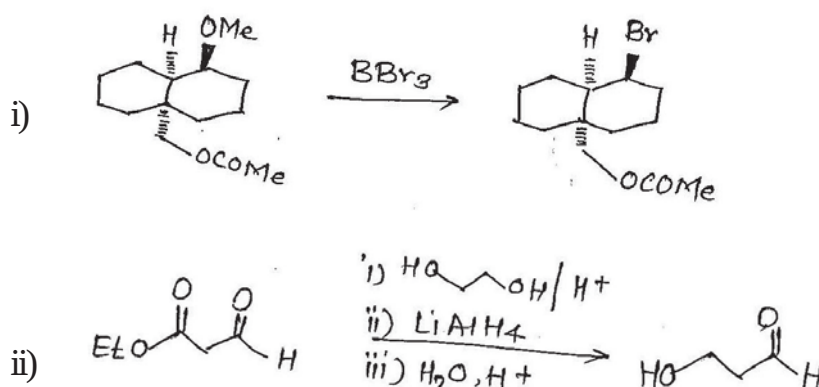
Instructions to the candidates:

- 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 questions from Q.6 to Q.8.
- 3) Answer to the two sections should be written in separate answer books.
- 4) Figures to the right indicates full marks.

SECTION - I

Q1) a) Suggest the mechanism.

[6]



b) Explain in details the synthesis of (–) shikimic acid by using chiron approach method. [5]

Q2) Attempt any three of the following.

[12]

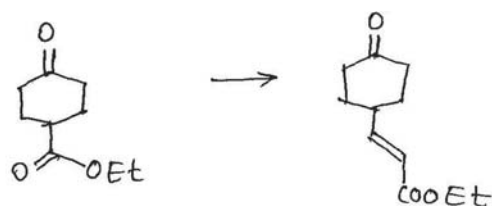
- a) Explain protection of amine by using F-moc and benzyl chloride. Suggest the suitable reagent for deprotection of it.
- b) Write a note on solid phase peptide synthesis.
- c) What is chiral templates? Explain role of chiral templates in organic synthesis.
- d) What is cyclitols? Write different types of cyclitols with uses.

P.T.O.

Q3) Attempt the following.

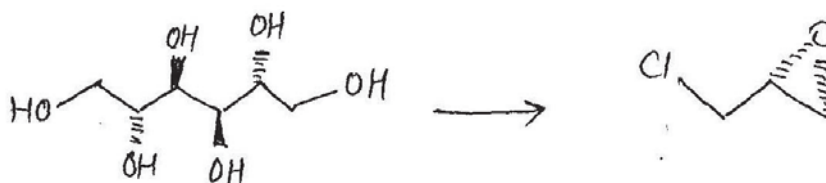
[12]

- a) Arrange the reagents sequentially with intermediate in following conversion.



LiAlH_4 ; $\text{Ph}_3\text{P}=\text{CH}-\text{COOEt}$; $\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$, H^+ ; PCC; $\text{H}_2\text{O}/\text{H}^+$

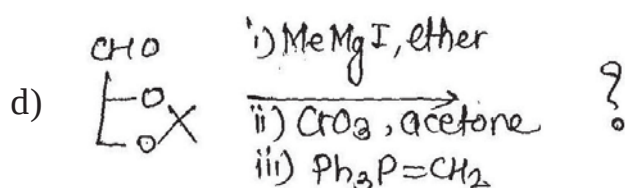
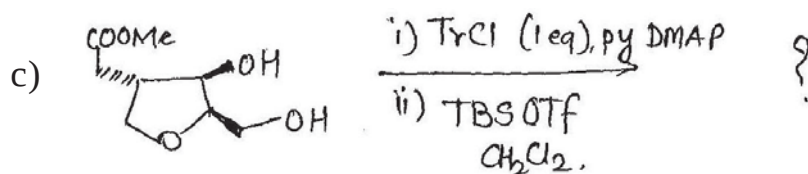
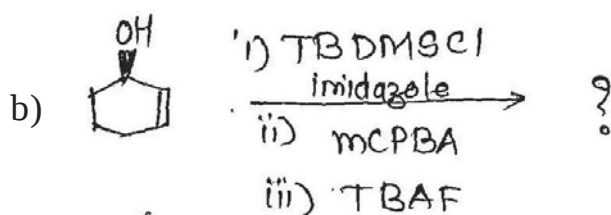
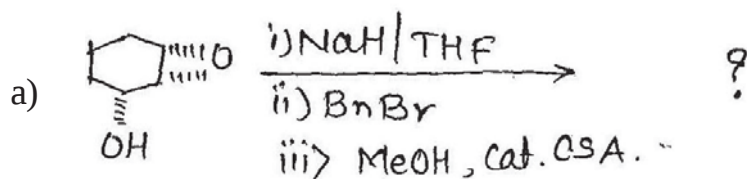
- b) Outline the following synthesis with mechanism



- c) Write total synthesis of (-) pentenomycin from D - manose.

Q4) Predict the product/s with mechanism

[12]

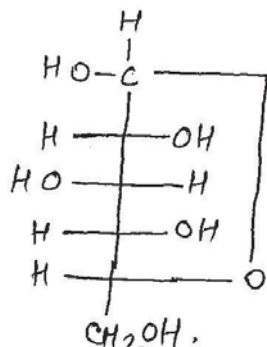


SECTION - II

Carbohydrate Chemistry

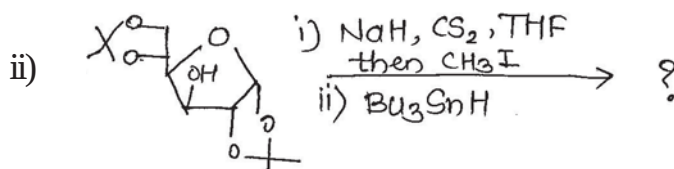
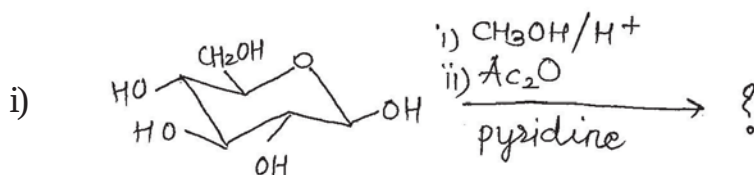
Q5) a) Attempt the following. [6]

i) Convert following sugar into Haworth projection and mills structure



ii) Write the zigzag structure of D-Galactose label the chiral centre with absolute configurations.

b) Predict the product [5]



Q6) Write a short note. (any three) [12]

- Mutarotation in glucose.
- Protecting group in carbohydrates.
- Total synthesis of oligosaccharides.
- Glycols and glycol derivatives.

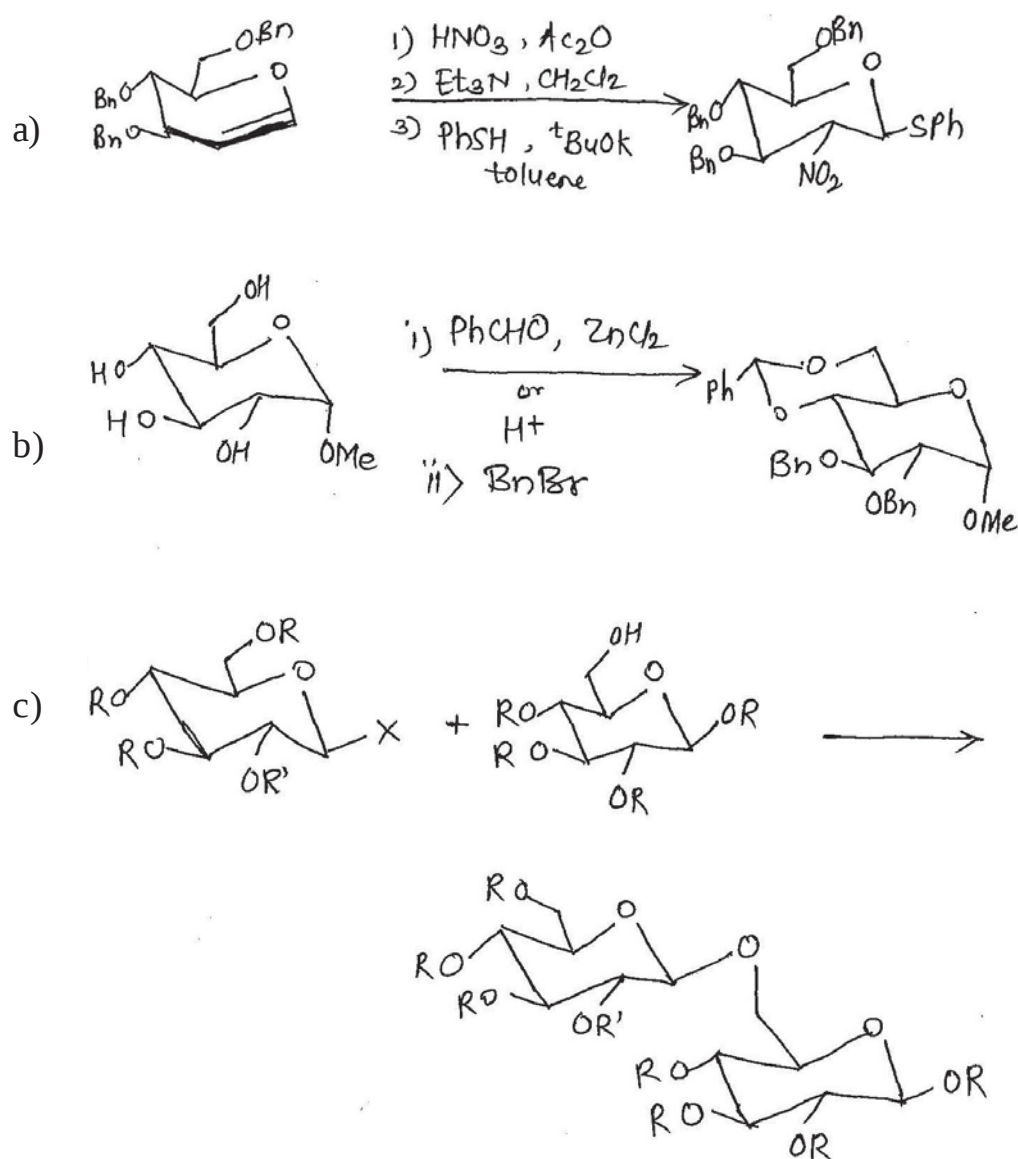
Q7) Attempt the following.

[12]

- Explain why orthogonal strategy is used for synthesis of oligosaccharides.
- What do mean by 1C_4 and 4C_1 conformations? Explain with examples.
- Explain reductive and oxidative cleavage of benzyldiene acetals.
- Explain anomeric effect in glucose.

Q8) Suggest the mechanism.

[12]



Total No. of Questions : 8]

PD3102

[6476]-42

M.Sc. (Part - II)

ORGANIC CHEMISTRY

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.
- 2) Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.8.
- 3) Answer to the two sections should be written in separate answer books.
- 4) Figures to the right indicates full marks.

SECTION - I

Q1) a) Answer the following (any two). [6]

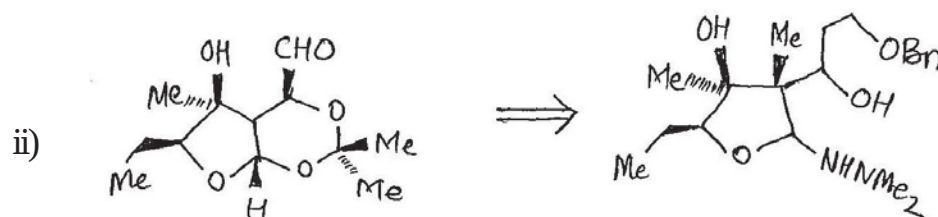
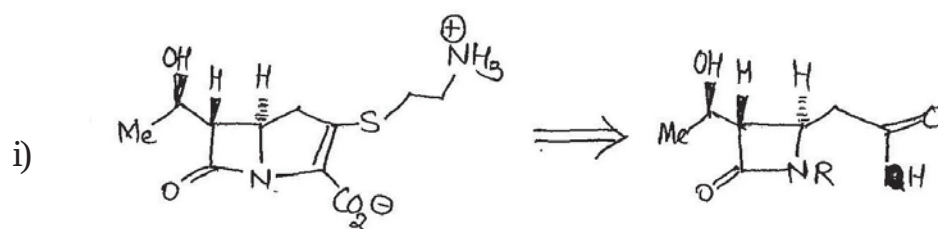
- i) Write the synthetic equivalent for following synthons with suitable examples.



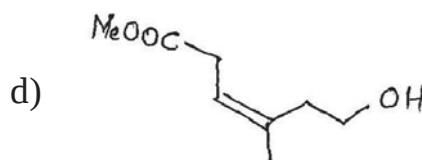
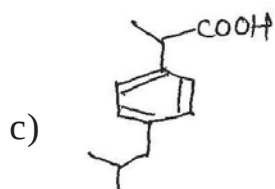
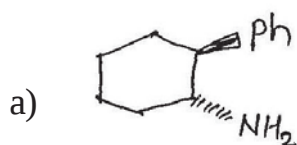
- ii) In the synthesis of 1, 2 - dicarbonyl compounds umpolung approach is involved. Explain.

- iii) Explain linear and convergent synthesis.

b) Write the retrosynthetic analysis and strategy for following intermediate steps. [5]



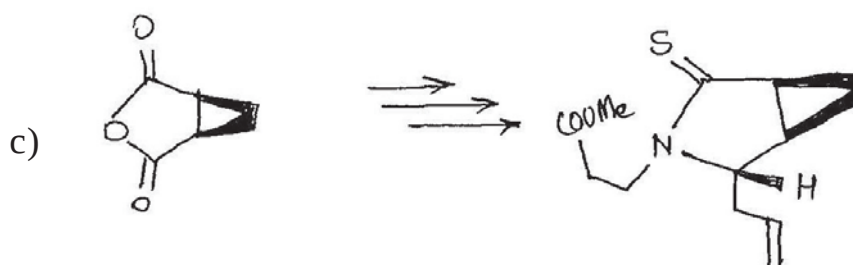
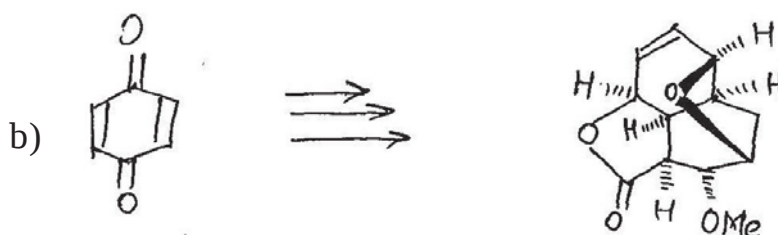
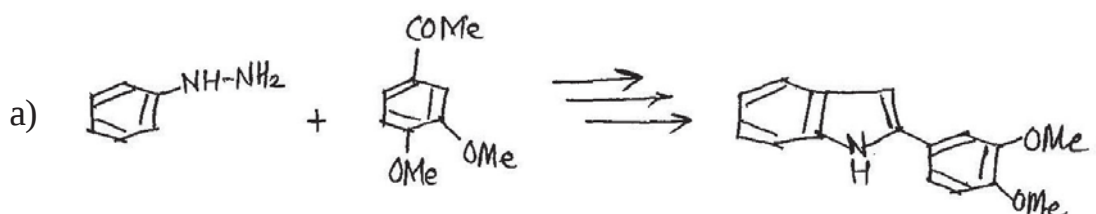
Q2) Using retrosynthetic analysis, suggest suitable method for the synthesis of following compounds (any three) [12]



Q3) Attempt the following. [12]

- Explain one group disconnections in alcohols and aryl ketones with examples.
- Explain illogical two group disconnects in 1, 4 - dioxxygenated dicarbonyl compounds.
- Draw the structure of erythronolide B. Assign absolute configuration at C_3 and C_8 carbon.
- Explain hydroxyl-directed epoxidations for total synthesis Indolizomycin.

Q4) Outline the steps involved in the following synthetic sequences. Indicate the reagents used and discuss stereochemistry involved. [12]

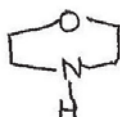
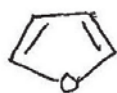


SECTION - II

Q5) a) Answer the following. [6]

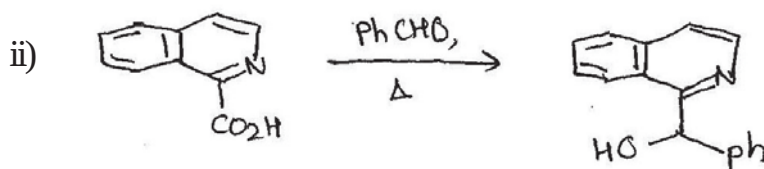
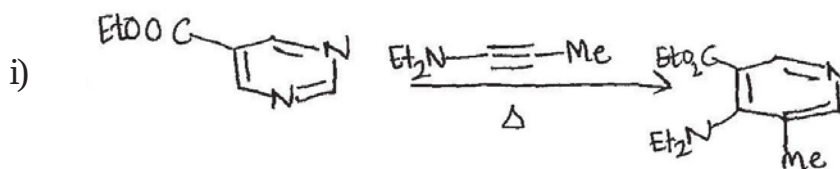
i) Name the following heterocycles using

- 1) Recognized trivial names
- 2) By systematic Hantzsch-Widman nomenclature.

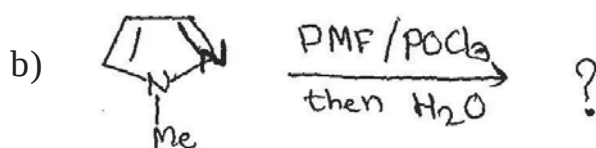
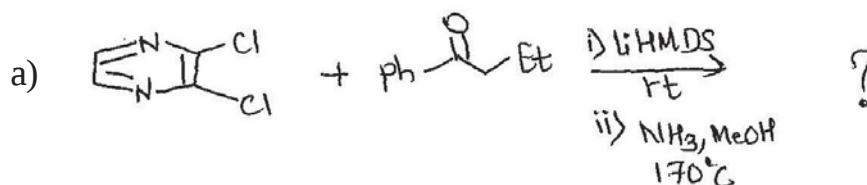


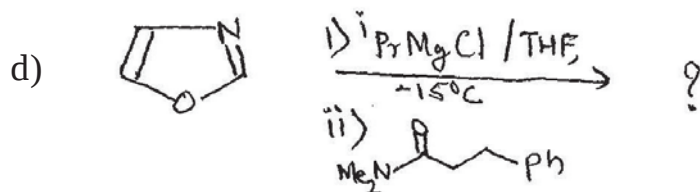
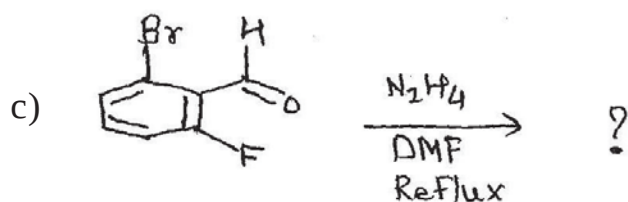
ii) 1,3-azoles shows electrophilic substitution reaction at C-4 whereas 1,2 - azoles at C-3 position. Explain.

b) Suggest a suitable mechanism for the following. [5]



Q6) Predict the product with a mechanism. [12]





Q7) Answer the following.

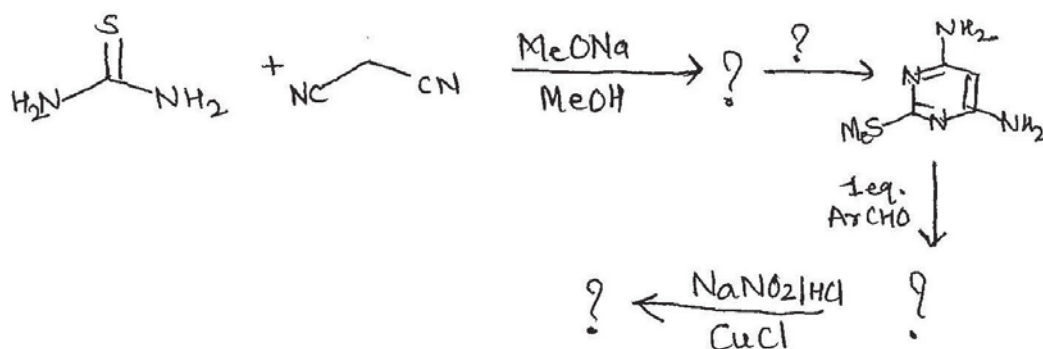
[12]

- Explain palladium catalyzed synthesis of benzofused Heterocyclic compounds.
- Give any one method for the synthesis of quinoxalines and imidazole.
- Explain electrophilic substitution reaction in pyrazole.

Q8) a) Answer the following.

[6]

- Write the structure & use of Omeprazole, Amlodipine and cilostazole.
 - 2-aminoquinoline on diazotization gives 2-quinolone. Explain.
- b) Complete the following reaction sequence and write the structure & reagents. [6]



Total No. of Questions : 8]

SEAT No. :

PD3103

[Total No. of Pages : 3

[6476]-43

M.Sc. - II

ANALYTICAL CHEMISTRY

**CCTP - 7, CHA - 390 : Electrochemical and Thermogravimetric
Methods of Chemical Analysis
(2019 Pattern) (Semester - III) (4 Credit)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 1 & Question 5 are compulsory.
- 2) Question 2 to 4 & question 6 to 8 carry equal marks.
- 3) Solve any two questions from Q.2 to Q.4 and any two questions from Q.6 to Q.8.
- 4) Figures to the right indicate full marks.
- 5) Use of log table & calculator are allowed.
- 6) Answer to two sections should be written on separate answers sheet.

SECTION - I

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

- i) What is linear scan voltammetry? Give examples.
 - ii) Differentiate between electrogravimetry and coulometry.
 - iii) What is the interference of dissolved oxygen in polarographic analysis?
 - iv) Why stripping voltammetry are more sensitive than other voltammetric methods.
 - v) Why pulse polarography is more sensitive than classical polarography?
- b) A sample of 0.8×10^{-3} m of metal ion in a 0.1M KCl solution gives diffusion current of $7.10 \mu\text{A}$, when mercury flow rate & mercury droptime were 3.0 mg/sec and 5.0 second respectively. If the diffusion coefficient of metal ion is $0.7 \times 10^{-5} \text{ cm}^2/\text{sec}$; determine the number of electrons involved in the reduction process. **[3]**

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

- i) Draw the ideal cyclic voltammogram for a suitable reversible redox reaction. Explain the method of determination of half wave potential from this voltammogram.
 - ii) How the reversible, quasi reversible and irreversible redox reactions are identify by cyclic voltammetric experiment?
- b) Attempt the following. **[6]**
- i) Distinguish between potentiostatic coulometry & amperostatic coulometry.
 - ii) Calculate the quantity of electricity in faraday, when a current strength of 54.3A. is passed for one hour through the electrolyte solution (1F = 96500 coulomb)

P.T.O.

- Q3) a)** Attempt the following. [6]
- Why hydrodynamic voltammetry is more sensitive than classical polarography?
 - Give construction of dropping mercury electrode. What is droptime and mercury flow rate.
- b)** Attempt the following. [6]
- What is pulse voltammetry? Distinguish between differential pulse voltammetry & square wave voltammetry.
 - What is coulometry? Explain the applications of controlled potential coulometry.
- Q4) a)** Attempt the following. [6]
- Distinguish between anodic stripping and cathodic stripping voltammetry with respect to their analytical working.
 - Draw the schematic diagram of polarographic cell. Explain significance of working electrode and reference electrode involved in it.
- b)** Attempt the following. [6]
- How hydrodynamic voltammetry work as a detector in liquid chromatography.
 - A 2.0 ml sample solution of Cd (II) produces 24.8 μA diffusion current on DC polarogram. By adding 1.0ml of $2.0 \times 10^{-3} \text{ M}$ Cd (II) solution to above solution, the new diffusion current is 59.8 μA . Calculate the concentration of Cd(II) in the sample solution.

SECTION - II

- Q5) a)** Solve any four of the following. [8]
- Define term power compensated DSC.
 - Define thermal analysis. Enlist types of thermal analysis methods.
 - What is dynamic mechanical analysis.
 - What is evolved gas analysis.
 - Enlist four thermal methods of simultaneous analysis.
- b)** A sample of inorganic compound is analyzed for moisture content and water of crystallization suppose anhydrous compound has molecular wt. 153g. It shows % wt. loss 4.1% at upto 105°C and 20.22% wt. loss from 140 to 225°C. Calculate moisture content and water of crystallizations in the compound. [3]

- Q6) a)** Attempt the following. [6]
- i) Write a note on TG-MS.
 - ii) Write a note on heat flux DSC.
- b) State the principle of TG - DTA. Draw and explain components of TG - DTA analysis. [6]
- Q7) a)** What is mean by thermomicroscopy? Give any three applications of thermomicroscopy in detail. [6]
- b) Explain the following. [6]
- i) What is glass transition temperature? Expalin use of DSC in determination of glass transition temperature?
 - ii) Write a note on Dielectric thermal analysis (DETA).
- Q8) a)** Attempt the following. [6]
- i) Write factors affecting thermometric titration.
 - ii) Which thermal method can be used to note changes like conversion of solid to liquid & Decomposition of Inorganic complex.
- b) Answer the following. [6]
- i) When heating rate is changed on DSC or DTA what will be the effect on peak or baseline.
 - ii) Write a note on TA Insfrared.



Total No. of Questions : 8]

SEAT No. :

PD3104

[Total No. of Pages : 3

[6476]-44

M.Sc. - 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) *Solve any 2 questions from 2 to 4 and solve any 2 questions from 6 to 8.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of logarithmic tables and scientific calculator is allowed.*

SECTION - I

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

- i) Define accuracy.
 - ii) What is a systematic error?
 - iii) What is transfer waiver?
 - iv) Give factors affecting the dissolution process.
 - v) Define assay validation.
- b) With a suitable diagram describe the USP Type I dissolution apparatus. **[3]**

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

- i) What is revalidation? When is it necessary to revalidate?
 - ii) What are errors? Describe different types of errors with suitable examples.
- b) Solve the following:- **[6]**
- i) Compare the parameters of selectivity and specificity.
 - ii) The following data was collected as a part of quality control study for the analysis of a pharmaceutical formulation with respect to Iron = 15%, 18%, 20% 22% and 21%. Estimate the mean median, range and standard deviation for the above data.

Q3) a) What is precision? Explain different types of precision in detail. **[6]**

b) What are the requirements of analytical method transfer? **[6]**

P.T.O.

- Q4) a)** What is ICH? Explain the different aspects related to ICH. [6]
- b) i) Explain the parameters of range and linearity. [3]
- ii) Determine the relationship between the response and concentration by linear regression analysis from the given data. [3]
- | | | | | | |
|-----------------|------|------|------|-------|-------|
| Concentration | 0.00 | 0.10 | 0.20 | 0.30 | 0.40 |
| standard (mg/l) | | | | | |
| Response value | 0.00 | 5.25 | 9.50 | 14.90 | 18.20 |

SECTION - II

- Q5) a)** Attempt the following any four. [8]
- i) Give examples of reverse phase sorbent system.
- ii) Give main optimization of PFE operating parameters.
- iii) How can emulsion formed in LLE be broken up?
- iv) Which solvents might you use for soxhlet extraction?
- v) Enlist components of microwave system.
- b) One liter of an aqueous solution contains 20 gms of an organic acid. Calculate the amount of the acid extracted in ether after: [3]
- i) Single extraction with 100 ml ether.
- ii) Five successive extractions with 100 ml ether. Distribution ratio for the extraction is 10.
- Q6) a)** Attempt the following. [6]
- i) Explain the SPME-GC applications in analysis of pesticides in aqueous samples.
- ii) Draw schematic diagram of pressurised MAE and explain its working.
- b) Attempt the following. [6]
- i) A metal chelate was extracted to the extent of 80% when equal volumes of aqueous and organic phases were shaken together. What will the % extraction if the volume of organic phase is doubled?
- ii) Explain in detail determination of Beryllium as the 'acetylacetonone' complex.

- Q7) a)** Attempt the following. **[6]**
- i) Explain the process of isolation of amino acids from liquid samples by ion-exchange SPE.
 - ii) Draw a schematic diagram illustrating the principle of column switching. Explain automation and online SPE.
- b)** Attempt the following. **[6]**
- i) Draw apparatus for soxhlet extraction & explain soxhlet extraction process.
 - ii) Explain purge and trap technique for the extraction of volatile organics in aqueous samples.
-
- Q8) a)** Attempt the following. **[6]**
- i) Describe direct immersion SPME techniques for semivolatile organic compounds in water.
 - ii) Explain different types of membrane microextraction techniques.
- b)** Attempt the following. **[6]**
- i) Discuss the instrumentation for pressurized fluid extraction.
 - ii) Describe any one application of Normal phase SPE.



Total No. of Questions : 8]

SEAT No. :

PD3105

[Total No. of Pages : 2

[6476]-45

M.Sc. - II

ANALYTICAL CHEMISTRY

**CHA-392: Advanced Chromatographic Methods
of Chemical Analysis
(2019 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 and 5 is compulsory.*
- 2) *Solve any two questions from 2-4 and any two questions from 5-8.*
- 3) *Figures to right indicate full marks.*
- 4) *Use of log table and calculator is allowed.*

SECTION - I

- Q1) a)** Answer any four of the following. **[8]**
- i) What is resolution? Give equation for resolution in chromatography.
 - ii) Enlist four factors affecting retention data.
 - iii) What is retention time? How it is determined?
 - iv) What is selected ion monitoring?
 - v) Give the principle of TOF mass analyser.
- b) Substance A and B showed retention time 6.23 and 8.92 min on a column of 100 cm length. Peak width are 0.90 and 1.1 min respectively then calculate column resolution average number of plates and plate height. **[3]**
- Q2) a)** What is gas chromatography? With block diagram explain instrumentation of gas chromatography. **[6]**
- b) Write notes on **[6]**
- i) Nitrogen rule in MS interpretation.
 - ii) Electron capture detector in GC.
- Q3) a)** Answer the following. **[6]**
- i) Explain determination of pesticides by GC-MS method from water sample.
 - ii) Discuss any one method of quantitative analysis by gas chromatography.
- b) Discuss the following. **[6]**
- i) Estimation of volatile organic matter from waste water sample by LLC-GC method.
 - ii) What is HETP? Discuss effect HETP on separation of components of mixture.

P.T.O.

- Q4) a)** What is ionization in MS? Explain any two methods of ionization in detail. [6]
- b)** Answer the following. [6]
- Explain split and splitless injection in gas chromatography.
 - Explain any one interface in detail used in GC-MS.

SECTION - II

- Q5) a)** Attempt any four of the following. [8]
- What is the principle of adsorption chromatography.
 - Describe functions of pumps in HPLC.
 - What is the effect of particle size of stationary phase on chromatographic separation?
 - What is the function of interface in LC-MS?
 - Which is Universal detector in HPLC? Why?
- b)** A standard solution of Glucose of 10 g/lit is prepared it gives peak area of 5400. A sample of glucose gives a peak area of 3600. A Fructose of 15g/lit injected as internal standard gave peak area of 6300 in both solution. Calculate calibration factor and amount of glucose in given sample. [3]
- Q6) a)** Write a short note on following. [6]
- Quantitative analysis by HPLC
 - Supercritical fluid chromatography
- b)**
- Explain principle and working of UV Detector. [3]
 - What is post column derivatisation? Give its advantages and disadvantages. [3]
- Q7) a)** Describe different methods of HPLC analysis. How a method is chosen on the basis of nature of sample components? [6]
- b)**
- Explain analysis of drug metabolites by LC-MS method. [3]
 - What is gradient elution? Describe effect of flow rate on retention time of compound. [3]
- Q8) a)** Write short note on following. [6]
- Fluorescence detector
 - Indirect Detection in HPLC
- b)**
- Describe chemically modified silica phases in HPLC. [3]
 - What is nomogram? Discuss in detail. [3]



Total No. of Questions : 8]

SEAT No. :

PD3106

[Total No. of Pages : 6

[6476]-46
M.Sc. (Part - II)
ANALYTICAL CHEMISTRY
CHA - 393(A) : Bioanalytical Chemistry
(2019 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 1 & Question 5 are compulsory.
- 2) Question 2 to 4 & question 6 to 8 carry equal marks.
- 3) Solve any two questions from Q.2 to Q.4 and any two questions from Q.6 to Q.8.
- 4) Figures to the right indicate full marks.
- 5) Use of log table & calculator are allowed.
- 6) Answer to two sections should be written on separate answers sheet.

SECTION - I

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

- i) Enlist planar chromatographic detector.
 - ii) Define HPTLC.
 - iii) Sketch neat labelled diagram of capillary electrophoresis.
 - iv) Give difference between Hydrodynamic and electrokinetic injection.
 - v) Enlist the detection methods used in capillary Electrophoresis.
- b) Explain mass spectrometric detection in TLC with respect to atmospheric pressure mass spectrometry. **[3]**

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

- i) Write a note on diode array scanner.
 - ii) Discuss quantitative and qualitative analysis applications.
- b) Write a note on excitation sources for fluorescence detection and optical layout of fluorescence detector. **[6]**

P.T.O.

- Q3) a)** Answer the following. [6]
- i) Explain electrokinetic injection system.
 - ii) Write a note on Isotachophoresis.
- b) Give the principle of electrophoresis. Explain zone electrophoresis with respect to use of support media, density gradient stabilization & Free zone electrophoresis. [6]

- Q4) a)** Answer the following. [6]
- i) Explain various types of gels used in gel electrophoresis.
 - ii) Explain in detail conductometric detection.
- b) Discuss the theory of electrophoretic migration. [6]

SECTION - II

- Q5) a)** Attempt any four of the following. [8]
- i) What is indirect ELISA?
 - ii) Write a deficiency disease and sources of vitamin A.
 - iii) How to preserve and store the urine sample.
 - iv) Write a deficiency disease and sources of vitamin D.
 - v) What are anticoagulants? Give two examples.
- b) The sample of blood was analysed for urea content by colorimetric method. The absorbance of sample is 0.210 & absorbance of standard is 0.250. Calculate the conc. of urea in sample. [3]
- [Given : conc. of standard urea = 50 µg/mL]

- Q6) a)** Discuss the following. [6]
- i) Estimation of vitamin B-2 by fluorometry.
 - ii) Explain in detail clonal selection theory.
- b) Answer the following. [6]
- i) Discuss the determination of blood potassium level by flame photometry.
 - ii) Estimation of vitamin C by volumetric method.

- Q7) a)** Explain the following. [6]
- i) Determination of creatinine from blood sample.
 - ii) Innate and adaptive immune system.
- b)** Answer the following. [6]
- i) Explain the method of preservation of faeces.
 - ii) State the principle and explain the procedure for estimation of urea in urine by direct colorimetry.
- Q8) a)** Explain in detail substrate and chromophore [Enzyme Conjugates] commonly used in ELISA. [6]
- b)** Answer the following. [6]
- i) Explain the spectrophotometric method for determination of tocopherols.
 - ii) Blood sample of patient was analysed for inorganic phosphate by TCA method. The absorbance of sample is 0.088 and absorbance of standard is 0.110. Calculate the conc. of inorganic phosphate in given sample. [conc. of std. phosphate = 2mmol/lit].



Total No. of Questions : 8]

PD3106

[6476]-46

M.Sc. (Part - II)

ANALYTICAL CHEMISTRY

**CHA - 393(B) : Analysis of Food and Controlled Substances
(2019 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 1 & Question 5 are compulsory.
- 2) Question 2 to 4 & question 6 to 8 carry equal marks.
- 3) Solve any two questions from Q.2 to Q.4 and any two questions from Q.6 to Q.8.
- 4) Figures to the right indicate full marks.
- 5) Use of log table & calculator are allowed.
- 6) Answer to two sections should be written on separate answers sheet.

SECTION - I

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

- i) What do you mean by dry ashing?
- ii) Write any one qualitative test for protein.
- iii) What are the steps involved in food analysis?
- iv) What is retrogradation of starch?
- v) What are parabens?

b) Analysis of FAME by GC gave the following areas for identified peaks.[3]

FAME	Peak area (AU)
A	14344172
B	1182738
C	2853369

Calculate the % composition of each fatty acid in the sample.

Q2) a) What are colour additives? Discuss various reasons for using color additives in foods. A sample of food containing colour additives was analysed by TLC and the distance travelled by solvent was 8.5 cm. If the colours C1, C2 and C3 were spotted at the distances of 3.1 cm, 4.9 cm and 5.5 cm respectively, calculate R_f value of each colour in the sample.[6]

- b) i) Write a note on oven drying methods for moisture removal. **[3]**
- ii) What are proteins? Write the principal of the smith protein Assay.[3]

[6476]-46

Q3) a) Explain the following terms - [6]

- i) Net protein utilization (NPU)
- ii) Digestibility (D)
- iii) Biological value (BV)

If nitrogen retained, nitrogen absorbed and nitrogen intake from protein by Rat was 2.85 mg, 2.25 mg and 9.37 mg respectively. Calculate NPU, D and BV of the protein sample.

- b) i) Discuss the factors that influence the selection of sampling plans. [3]
- ii) Write a note on nonstarch polysaccharides. [3]

Q4) a) Outline an analytical method for the determination of iodine value of oil. A 0.35gm oil sample was treated with Wij's solution. After 30 minutes it was treated with 10% KI solution and liberated iodine was titrated with 0.1M $\text{Na}_2\text{S}_2\text{O}_3$ and it gave a burette reading of 9.6ml. If the blank titration reading was 25ml, calculate the iodine value of oil. [6]

- b) i) Define Ash value. Discuss the types and significance of Ash value.
- ii) Explain the determination of reducing sugars by Nelson - Somogyi method. [6]

SECTION - II

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

- i) Write the fluorescence Testing of LSD.
- ii) Write the platinum chloride test.
- iii) Write the name & structure of active drug present in Cannabis sativa.
- iv) Write the morphological characteristics of Catha Edulis.
- v) What NDPS Act 1985?

- b) A sample of drug containing barbiturates was analysed by TLC and the distance travelled by solvent, sample B_1 , B_2 and B_3 were 8.5cm, 3.1 cm, 4.9 cm and 5.5 cm respectively. Calculate the R_f value of each compound in sample. [3]

Q6) a) Discuss the synthesis of pure cocaine. [6]

b) i) Explain the chemistry of colour formation. [3]

ii) A drug sample containing LSD was mixed with 1% tartaric acid & extracted in CHCl_3 . The CHCl_3 extract was analyzed using GCMs and the observations are as follow -

LSD (mg/ml)	Peak area (AU)
0.2	110
0.4	212
0.6	336
0.8	454
1.0	662
Sample	555

Determine the amount of LSD in the sample. [3]

Q7) a) Explain the origin and sources of diamorphine. A sample containing diamorphine was analysed by LC method. It gave following observations by LC method. It gave following observations. [6]

$$C_s = 2.5 \text{ mg/ml}, P_x = 4.5, A_x = 5.6, P_s = 3.3, A_s = 6.7$$

Calculate the concentration (C_x) of diamorphine in the sample.

b) i) Discuss the Zimmerman Test. [3]

ii) Write a note on identification of Khat. [3]

Q8) a) Discuss the quantification of amphetamines by HPLC. A sample containing amphetamine shows a peak height of 50 mAUmin where as the peak height for the reference standard solution having concentration of $4.5 \mu\text{g/ml}$ is 65 mAUmin. Calculate the concentration of amphetamine present in the sample. [6]

b) i) Discuss the origin, sources and manufacture of Cannabis. [3]

ii) What are barbiturates? Write the structure of amobarbital and phenobarbital. [3]



Total No. of Questions : 8]

SEAT No. :

PD-3107

[Total No. of Pages : 4

[6476]-51

M.Sc. (Part - II)

PHYSICAL CHEMISTRY

CHP - 410 : Molecular Structure and Spectroscopy
(2019 Pattern) (Semester - IV) (Credit-4)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates :

- 1) Answers to the two sections should be written in separate answer books.
- 2) Question 1 and 5 are compulsory.
- 3) Answer any 2 Questions out of Q2, Q3 & Q4 and any 2 questions out of Q6, Q7 & 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	$= 6.023 \times 10^{23} \text{ mol}^{-1}$
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	$= 6.626 \times 10^{-16} \text{ erg s}$ $= 6.626 \times 10^{-34} \text{ Js}$
4. Electronic Charge	e	$= 4.803 \times 10^{-10} \text{ esu}$ $= 1.602 \times 10^{-19} \text{ C}$
5. 1 eV		$= 23.06 \text{ kcal mol}^{-1}$ $= 1.602 \times 10^{-12} \text{ erg}$ $= 1.602 \times 10^{-19} \text{ J}$ $= 8065.5 \text{ cm}^{-1}$
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		$= 1.673 \times 10^{-24} \text{ kg}$
11. Bohr magneton	β_e	$= -9.274 \times 10^{-24} \text{ J T}^{-1}$
12. Nuclear magneton	β_n	$= 5.051 \times 10^{-27} \text{ J T}^{-1}$
13. Mass of an electron	m_e	$= 9.11 \times 10^{-31} \text{ kg}$

P.T.O.

SECTION - I

- Q1)** a) Attempt any four of the following : [8]
- i) Define chemical shift in NMR spectroscopy.
 - ii) What are the advantages of TMS.
 - iii) Why microwave radiations are used to observe ESR signals.
 - iv) What are the limitations of NQR?
 - v) Explain the theory of spin-spin interaction for ABC type molecule.
- b) Compare the number of lines in esr of radicals $\cdot\text{XH}_2$ and $\cdot\text{XD}_2$ [X spin state is 5/2] [3]
-
- Q2)** a) Attempt the following : [6]
- i) State the characteristics of high resolution nmr instrumentation.
 - ii) Discuss zero field splitting in esr.
- b) Attempt the following : [6]
- i) Explain the term quadrupole coupling constant.
 - ii) Discuss the concept of electric field gradient.
-
- Q3)** a) Give the applications of NQR with suitable example. [6]
- b) Attempt the following : [6]
- i) Write a note on B_c spectroscopy.
 - ii) Explain the following terms with respect to NMR spectroscopy.
 - a) Shielding
 - b) Deshielding
 - c) Coupling constant
-
- Q4)** a) Discuss the advantages of FT-NMR. [6]
- b) Attempt the following : [6]
- i) State the advantages of B_c NMR over PMR spectroscopy.
 - ii) Calculate the frequency required to excite proton from $M_1 = 1/2$ to $M_1 = -1/2$.
(Given : $g_N = 5.585$, $H_o = 1.4\text{T}$).

SECTION - II

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

- i) State and explain Wierl equation.
- ii) Explain the term dimagnetic susceptibility.
- iii) What are counter method to detect x-rays?
- iv) State and explain de Broglie hypothesis.
- v) Which reflection can not be observed for a primitive cubic lattice and why?

b) Calculate the temperature needed for the average wavelength of the neutron to be 100 Pm.

(Given : Mass of neutron = 1.675×10^{-27} kg) **[3]**

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

- i) Explain Faraday method of measuring magnetic susceptibility.
- ii) What are the methods to overcome the phase problem observed in x-ray diffraction pattern?

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

- i) Distinguish between the neutron diffraction and electron diffraction technique for the molecular structural analysis.
- ii) Describe the factors which contribute to a paramagnetism in a substance.

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

- i) Describe patterson synthesis for determining the relative orientations of pairs of atom in a crystal.
- ii) What is mean by systematic absence? How do they arise for body centre cubic unit cell?

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

- i) What is Pascal constant? Give its uses.
- ii) Explain the terms Ferro, Ferri and Anti Ferro magnetism.

Q8) a) Attempt the following. [6]

- i) Enlist the measurement techniques used in neutron diffraction analysis. Explain any one in brief.
- ii) Explain phenomena of scattering of neutron by solid and liquid.

b) Attempt the following. [6]

- i) Calculate structural factor $F(hkl)$ for the FCC lattice and determine which reflection would be absent from diffraction pattern.
- ii) State the application of neutron diffraction technique in the framework of molecular structure.



Total No. of Questions : 8]

SEAT No. :

PD3108

[Total No. of Pages : 3

[6476]-52

Second Year M.Sc.

PHYSICAL CHEMISTRY

CCTP-II CHP-411 : Surface Chemistry and Electrochemistry
(2019 Pattern) (Semester-IV) (4 Credits)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answer books.
- 2) Questions 1 and 5 are compulsory.
- 3) Answer any 2 questions out of Q.2, Q.3 and Q.4 and any 2 questions out of Q.6, Q.7 and Q.8.
- 4) Figures to the right 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 | $N = 6.023 \times 10^{23} \text{ mol}^{-1}$ |
| 2) Boltzmann Constant | $k = 1.38 \times 10^{-16} \text{ erg K}^{-1} \text{ molecule}^{-1}$
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| 4) Electronic Charge | $e = 4.803 \times 10^{-10} \text{ esu}$
$= 1.602 \times 10^{-19} \text{ C}$ |
| 5) 1 eV | $= 23.06 \text{ k cal mol}^{-1}$
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$= 8065.5 \text{ cm}^{-1}$ |
| 6) Gas Constant | $R = 8.314 \times 10^7 \text{ erg K}^{-1} \text{ mol}^{-1}$
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$= 1.987 \text{ cal K}^{-1} \text{ mol}^{-1}$ |
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| 8) Speed of light | $c = 2.997 \times 10^{10} \text{ cm s}^{-1}$
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| 12) Nuclear Magneton | $\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$ |
| 13) Mass of an electron | $m_e = 9.11 \times 10^{-31} \text{ Kg}$ |

P.T.O.

SECTION - I

- Q1)** a) Attempt any four of the following : [8]
- i) Define chemisorption.
 - ii) What is wetting phenomenon? Give its two application.
 - iii) Explain the term surface tension.
 - iv) Draw a neat labelled diagram of B.E.T. model.
 - v) What is capillary condensation?
- b) Distinguish between physisorption and chemisorption. [3]
- Q2)** a) Answer the following. [6]
- i) Describe with neat labelled diagram the volumetric method of measurement of adsorption.
 - ii) Discuss the fourth flotation technique.
- b) Answer the following. [6]
- i) Explain the mechanism of chemisorption of transition metal.
 - ii) Discuss the mechanism of detergency.
- Q3)** a) Derive the equation for isosteric heat of adsorption. [6]
- b) Answer the following. [6]
- i) Describe the porosity meter method of determination of pore size.
 - ii) Write the assumption for potential theory for multilayer adsorption.
- Q4)** a) Derive and explain Gibbs adsorption equation. [6]
- b) Answer the following. [6]
- i) The data given below was obtained for the adsorption of CO on charcoal at 0°C and 1 atm. Verify that the data obey Langmuir monolayer adsorption. Determine the value of K and V_m.
- | | | | | | | |
|---------|------|------|------|------|------|------|
| P(torr) | 100 | 200 | 300 | 400 | 500 | 600 |
| V(cc) | 10.2 | 18.6 | 25.5 | 31.4 | 36.9 | 41.6 |
- ii) Explain Freundlich adsorption isotherm.

SECTION - II

- Q5) a)** Attempt any four of the following : [8]
- i) Write Butler-Volmer equation and explain the term in it.
 - ii) What is fuel cells?
 - iii) What is activity and activity coefficient?
 - iv) Write a types of electrode.
 - v) Why does Debye-Huckel limiting law referred as limiting law.
- b) Derive the Tafel equation. [3]
- Q6) a)** Answer the following. [6]
- i) Describe Hydrogen-Oxygen cell.
 - ii) Give assumption of Debye-Huckel theory.
- b) Attempt the following. [6]
- i) Discuss the variation of emf with temperature.
 - ii) What are advantages of fuel cell?
- Q7) a)** Answer the following. [6]
- i) Discuss electrical double layer in detail.
 - ii) Derive the expression showing relation between absolute and conventional mobility.
- b) Attempt the following. [6]
- i) Describe the lithium ion battery.
 - ii) Explain stern adsorption theory of double layer.
- Q8) a)** Attempt the following. [6]
- i) Write a note on Tafel plot.
 - ii) What is zeta potential.
- b) Attempt the following. [6]
- i) Describe the Gouy-Chapman diffuse layer theory.
 - ii) Describe the dry cell.



Total No. of Questions : 8]

SEAT No. :

PD3109

[Total No. of Pages : 6

[6476]-53

S.Y. M.Sc.

PHYSICAL CHEMISTRY

CHP-412(A) CBOP - 4 : Material Chemistry and Catalysis
(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answerbook.
- 2) Questions 1 and 5 are compulsory.
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- 4) Figures to the right indicate full marks.
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- 6) Neat diagrams must be drawn wherever necessary.

Physico-Chemical Constants

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| 1) Avogadro Number | $N = 6.023 \times 10^{23} \text{ mol}^{-1}$ |
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| 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 | $= 4.184 \times 10^7 \text{ erg}$
$= 4.184 \text{ J}$ |
| 10) 1 amu | $= 1.673 \times 10^{-24} \text{ kg}$ |
| 11) Bohr Magneton | $\beta_e = -9.274 \times 10^{-24} \text{ J T}^{-1}$ |
| 12) Nuclear Magneton | $\beta_n = 5.051 \times 10^{-27} \text{ J T}^{-1}$ |
| 13) Mass of an electron | $m_e = 9.11 \times 10^{-31} \text{ Kg}$ |

P.T.O.

SECTION - I

(CHP-412(A)CBOP-4 : Material Chemistry and Catalysis)

- Q1)** a) Attempt any four of the following : [8]
- i) Draw the schematic cross sectional diagram of the DC-sputtering system.
 - ii) Write two advantages of full wave rectifier.
 - iii) What is the Langmuir-Blodgett film?
 - iv) State the optical properties of solid devices.
 - v) Define the term quantum dot.
- b) Explain the pairing modes of hitech materials. [3]
-
- Q2)** a) Attempt the following : [6]
- i) Discuss the applications of superconductors.
 - ii) What is N-P-N transistor? Explain the three modes of its operation.
- b) Attempt the following : [6]
- i) Describe the basic structure and operation of a capacitor.
 - ii) How do perovskites account for defects in crystals?
-
- Q3)** a) Explain the sol-gel method with suitable diagram to prepare thin films. [6]
- b) Attempt the following : [6]
- i) Discuss the term 'reactive sputtering'. Give its consequences.
 - ii) Define specific heat capacity. Give its significance and unit.
-
- Q4)** a) Explain the term MOCVD with suitable diagram to prepare thin film. [6]
- b) Attempt the following : [6]
- i) Write the normal state properties of 2-1-4 materials.
 - ii) The Fraction of nonreflected light that is transmitted through a 400 mm thickness of glass is 0.76. Calculate the absorption coefficient of the material.

SECTION - II

- Q5) a)** Attempt any four of the following : [8]
- i) What are zeolites? Give its an example.
 - ii) Define the term catalytic selectivity.
 - iii) Give any four factors which affects the activity of catalyst.
 - iv) State the principle of calcination method in catalyst activity.
 - v) Write the steps involved in Langmuir-Hishelwood mechanism.
- b) Explain the adsorption theory of catalysis. [3]
-
- Q6) a)** Attempt the following : [6]
- i) How is the characterisation of catalyst done by using AES technique?
 - ii) What is the deactivation of a catalyst? Explain the causes of deactivation.
- b) Attempt the following : [6]
- i) Write a note on homogeneous catalysis.
 - ii) Derive the expression for kinetic of unimolecular surface reaction.
-
- Q7) a)** Attempt the following : [6]
- i) Discuss the hydrolysis and vapour deposition method of catalyst preparation.
 - ii) Write a note on enzyme catalysis.
- b) Draw and describe the various types of physical adsorption isotherms. [6]
-
- Q8) a)** Attempt the following : [6]
- i) Describe the XPS method to determine solid particle size.
 - ii) Write any three principles of green chemistry.
- b) What is the chemisorption? Discuss the mechanism of chemisorption on metal oxides. [6]



Total No. of Questions : 8]

PD3109

[6476]-53

S.Y. M.Sc.

PHYSICAL CHEMISTRY

**CHP-412(B) CBOP - 4 : Biophysical Chemistry and Special Topics
in Nuclear & Radiation Chemistry
(2019 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate answerbook.
- 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 indicate full marks.
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- 6) Neat diagrams must be drawn wherever necessary.

Physico-Chemical Constants

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7) Faraday Constant	$F = 96487 \text{ C equiv}^{-1}$
8) Speed of light	$c = 2.997 \times 10^{10} \text{ cm s}^{-1}$ $= 2.997 \times 10^8 \text{ m s}^{-1}$
9) 1 cal	$= 4.184 \times 10^7 \text{ erg}$ $= 4.184 \text{ J}$
10) 1 amu	$= 1.673 \times 10^{-24} \text{ kg}$
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)** Attempt any four of the following : **[8]**
- i) Draw the structure of cell membrane.
 - ii) What are denaturing agents.
 - iii) Define exogenic and endogenic reactions.
 - iv) Explain the term root mean square end to end distance.
 - v) Mention the parts used in measurement of ORD.
- b) Discuss the different stages of protein Biosynthesis. **[3]**
-
- Q2) a)** Attempt the following : **[6]**
- i) What are proteins? Explain structure and function of proteins.
 - ii) Discuss hydrophobic interactions.
- b) Attempt the following : **[6]**
- i) Give the significance of Michaleis-Menten equation.
 - ii) Discuss the different applications of CD spectrometry.
-
- Q3) a)** Explain the reactions related to hydrolysis of ATP. **[6]**
- b) Attempt the following : **[6]**
- i) Explain diffraction methods for studying the structure of Biopolymers.
 - ii) Explain reversible enzyme inhibition.
-
- Q4) a)** Write a short note on : **[6]**
- i) Michaelis constant
 - ii) α -helix
- b) Attempt the following : **[6]**
- i) Discuss the problems of protein folding.
 - ii) Explain Biological importance of Nucleic acid.

SECTION - II

- Q5)** a) Attempt any four of the following : [8]
- i) Define personal dosimetry.
 - ii) What is therapeutic use of radiation?
 - iii) Explain term nuclear star.
 - iv) Give two applications of radiopharmaceutical
 - v) Enlist natural sources of radiation.
- b) Explain the methods for management of high level radioactive waste.[3]
-
- Q6)** a) Attempt the following : [6]
- i) What are the conditions required for selecting a radioactive nuclide as indicator for radiometric titrations?
 - ii) Write a note on pulse radiolysis.
- b) Attempt the following : [6]
- i) What were the reasons for chernobyl accident?
 - ii) Explain the origin of radioactive waste.
-
- Q7)** a) Explain in detail primordial nucleosynthesis. [6]
- b) Attempt the following : [6]
- i) Write the biological effect of radiation.
 - ii) Explain cosmology.
-
- Q8)** a) Write a note on solar neutrino problems. [6]
- b) Attempt the following : [6]
- i) What are the ideal properties on a radionuclide used for diagnostic purposes?
 - ii) Discuss general principle of radiometric titration.



Total No. of Questions : 6]

SEAT No. :

PD3110

[Total No. of Pages : 3

[6476]-54

M.Sc. - II

INORGANIC CHEMISTRY

CHI - 430 : Heterogeneous Catalysis and It's Applications

(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.
- 2) Figures to the right indicate full marks.
- 3) Draw neat diagrams wherever necessary.
- 4) Write each section in separate answer book.

SECTION - I

(Heterogeneous Catalysis)

Q1) a) Answer the following : [8]

- i) Define chemisorption and physisorption.
- ii) What is phase transfer catalysis? Explain with suitable example.
- iii) Which properties of transition metals makes them good catalyst? Explain.
- iv) What are active sites in heterogeneous catalysis?

b) Give the classification of heterogeneous catalyst. [3]

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

- i) Discuss various methods of heterogenization of homogeneous transition metal complexes.
- ii) Give an account of factors influencing on zeolite synthesis.

P.T.O.

- b) Answer any Two of the following : [6]
- i) What is supported metal catalyst? Enlist their advantages.
 - ii) What is chemical reactor? Explain the advantages of fluidized bed reactor.
 - iii) Describe the method for preparation of Raney-Ni catalyst.

- Q3)** a) Answer any one of the following : [6]
- i) Give an account of various processes of deactivation of heterogeneous catalyst.
 - ii) Discuss post synthetic treatments of heterogenous catalyst.
- b) Answer any Two of the following : [6]
- i) Write a note on MFI type of zeolite frame work structure.
 - ii) Discuss the role of support in supported metal catalyst.
 - iii) Explain the importance of surface area and porosity of heterogeneous catalyst.

SECTION - II

(Applications of Heterogeneous Catalysis in Organic Synthesis)

- Q4)** a) Answer the following : [8]
- i) What is solid acid catalyst? Give any two examples.
 - ii) How pyrophyllite clay is formed?
 - iii) What is catalytic converter? Where it is used?
 - iv) What is water-gas shift reaction? Which catalyst is used in it?
- b) What is semiconductor? Discuss the role of semiconductor as a catalyst with suitable example. [3]

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

- i) What do you mean by pillered and intercalated clays? Discuss their use as a catalyst.
- ii) Describe the conversion of biomass on solid catalyst.

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

- i) Discuss industrial applications of electrocatalysis.
- ii) Discuss selective hydrogenation of hydrocarbons.
- iii) What is Fischer-Tropsch Synthesis? Discuss the limitations of Fischer-Tropsch synthesis.

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

- i) What are perovskites? Explain their uses as a catalyst for pollution control.
- ii) Discuss the use of BiMO_4 as oxidation and Ammoxidation catalysts.

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

- i) Write a note on methanol synthesis using heterogeneous catalysis.
- ii) What is photocatalysis? Why TiO_2 is a good photocatalyst?
- iii) What is MCM-41? Give its applications.



Total No. of Questions : 6]

SEAT No. :

[Total No. of Pages : 3

PD3111

[6476]-55

M.Sc. - II

INORGANIC CHEMISTRY

**CCTP-11-CHI-431 : Inorganic Nanomaterials : Properties,
Applications and Toxicity
(2019 Pattern) (Semester-IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) All questions are compulsory.*
- 2) Neat diagrams must be drawn wherever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Use of logarithm table and calculator are allowed.*
- 5) Answer to the two sections should be written in separate answer books.*

SECTION-I

(Nano-Structure Materials & Applications)

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

- i) What are Nanites? Explain with example.
 - ii) Define the term nanocomposites.
 - iii) What are 2D nanostructures?
 - iv) What are quantum dots? Give examples.
- b) Explain the effect of nanomaterials on surface area and quantum effect. **[3]**

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

- i) Discuss structural and thermal properties of nanomaterials.
- ii) Discuss about 0D, 1D, 2D and 3D nanostructure with suitable example.

P.T.O.

- b) Answer any two of the following. [6]
- i) What are nanocomposite? Explain any two methods of fabrication of nanocomposite.
 - ii) Discuss the difference between natural and artificial nanoparticles with suitable example.
 - iii) Explain in brief about SWCNT and MWCNT.

- Q3)** a) Attempt any one of the following. [6]
- i) Discuss the advantages of nanobiotechnology and polymer nanotechnology.
 - ii) What is computational nanotechnology? Discuss the applications of computational nanotechnology.
- b) Attempt any two of the following. [6]
- i) Discuss Moore's Law.
 - ii) What are Stalwarts of nanotechnology? Explain in brief.
 - iii) What do you mean by wet nanotechnology and dry nanotechnology?

SECTION-II

(Nanotoxicology & Biosafety)

- Q4)** a) Answer the following. [8]
- i) Explain the term cytotoxicity.
 - ii) What is nano toxicology?
 - iii) Explain role of Biosensors.
 - iv) What do you mean by Nano etymology?
- b) Discuss the toxic effect cadmium and lead nanostructure on human body. [3]
- Q5)** a) Answer any one of the following. [6]
- i) What do you mean by chemical toxicity? Explain the common methods to prevent the nano toxicity.
 - ii) Discuss the epidemiological evidences in toxicity.

- b) Answer any two of the following. [6]
- i) What do you mean by zeta potential? Give importance of zeta potential.
 - ii) Discuss the techniques used for toxicity detection in cells.
 - iii) Give common desalination methods used for nanotoxicity in sewage.

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

- i) Discuss the future challenges of nanotoxicology.
- ii) Discuss advantages of nanostructures used in medicines.

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

- i) Write a short note on Forensic science for toxicity detection.
- ii) Write a short note on apoptosis assay.
- iii) How nanomaterials can be useful in therapeutics? Explain.



Total No. of Questions : 6]

SEAT No. :

PD3112

[Total No. of Pages : 4

[6476]-56

M.Sc. - II

INORGANIC CHEMISTRY
CHI-432(A) : Material Science
(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate full marks.*
- 3) *Use of calculator is allowed.*
- 4) *Answer to the two sections should be written in separate answer book.*

SECTION - I

(Crystal Defects, Magnetic & Superconducting Materials)

- Q1) a)** Answer the following : **[8]**
- i) What is line defect? Explain its type.
 - ii) Distinguish type-I & II super conductors.
 - iii) What is plane defect? Explain its type.
 - iv) What is permanent magnet?
- 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 one of the following : **[6]**
- i) What is hysteresis loop? What is saturation magnetisation and caressive force? Explain the hysteresis loop of hard and soft materials.
 - ii) What is kirkendall effect? Explain with the help of pure copper and brass alloy.
- b) Answer any two of the following : **[6]**
- i) Explain the classification of superconductors.
 - ii) Write a note on meissner effect
 - iii) Write a short note on fullerenes.
- Q3) a)** Attempt any one of the following : **[6]**
- i) Derive the expression $x = \frac{C}{T - T_C}$.
 - ii) State and explain the ficks law and second law of diffusion.
- b) Attempt any two of the following : **[6]**
- i) Write a short note on Garnet ferrite.
 - ii) What is hard and soft magnet?
 - iii) Write a note on perovskite.

P.T.O.

SECTION - II

(Ceramics, Composite, Cementitious & Biomaterials)

- Q4) a)** Answer the following : [8]
- i) What are carbon fibers? Explain with example.
 - ii) What is non-portland cement?
 - iii) Explain metallic materials
 - iv) Define :
 - 1) Gel
 - 2) Set accelerators
- b) What is phosphate cement? Explain with its properties and uses. [3]
- Q5) a)** Attempt any one of the following : [6]
- i) What are biomaterials? Give the classification of biomaterials.
 - ii) Explain dielectric properties of ceramic materials.
- b) Attempt any two of the following : [6]
- i) Give applications of ceramic materials.
 - ii) What is bioactive glasses?
 - iii) Write a note on special concretes.
- Q6)** Attempt any one of the following : [6]
- a) i) What is cement? Explain different types of portland cement. Give its applications.
 - ii) What is wood? What are different parts of wood? Explain with function of each parts.
- b) Attempt any two of the following : [6]
- i) Give the full form of
 - 1) C_3S
 - 2) LLDPE
 - 3) CME
 - ii) Write a note on Heart wood and sap wood.
 - iii) Explain high alumina cement.



Total No. of Questions : 6]

PD3112

[6476]-56

M.Sc. - II

INORGANIC CHEMISTRY

**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) Neat diagrams must be drawn whenever necessary.*
- 3) Figures to the right indicate full marks.*
- 4) Use of logarithm table and calculator is allowed.*
- 5) Answer to the two sections should be written in two separate answer books.*

SECTION - I

(Inorganic Chemistry Applications in Industry)

- Q1) a)** Answer the following : **[8]**
- i) Give the importance of chemical safety.
 - ii) What do you mean by electro deposition?
 - iii) What is Air Quality Index (AQI).
 - iv) Define Green Chemistry.
- b)** Explain hazards of SO₂ as environmental pollutant. **[3]**
- Q2) a)** Attempt any one of the following : **[6]**
- i) What do you mean by chemical safety? Discuss common methods used for chemical safety.
 - ii) Explain the methods for electroplating for precious metals.
- b)** Attempt any two of the following : **[6]**
- i) What are military explosives? Explain in brief.
 - ii) Explain the hazards of carbon monoxide poisoning.
 - iii) Explain role of corrosion inhibitors in paint coating.
- Q3) a)** Answer any one of the following : **[6]**
- i) Discuss the methods used for chemical storage and safety issues in chemical industry.
 - ii) What are explosives? Explain explosives made by nitration and dynamite.
- b)** Write short notes on any two of the following : **[6]**
- i) Sustainable development.
 - ii) CO₂ and NO₂ pollutants : Effects on Health.
 - iii) Environmental aspects of Electro deposition.

SECTION - II

- Q4)** a) Attempt the following : [8]
- i) Define geothermal energy.
 - ii) What is mean by Biomass?
 - iii) What do you mean by sludge?
 - iv) What do you mean by sewage?
- b) What is solid phase extraction? Explain. [3]
-
- Q5)** a) Attempt any one of the following : [6]
- i) What are Fuel cells? Explain importance and applications of fuel cells for future scope.
 - ii) What do you mean by solar cells? Explain the role of solar cells in industry & household applications.
- b) Attempt any two of the following : [6]
- i) What is reverssible (Regenerative) Fuel cells?
 - ii) What are future energy sources for twenty first century?
 - iii) What do you mean geothermal energy?
-
- Q6)** Attempt any one of the following : [6]
- a) i) What is biomass? Explain importance of biomass for biodiesel and biofuel production.
 - ii) Explain how detergents, pesticides and anthropological activities responsible for water pollution?
- b) Attempt any two of the following : [6]
- i) Write short note on trickling filters.
 - ii) Explain importance of Water Quality Index (WQI).
 - iii) Write short note on Photovoltaic cells.



Total No. of Questions : 8]

SEAT No. :

PD3113

[Total No. of Pages : 4

[6476]-57

M.Sc. - II

ORGANIC CHEMISTRY

**CCTP - 10 - CHO - 450 : Chemistry of Natural Products
(2019 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

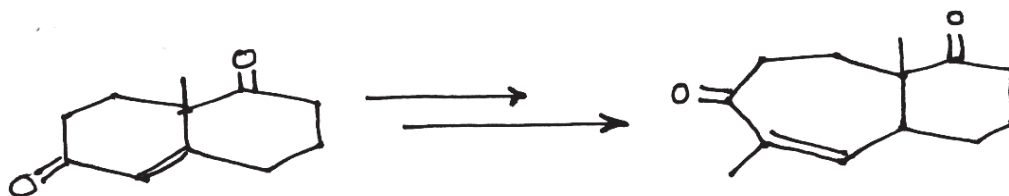
- 1) *Q.1 & Q.5 are compulsory and carry 11 marks each.*
- 2) *Attempt any two questions from Q.2 to Q.4 and two questions from Q.6 to Q.8.*
- 3) *Answer to the two sections should be written in separate answer books.*
- 4) *Figures to the right indicate full marks.*

SECTION - I

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

- i) Write two protecting groups reagents for hydroxyl group with suitable example.
- ii) Write a short note on Stark-Zhao reaction.
- iii) Write a role of reagents in the synthesis :
 - 1) Li/NH_3
 - 2) NMP
- iv) Write the structure of Hirsutellone B with correct stereochemistry.
- v) Write any one Retrosynthesis of Longifolene.

b) Write the correct sequence of reagents for the following conversion : **[3]**

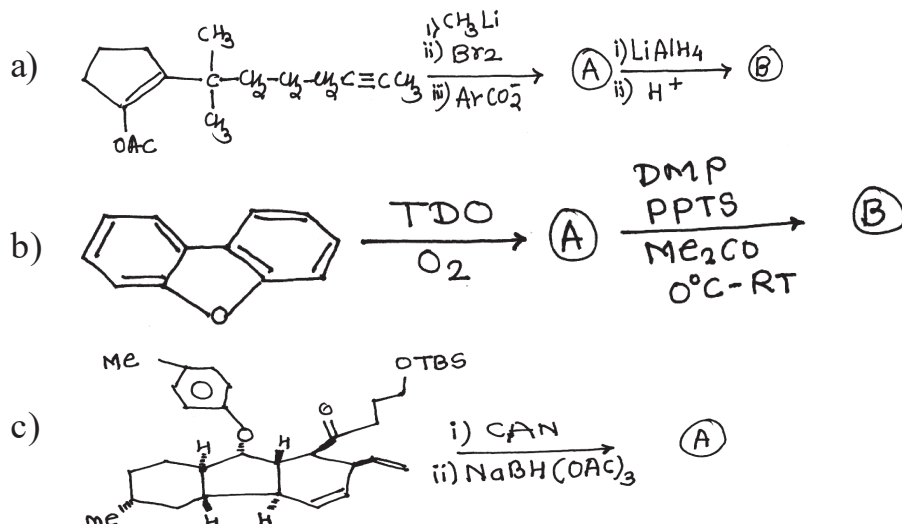


- i) OSO_4
- ii) TsCl
- iii) $\text{Ph}_3\text{P} = \text{CHCH}_3$
- iv) $\text{HOCH}_2\text{CH}_2\text{OH}$
- v) $\text{H}^+, \text{H}_2\text{O}$
- vi) $\ominus\text{OH}$

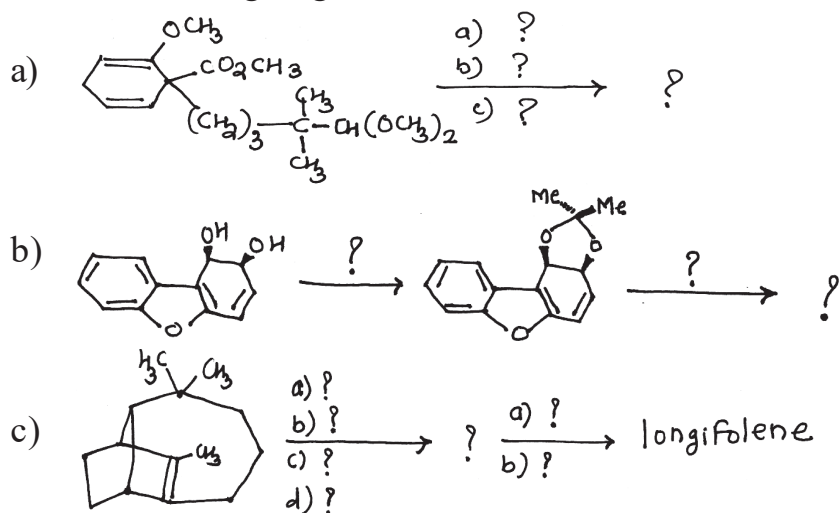
P.T.O.

Q2) Predict the products with mechanism :

[12]

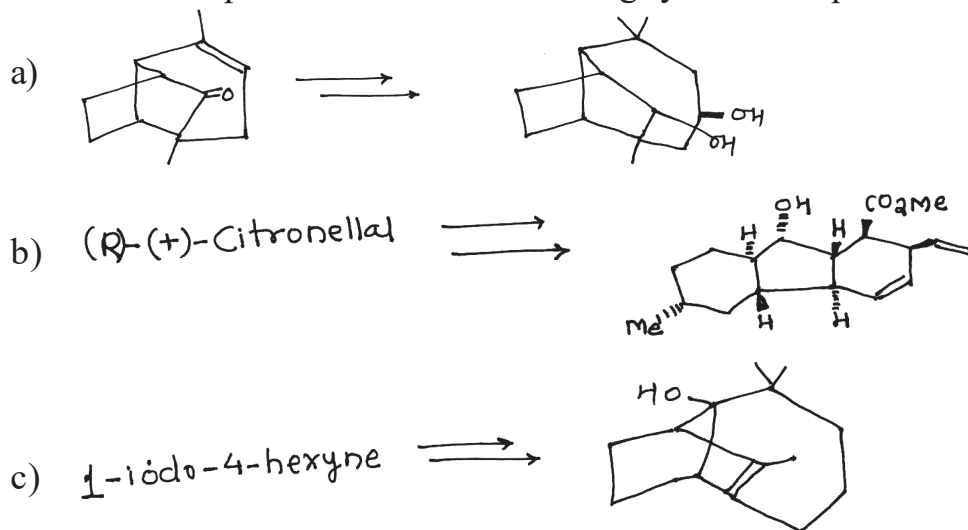


Q3) Write the missing reagents and intermediates for the following conversions : [12]



Q4) Outline the steps involved in the following synthesis sequence :

[12]



SECTION - II

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

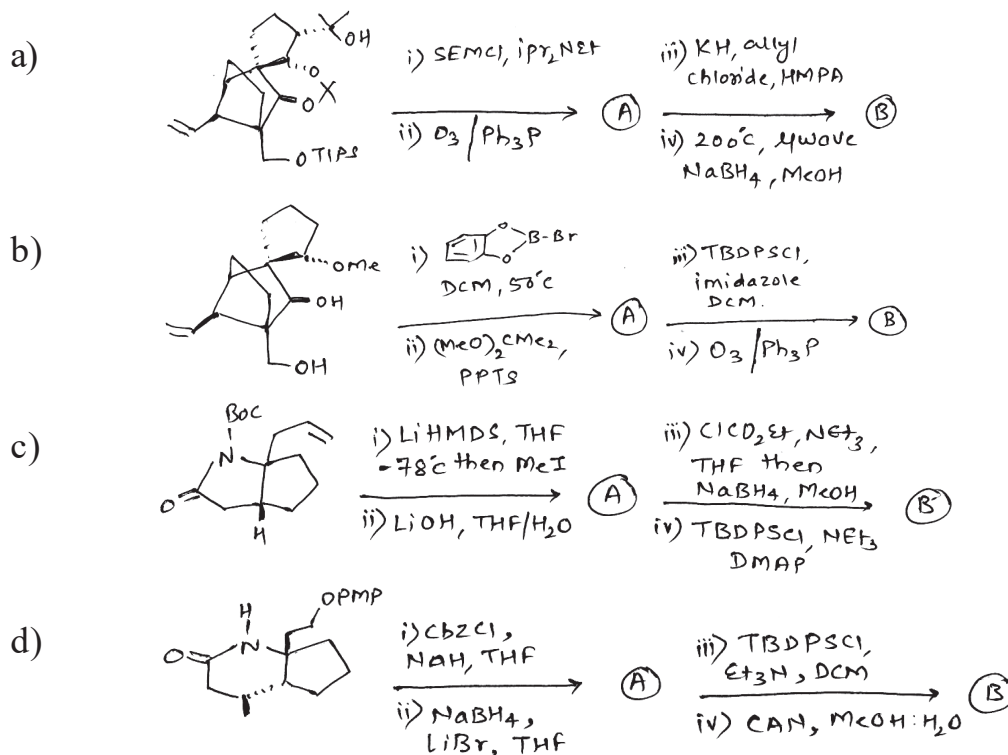
- i) Draw the structure and show key $^1\text{H-NMR}$ coupling constants and NOEs exhibited by both originally assigned and natural vannusal B.
- ii) Write role of following reagents.
 - 1) TsNHNH_2 , MeOH , 50°C
 - 2) NaBH_4 , THF
- iii) Explain Shapiro reaction with reference to vannusal B synthesis.
- iv) Draw correct structure of Pinnaic acid and write the key structural features.
- v) What is tandem hydrogenation-cyclization reaction observed in Pinnaic acid synthesis.

b) Write the correct full form, structure and use of the following reagents. [3]

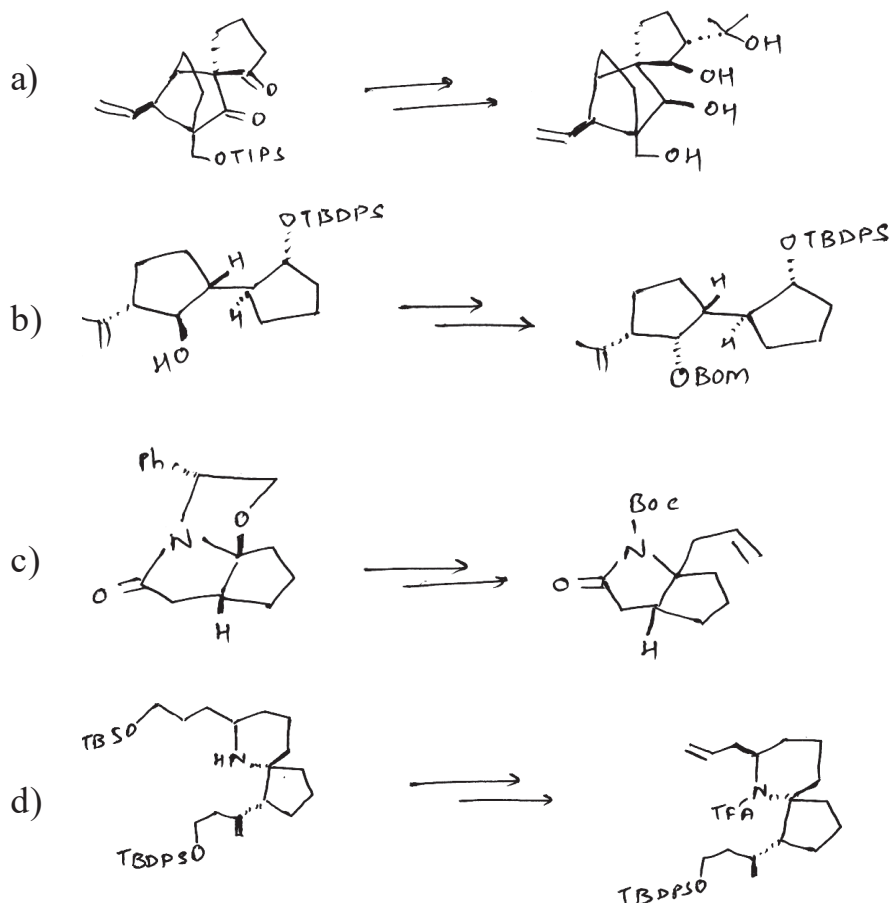
- i) IBX
- ii) CSA

Q6) Predict the products (any 3) :

[12]



Q7) Write correct reagents and steps involved in the following conversions :[12]



Q8) Answer the following :

[12]

- Explain Grieco elimination with reference to Pinnaic acid asymmetric synthesis.
- Draw correct structures of all eight diastereomers of Vannusal B.
- Write detailed note on Mitsunobu reaction with reference to Vannusal's synthesis.



Total No. of Questions : 8]

SEAT No. :

PD3114

[Total No. of Pages : 4

[6476]-58

M.Sc. - II

ORGANIC CHEMISTRY

CCTP-11-CHO-451 : Organometallic Reagents in Organic Synthesis
(2019 Pattern) (Semester-IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer to the two sections should be written in separate books.
- 2) Question No. 1 and 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 indicate full marks.

SECTION-I

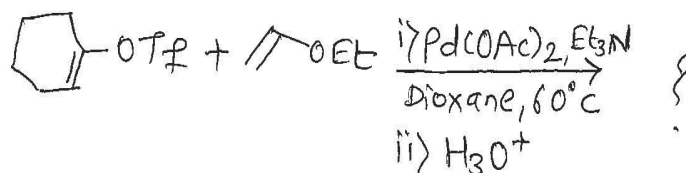
Q1) a) Explain the following (any 4) [8]

- i) R_uO_4 is used for the oxidation of primary alcohol.
- ii) Application of $TiCl_4$ in organic synthesis.
- iii) Role of cuprous Iodide in coupling reactions.
- iv) Fluoride activators are used in Hiyama coupling reaction.
- v) Use of Iridium complexes in organic synthesis.

b) Discuss Kumada coupling reaction along with catalytic cycle. [3]

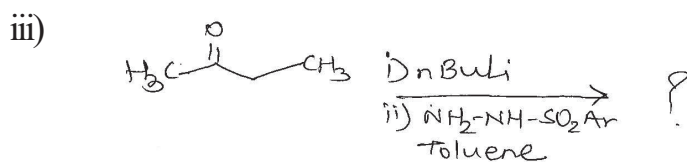
Q2) a) Predict the product for following reactions. [6]

i)



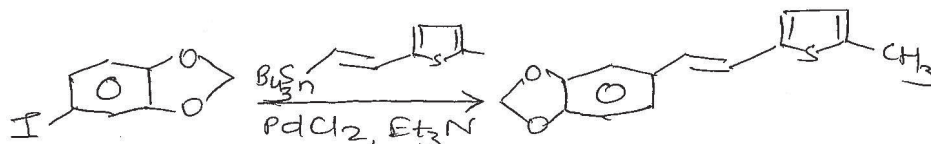
ii) $Br-CH_2-CH=CH-(CH_2)_6-CH=CH-CH_2-Br \xrightarrow{Ni(0)_4} ?$

P.T.O.

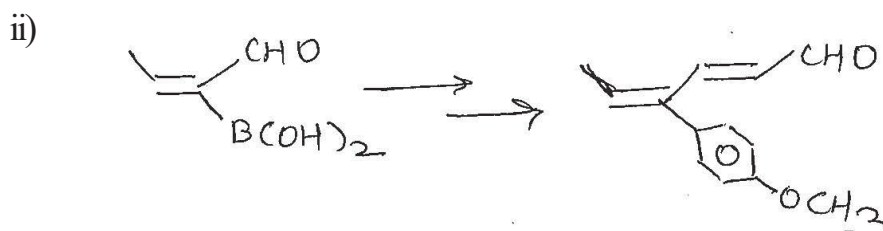
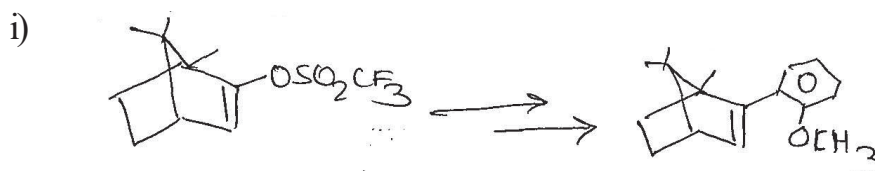


b) Answer the following. [6]

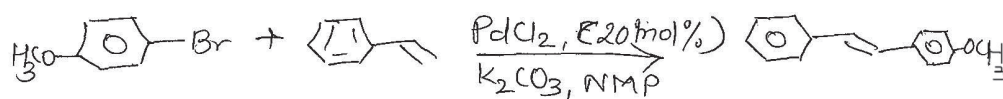
- Explain Wittig and Wittig-Horner reactions with suitable examples.
- Suggest the mechanism for the following transformation.



Q3) a) Suggest the suitable reagents and its mechanism for the following conversions. [8]



b) Calculate the amount of catalyst PdCl_2 required for the following reaction. [4]

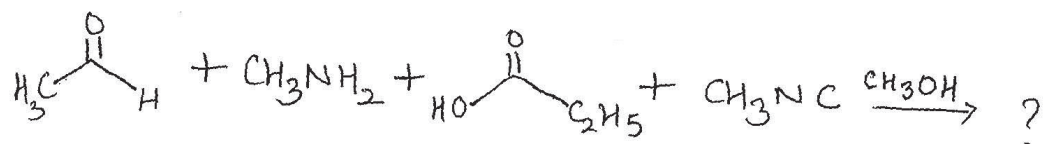


Given M.W. of $\text{PdCl}_2 = 177.33$ g/mole.

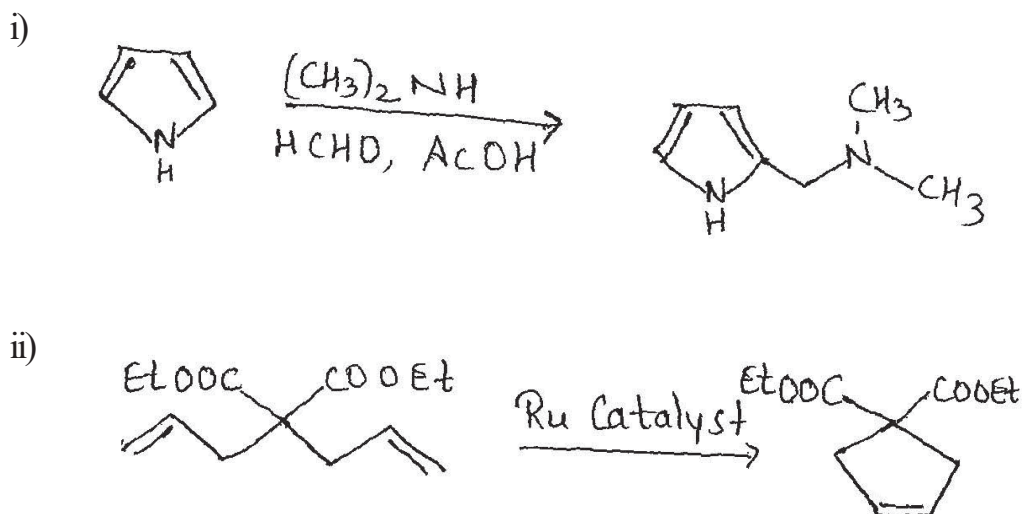
- Q4) a)** Write a note on. [6]
- Buchwald-Hartwig coupling reaction.
 - Peterson olefination.
- b)** Answer the following. [6]
- Discuss Wacker's process in detail.
 - Explain Ruthenium assisted transfer Hydrogenation reaction.

SECTION-II

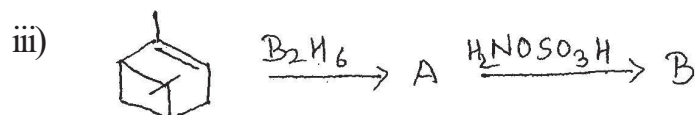
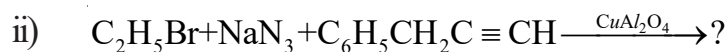
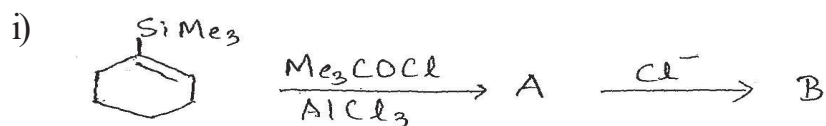
- Q5) a)** Answer any four of the following. [8]
- How Vinyl silanes can be prepared from ketones?
 - Compare thermal and Ruthenium catalyzed Huisgen 1,3 dipolar cycloaddition of alkynes to azides.
 - How n-butyl alcohol can be prepared using hydroboration approach?
 - What is ROMP? How it is different from ROM?
 - What are multicomponent reactions? Discuss the applications of dihydropyrimidones.
- b)** Predict the product and suggest the mechanism for the following reaction. [3]



- Q6) a)** Suggest the mechanism for the following reactions. [6]



b) Predict the product/s of the following reactions. [6]

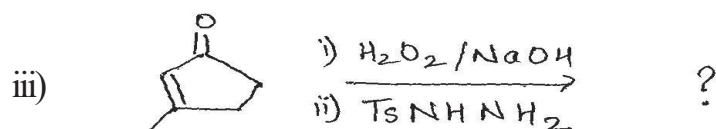
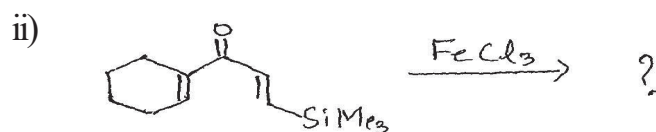
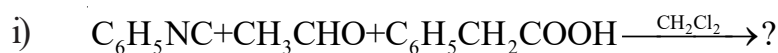


Q7) a) Write short notes on. [6]

i) Baylis Hilman reaction.

ii) Mannich reaction

b) Predict the product for the following reactions. [6]



Q8) a) Carry out the following conversion employing Boron/Silicon reagents. [6]



b) Write short notes on. [6]

i) Shrock catalyst

ii) Use of 9-BBN in organic synthesis.

iii) Use of silicon in the protection of alcohol.



Total No. of Questions : 8]

SEAT No. :

PD3115

[Total No. of Pages : 4

[6476]-59

M.Sc. - II

ORGANIC CHEMISTRY

**CBOP-4 : CHO-452(A) : Concepts and Application of Medicinal Chemistry
(2019 Pattern) (CBCS) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q.1 and Q.5 are compulsory carry 11 marks.*
- 2) *Attempt any two questions from Q.2 to Q.4 and Q.6 to Q.8.*
- 3) *Answer to the two sections should be written in seperate answer book.*
- 4) *Figures to the right indicate full marks.*

SECTION - I

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

- i) Write biological significance of TPP.
- ii) Draw structure of oxamniquine and give it's uses.
- iii) Write advantages of solution phase peptide synthesis.
- iv) What is blood-brain barrier.

b) Write note on sources of drugs. **[3]**

Q2) Answer the following. (Any three) **[12]**

- a) What are proteins? Explain their biological role.
- b) Write note on modern techniques of disease diagnosis.
- c) Explain drug-receptor interactions in brief.
- d) Write note on modern drug development process.

Q3) Answer the following. (Any three) **[12]**

- a) What are peptides? Explain their uses.
- b) Explain principles of drug design.
- c) Write note on proton pump inhibitors.
- d) Explain drug biotransformation process.

Q4) Answer the following. (Any three) **[12]**

- a) Explain ADME of drug.
- b) Explain biological significance of folic acid.
- c) Write note on peptide synthesis.
- d) Explain pharmacodynamics of drug.

P.T.O.

SECTION - II

Q5) a) Answer the following : [8]

- i) Explain the term 'Partition Coefficient'.
- ii) What is bioisoster?
- iii) What is the meaning of 'Selective toxicity' in drug design.
- iv) Draw the stereostructure of Statin - I.

b) Attempt the following : [3]

Discuss importance of each term involved in the Hansch equation.

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

- a) What are azoles? Discuss their mode of action.
- b) What are antibiotics? Write characteristics of Ideal antibiotics.
- c) Define and explain the term 'Prodrug' with an example.
- d) Discuss : β -lactam antibiotics as cell wall inhibitors.
- e) Draw the structure of chloramphenicol. Explain its mode of action.

Q7) Attempt any four of the following : [12]

- a) Write note on : Antifungal agents.
- b) Discuss various problems associated with penicillin-G
- c) What are sulphonamides? Discuss their SAR.
- d) Explain the term pharmacophore with an example.
- e) Discuss SAR and applications of tetracyclins.

Q8) Answer of the following : [12]

- a) Write note on : Quinolones and fluoro quinolones.
- b) Discuss metabolic stability of drug with an example.
- c) How electronic factors affects ionization of the drug?
- d) What are antiviral agents? Discuss acyclovir as an antiviral agent.



Total No. of Questions : 8]

PD3115

[6476]-59

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 Q.2 to Q.4 and two questions from Q.6 to Q.8.*
- 3) *Answer to the two sections should be written in separate answer books.*
- 4) *Figures to the right indicate full marks.*

SECTION - I

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

- i) Explain Hole-transport materials.
 - ii) Discuss methods used for synthesis of COFs.
- b) Draw the topology diagrams representing a general basis for COF design by using following symmetry in their building block monomers. **[3]**
- i) C_2 linear + C_2 square planer.
 - ii) C_4 + C_2 linear symmetry.

Q2) Answer the following : **[12]**

- a) Explain single layered COFs.
- b) Explain the applications of LiF/Al electrode used in OLED.
- c) Describe the role of two layers in an OLED system.

Q3) Answer the following : **[12]**

- a) Explain the ultraviolet photoelectron spectroscopy method for determination of the nature of the metal-organic interface.
- b) Write the synthesis of SCOF-1 with $CuSO_4 \cdot 5H_2O$.
- c) Write the comparison of the advantages and disadvantages of the synthesis strategies of COFs.

Q4) Answer the following : **[12]**

- a) Explain role of transition metal complexes used in OLEDs.
- b) Write a note on Fluorescent dopants.
- c) Explain the electrochemical energy storage and electrical devices application of COFs.

SECTION - II

Q5) a) Answer the following : [8]

- i) Define supramolecular chemistry. Explain its advantages.
- ii) Explain light operated molecular Tweezers.

b) Describe pH-dependent switchable catalysts. [3]

Q6) Answer the following : [12]

- a) Write a note on artificial molecular motors with example.
- b) Explain 'Electric Field' induced switching'.
- c) Write a note on supramolecular chemistry of Boron containing organic molecule.

Q7) Answer the following : [12]

- a) Discuss the role of single molecule junction in the development of single molecule switches.
- b) Discuss the synthesis and redox properties of pentalene-derived DBB analogous.
- c) Explain the use of calixarene and draw its structure.

Q8) Answer the following : [12]

- a) Explain self-assembled hybrid organic inorganic materials in self assembly and supramolecular chemistry.
- b) Explain the control of rotation in ferrocene complex through protonation.
- c) Draw the structure of Rotaxane. Explain any two applications.



Total No. of Questions : 8]

SEAT No. :

PD3116

[6476]-60

[Total No. of Pages : 3

M.Sc.-II (Analytical Chemistry)
CCTP - 10 - CHA - 490 : ADVANCED ANALYTICAL
SPECTROSCOPIC TECHNIQUES
(2019 Pattern) (Semester - IV) (Credit - 4)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.1 & Q.5 are compulsory.*
- 2) Solve any two questions from Q.2 to Q.4 and solve any two questions from Q.6 to Q.8.*
- 3) Answers of two sections must be written on separate answer books.*
- 4) Figures to the right indicate full marks.*
- 5) Use of logtables & calculator is allowed.*

SECTION - I

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

- i) Explain the principle of atomic fluorescence spectroscopy.
 - ii) What is spectral interference in AAS?
 - iii) Explain the separation of ions by quadrupole mass analyser.
 - iv) Draw labelled diagram of Inductively coupled plasma torch.
 - v) What is purpose of isotope dilution analysis in ICP-MS?
- b) The amount of zinc in the sample was analysed by AAS. A 10.0 gram of sample after treatment was diluted to 100 ml. The Sample solution shows absorbance 0.36 The 5.0 ml sample plus 5.0 ml 5 PPM Zinc standard shows absorbance 0.58. Calculate the amount of Zinc in the sample. **[3]**

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

- i) Give construction, advantages and dis-advantages of premix burner.
 - ii) Write a note on a total Sulphur analyser.
- b) Draw the block diagram of AFS. Explain the function of each component involved in it. **[6]**

P.T.O.

Q3) a) Attempt the following : [6]

- i) Explain the isobaric & molecular interferences in ICP-AFS?
- ii) Explain LASER enhanced ionization spectroscopy.

b) Attempt the following : [6]

- i) Explain cold vapour technique for mercury determination by AAS.
- ii) Potassium in water sample was analyzed by FES. A 25 PPM standard solution of potassium showed flame intensity of 85 units. A 10.0 ml water sample diluted to 50 ml showed flame intensity 37 units. Calculate the level of potassium in water.

Q4) a) Attempt the following : [6]

- i) Enlist the different sample preparation techniques for solid samples. Explain any one of them.
- ii) Explain standard addition method for quantitative analysis in AAS.

b) Draw the schematic diagram of ICP-AES. Explain different components of it in detail. [6]

SECTION - II

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

- i) What is phosphorescence?
- ii) Give the principle of photoelectron spectroscopy.
- iii) Define the term quantum yield.
- iv) Draw the hyperfine splitted ESR spectrum of cyclopentadienyl radical.
- v) Give any four applications of ESR.

b) 1.2 PPM 5.0 ml Cd(II) solution was extracted three times with 5.0 ml CCl_4 containing 8-hydroxy quinoline & combined extract was diluted to 50 ml. Similar treatment is given to sample containing Cd(II). The fluorescence intensity for standard is 40 while sample is 18. Calculate Mg of Cd(II) in the 500 ml sample solution. [3]

Q6) a) Attempt the following : [6]

- i) Which of the following nuclei are ESR active? Why?
 ^{14}N , ^{12}C , ^1H
- ii) Explain with suitable example, the ESR spectrum of free radicals containing nuclei with spin $I > \frac{1}{2}$.

b) With schematic diagram explain instrumentation of Auger electron spectroscopy. [6]

Q7) a) Attempt the following : [6]

- i) What is hyperfine splitting in ESR? Draw and explain ESR spectrum of glycolic acid radical.
- ii) An XPS electron was found to have a kinetic energy of 1052.6 eV, when ejected with an aluminium $K\alpha$ source ($\lambda = 0.8393 \text{ nm}$) and measured in a spectrometer with a work function of 27.8 eV. The electron is believed to be an Na(1s) electron in NaNO_3 . What was the binding energy of an electron?

Given $h = 6.626 \times 10^{-34} \text{ JS}$

$C = 3.0 \times 10^8 \text{ M/S}$

b) With a schematic diagram discuss the instrumentation of spectro fluorimetry. Discuss the function of each component involved in it. [6]

Q8) a) Attempt the following : [6]

- i) Give the construction & working of X-ray gun in electron spectrometry.
- ii) Explain the excitation & emission spectra with suitable example.

b) Attempt the following : [6]

- i) With the help of Pascal triangle explain how to calculate ratio of line intensity for nuclear spin $= \frac{1}{2}$.
- ii) If a resonance was observed for an unpaired electron at a magnetic flux density 0.3157 T & frequency 9.5 GHz. Calculate g-factor for electron.



Total No. of Questions : 8]

SEAT No. :

PD3117

[Total No. of Pages : 3

[6476]-61

M.Sc. - II

ANALYTICAL CHEMISTRY

CCTP - 11 - CHA - 491 : Chemical Methods of Pharmaceutical Analysis
(2019 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answers to the two sections must be written in separate answer books.
- 2) Use of logtable and calculator is allowed.
- 3) Question 1 and Q.5 are compulsory.
- 4) Attempt any two questions from Q.No. 2 to Q.No. 4.
- 5) Attempt any two questions from Q.No. 6 Q.No. 8.
- 6) Figures to the right indicate full marks.

SECTION - I

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

- i) What is uniformity of weight?
- ii) What are otic solution?
- iii) Define shelf life of pharmaceutical preparation.
- iv) What are Biological assay?
- v) What is powder fineness? Enlist the types of Powder.

b) A 2 gm drug sample of saponification value 265 mg. KOH was saponified using 0.55N alcoholic KOH solution. The blank titration reading was 25ml of 0.55N HCl solution. Find the quantity of alcoholic KOH consumed by the drug per gm. **[3]**

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

- i) Explain the determination of acetyl value of a substance.
 - ii) Explain in detail the lag phase and the logphase.
- b) What is agar diffusion assay? Discuss the theory and practice of tube assay for growth - inhibiting substances. **[6]**

P.T.O.

- Q3) a)** Answer the following. [6]
- i) Write a note on standard and reference materials used for microbiological assay.
 - ii) What are capsules? Discuss the classification of capsules in detail.
- b) How particle size is determined by Microscopy? Write the advantages and disadvantages of this technique. [6]

- Q4) a)** Attempt the following. [6]
- i) Discuss the principle, reaction and procedure for the limit test of chloride.
 - ii) 2.5gm of an oil sample required 2.55ml of N/100 KOH to neutralise the fatty acids in oil. Find the acid value of the sample.
- b) Attempt the following. [6]
- i) Explain the factors affecting on the final cell count in microbiological assay.
 - ii) Discuss the friability test for uncoated tablets.

SECTION - II

- Q5) a)** Attempt any four [8]
- i) What are related substances?
 - ii) When the marketing authorization may be withdrawn before expiration?
 - iii) What are redox titrations?
 - iv) Write the functions of excipients.
 - v) Write the structures of
 - 1) Fluoxetine
 - 2) Mupirocin
- b) 1.1023 gm of pharmaceutical ingredient is transferred to weighing glass of weight 18.2361gm. After drying to a constant weight, the total mass was 19.3361gm. Calculate the loss on drying of pharmaceutical ingredient. [3]

- Q6) a)** What are foreign anions? Describe the test for foreign chlorides and sulphates in furosemide according to phar. Eur.. [6]
- b)**
- i) Discuss the assay of diphenhydramine by titration method. [3]
 - ii) The results obtained for tablets specified to contain 10mg phenindione are as - 10.1mg, 10.1mg, 10.3mg, 10.4 mg, 10.4 mg, 10.4 mg, 10.8 mg, 11.1 mg, 11.2 mg, 11.4 mg. State whether the tested tablets comply with requirements. [3]
- Q7) a)** Explain the assay of hydrocortisone by UV-spectrophotometry according to phar. Eur.. A 0.0915 gm of the hydrocortisone sample was dissolved in 100ml ethanol, 2ml of this solution was further diluted to 100ml ethanol. The absorbance of this solution at 241.5nm was 0.798. Calculate the percentage of hydrocortisone present in the sample if the specific absorbance is 440 (1cm, 1%). [6]
- b)**
- i) Write a note on the identification of mupirocin by IR spectrophotometry. [3]
 - ii) A 0.303 gm of Fe tablet powder is weighed and dissolved in 1M sulphuric acid with gentle heating. 25ml of water was added and the solution is titrated with 0.1006 M ammonium cerium (iv) sulphate using ferroin solution as indicator. The burette reading was 17.62ml. [3]

Calculate the amount of Fe present in the Ferrous fumarate tablet. (Molar Mass = 169.9 gm/mol)

- Q8) a)** Explain the identification of Beclomethasone Dipropionate by LC according to phar. Eur.. A sample of drug containing Beclomethasone Dipropionate (MW = 408) shows a peak height of 26 mAUmin where as the peak height for the reference solution having concentration of 35.92 µg/ml is 37 mAUmin. Calculate the concentration of Beclomethasone Dipropionate present in the sample. [6]
- b)**
- i) Explain the structure of European Pharmacopeia. [3]
 - ii) A 0.2099 gm of ephedrine sample was dissolved in 5ml ethanol and added to 20ml of 0.1024 m HCl. This solution was titrated with 0.0998M NaOH and the burette reading was 7.75ml. Calculate the percentage of ephedrine present in the sample. (MW - 165.2). [3]



Total No. of Questions : 8]

SEAT No. :

[Total No. of Pages : 6

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M.Sc.-II

ANALYTICAL CHEMISTRY

**CBOP-4-CHA-492(A) : Laboratory Automation & Environmental
Analytical Chemistry
(2019 Pattern) (Semester -IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Q No. 1 and Q No. 5 are compulsory.*
- 2) *Attempt any two questions from Q2 to Q4 for section I and from Q6 to Q8 for section II.*
- 3) *Answer to the sections should be written on separate answer books.*
- 4) *Figures to the right indicates full marks.*
- 5) *Use of logtable and calculator is allowed.*

SECTION-I

Q1) a) Solve any Four. [8]

- i) Give any two uses of chemical sensor.
- ii) What is parallel integration?
- iii) Give the type of calorimetric and optical sensor.
- iv) Give any two benefits of LIMS.
- v) What is control loop? Give its types.

b) Discuss advantages and disadvantages of automation. [3]

Q2) a) Explain the following. [6]

- i) Give the brief account of Biotransduction.
 - ii) Describe miniaturized analytical system and discuss its component.
- b) Give classification of analyser and explain discrete sample analyser in detail. [6]**

P.T.O.

- Q3) a)** Explain the following. [6]
- What is voltametric chemical sensor.
 - Explain Glass micro-matching.
- b)** Discuss the following. [6]
- Describe Electrochemical sensors and give its application.
 - Explain Indicator mediate sensor.
- Q4) a)** Explain the following. [6]
- Give an account of Laminar H-filter for extraction of low molecular weight components during sampling.
 - Explain serial integration in detail.
- b)** Give the principal and basic instrumentation of flow injection analysis (FIA). [6]

SECTION-II

- Q5) a)** Solve any Four of the following [8]
- Give the principle of analysis of oxidants from polluted air sample.
 - What is chlorine demand?
 - Give the health hazards of NO_x in air.
 - How methylated arsenic is formed?
 - Give the name of any four organic pollutants in water.
- b)** Phosphate from water was analysed by colorimetric method. 2.50 ppm standard showed absorbance 0.623. 5ml sample treated as standard showed absorbance 0.732. Calculate mg of phosphate in water sample. [3]
- Q6) a)** Answer the following. [6]
- Explain methylene blue method for the estimation of sulfide in water sample.
 - Discuss determination of NO_3^- by cadmium reduction method.
- b)** Write notes on the following [6]
- Determination of anions by ion chromatography
 - Turbidity of polluted water and its determination

- Q7) a)** Explain the following. **[6]**
- i) Chemiluminescence method for the determination of nitrogen oxide in air.
 - ii) Determination of acidity of water by titrimetric method.
- b)** Solve the following **[6]**
- i) Discuss sources and toxic effects of heavy metals Cd(II), Hg(II) and Pb(II).
 - ii) Cd(II) in polluted water sample is analysed by ICP-AES method. 200PPb standard of Cd(II) in water showed intensity 26 units. 50 ml polluted water sample diluted 100 ml and analysed. It showed flame intensity 12 units. Calculate Cd(II) in 1000 ml water sample.
- Q8) a)** Answer the following **[6]**
- i) What is acid digestion method? Explain nitric acid digestion method of water for metal ion analysis.
 - ii) What are organic pollutants in water? Give their sources and health hazards.
- b)** Solve the following **[6]**
- i) Discuss XRF method for the analysis of particulate matter in air.
 - ii) Polluted water sample (50ml) was analysed for alkalinity by potentiometric method. The end point is observed at 6.2 ml with 0.02 M HCl. Calculate alkalinity in terms CaCO_3 mg per liter.



Total No. of Questions : 8]

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M.Sc.-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) *Q1 & Q5 is compulsory.*
- 2) *Attempt any two questions from Q2 to Q4 for section I and from Q6 to Q8 for section II.*
- 3) *Answer to the two sections must be written on separate answer book.*
- 4) *Use of log table and calculator is allowed.*
- 5) *Figures to the right indicate full marks.*

SECTION-I

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

- i) Give various forms of nitrogen
 - ii) What is meant by Basic slag.
 - iii) What is meant by exchangeable bases and base saturation?
 - iv) Give classification of nutrients
 - v) Define fulvic acid and humic acid
- b) 0.55 gm of nitrogen fertilizer was analysed by kjeldhal's method and ammonia produced was absorbed in 50ml N/10 H_2SO_4 . The excess of acid required 19 ml of N/10 NaOH solution for neutralisation. Find percentage of nitrogen in fertilizer. **[3]**

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

- i) Explain in detail sampling of soil.
 - ii) Give the method for estimation of water soluble phosphorous in fertilizer.
- b) Explain in detail method for analysis of aldicarb by GC method. **[6]**

- Q3) a)** Attempt the following. [6]
- i) Explain cation exchange capacity and give its method of determination.
 - ii) Give the colorimetric method for determination of organic carbon in soil.
- b) To complete the reaction 10ml of 0.01M ZnSO_4 solution required 9.7ml of EDTA. 0.250 gm of soil sample containing magnesium was dissolved in 100ml of acid. An aliquot of 10ml of same solution required 13 ml of EDTA. Calculate the percentage of magnesium in sample [Given: At. Wt. Mg = 24.30gm] [6]
- Q4) a)** Attempt the following. [6]
- i) Describe method for determination of citrate soluble phosphorous.
 - ii) Explain in detail drying techniques used for soil analysis.
- b) Give analytical method for determination of captafol by HPLC method. [6]

SECTION-II

- Q5) a)** Attempt any four of the following. [8]
- i) Distinguish between addition and condensation polymerisation.
 - ii) Give example of synthetic , natural polymer.
 - iii) Define anionic surfactant.
 - iv) Define iodine value
 - v) What is meant by monodisperse and polydisperse system?
- b) The intrinsic viscosity of myosine is $317 \text{ cm}^3/\text{gm}$. Calculate concentration of myosine in water which could have a relative viscosity 1.5? [3]
- Q6) a)** Attempt the following. [6]
- i) Give analytical procedure for determination of fatty acid and sulphonic acid.
 - ii) Explain mechanical properties of polymer with respect to tensile-stress strain curves.
- b) Explain in detail preliminary identification methods of polymer. [6]

- Q7) a)** Attempt the following. **[6]**
- i) Explain with neat diagram cryoscopic method.
 - ii) Explain how to determine mean molecular weight of alkane monosulphonate?
- b) A polymer with $M = 1,00,000$ Obey's Mark - Howink equation. $K = 1.2 \times 10^{-4}$ and $\alpha = 0.72$ then calculate the intrinsic viscosity. **[6]**
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- Q8) a)** Attempt the following. **[6]**
- i) Write a note on determination of molecular weight by viscosity technique.
 - ii) Explain para-toluidine precipitation method for anionics determination.
- b) Explain with schematic diagram extrusion moulding method. **[6]**

