NOTE: Attempt any FIVE questions. All questions carry equal marks.

Q1. What are opposed reactions? Develop a kinetic expression for 2nd order opposed by 2nd order reaction. Give examples.   20

Q2. a. How barometric formula could be used to calculate the effect of altitude on distribution. 10

b. What is Nerst heat theorem? Give its applications   10

Q3. a. Derive an expression for average velocity by using Maxwell's Law for velocity distribution. 10

b. Define Normalization of wave functions. Discuss the effect of normalized wave function. 10

Q4. From Schrodinger wave equation, how would you develop a relationship to derive Azimuthal quantum number? 15

b. What is the significance of principle quantum number? 05

Q5. a. Discuss the effect of temperature upon Partition function.   05

b. Derive an expression for rotational partition function.   15

Q6. a. Define degeneracy? Show that degeneracy exists for a particle moving in three dimensional box 10

b. What is a fuel cell. Describe the construction working and applications of Molten Carbonate fuel cells.   10

Q7. a. What are rigid rotors? Calculate the energy levels of the rigid rotors and bond length of simple molecules.   12

b. Write down the postulates of quantum mechanics 08

Q8. a. What is a fuel cell. Describe the construction working and applications of Molten Carbonate fuel cells 10

b. Give an account of the experimental methods that are used to study the kinetics of fast reactions.   10

Q9. Write note on any two of the following: (10+10)

(i)   Adiabatic Demagnetization

(ii)   Clausius Inequality

(iii) Concentration Cells

**NOTE: Attempt any FOUR questions. All questions carry equal marks.**

Q. No.1 a) Explain CFT. What are the factors which affect crystal field splitting? **13**

b) What is meant by Lanthanide Contraction? Explain its occurrence and consequences. **12**

Q. No.2 a) Explain geometries the molecules of AB_3E_2 and AB_4E type on the bases of VSEPR theory giving Two examples for each. **15**

b) How Transition Metal complexes are prepared by different methods. Give suitable examples. **10**

Q. No.3 a) Discuss the chemistry of $Fe(CO)_5$. **10**

b) Explain the structure of following molecules on the basis of VBT? **15**

i) $[Mo(CN)_8]^{-4}$ ii) I_3^- iii) $XeOF_4$ iv) $[PF_6]^-$ v) NOCl

Q. No.4 a) Explain the chemistry of $Fe(CO)_2(NO)_2$. **10**

b) Describe Optical isomerism in metal complexes. **15**

Q. No.5 a) Explain the Bent bond by giving suitable examples. **10**

b) The low oxidation state of transition metals is stabilized by π-acceptor ligands. Justify this statement with reference to bonding in metal carbonyls. **15**

Q. No.6 a) Discuss the applications of lanthanides in daily life. **15**

b) Describe the Metallic bonding on the basis of Electron Sea Theory. **10**

Q. No.7 Write note on any **TWO** of the followings: **2x12.5 =25**

i) Jahn-Teller Distortion

ii) N(E) Curves

iii) Semi-Conductors

**NOTE: Attempt any FIVE questions. All questions carry equal marks.**

Q. NO. 1.

A) Predict the major products of following reaction via free radical mechanism. Draw complete mechanism for all steps.   **[5 x 3 = 15]**

I) + (NBr) $\xrightarrow{\text{Peroxide}}$?

II) + EtOOC⌣COOEt $\xrightarrow{\text{Peroxide}}$?

III) 2 $\xrightarrow{\text{Cu}}$?
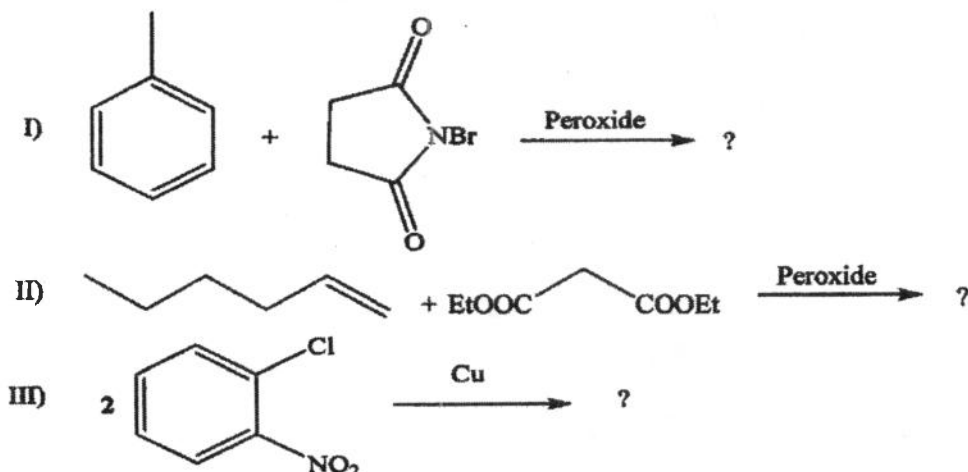
B) Describe Electron spin resonance methods for detection of free radicals.   **[5]**

Q. NO. 2.

A) Arrange the following compounds in the increasing order of their acidity. Give reasons for your order.   **[7]**
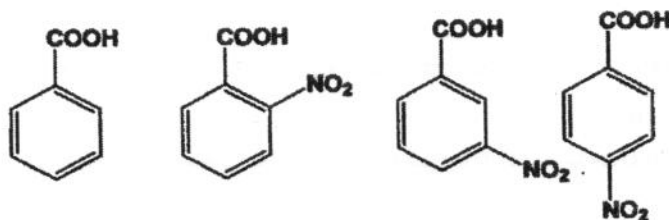

B) Which is more acidic, formic acid or benzoic acid? Give reason.   **[3]**

C) Compare the basicity of compounds of following groups. Justify your answer. **[2.5 x 4 =10]**

I.   Ammonia and Aniline
II. 2-Methylaniline and 4-Methylaniline
III. C_2H_5ONa and C_2H_5SNa
IV. Aniline and Pyrrole

Q. NO. 3.

How would you bring about the following conversions? Write complete mechanisms for all steps involved.   **[4 X 5 = 20]**

I) $H_3C \!-\!\!\equiv\!\!- CH_3 \longrightarrow$

II) $\longrightarrow$

III) $\longrightarrow$

IV) $\longrightarrow$

V) $\longrightarrow$
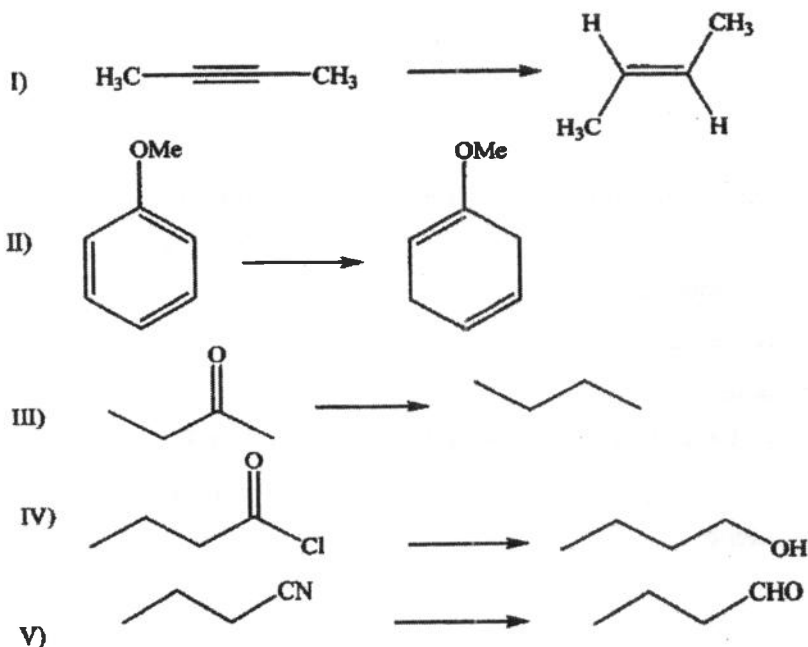
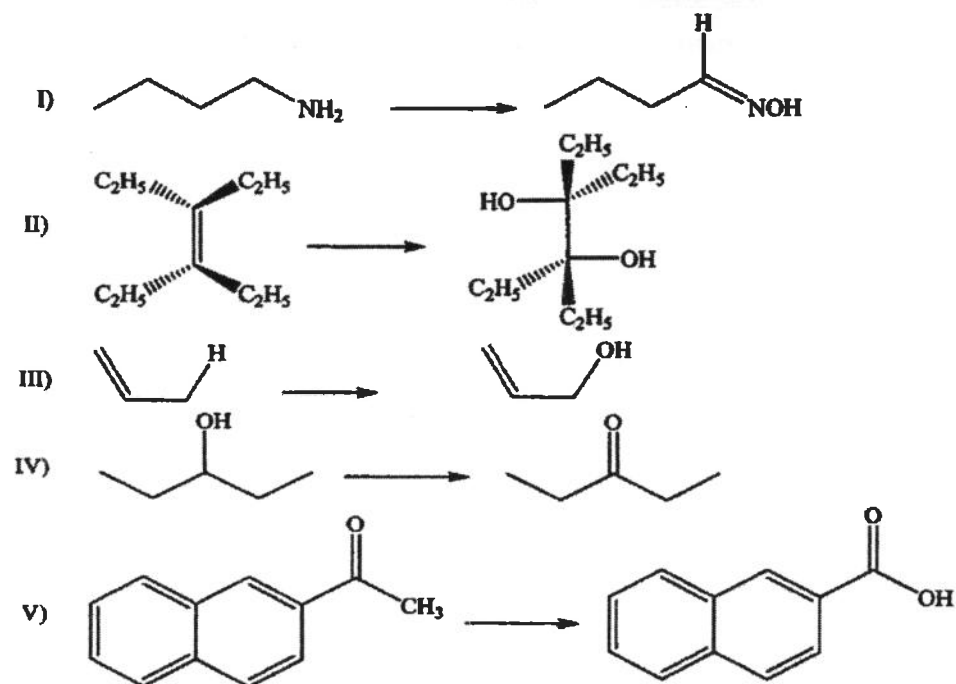## Q. NO. 4.

How would you bring about the following conversions? Write complete mechanisms for all steps involved. [4 X 5 = 20]

Q. NO. 5.

Write a note on the following reactions (reaction, mechanisms and synthetic applications). [10 x 2 = 20]

I) Knoevenagel condensation

II) Perkin reaction

Q. NO. 6.

A) Draw the Fisher projections for all the stereoisomers of 3-bromo-2-butanol and label each chiral carbon atom as *R* or *S*. [4]

B) Describe the different methods used for the resolution of racemic mixture. Give examples for each method. [4]

C) Differentiate the following terms with examples. [2 x 4 = 8]

    I) Enantiomers and Diastereomers

    II) Configurational isomerism and conformational isomerism

    III) Relative configuration and Absolute configuration

    IV) Diaseterotopic and enantiotopic hydrogen

D) Draw the perspective formulas of the enantiomers of following compounds and label each enantiomer as R or S. [2 x 2 = 4]

    I) 2-Methyl-1-butanol

    II) 1-Chloro-2-methylbutane

Q. NO. 7.

A) Draw all possible conformations of each of the following molecules and explain which is more stable. [3 x 3 = 9]

    I) *trans*-1-Ethyl-3-phenylcyclohexane

    II) 1, 3, 5-Tribromocyclohexane (all *cis*)

    III) *cis*-4-*tert*-Butylcyclohexanol

B) Draw both the geometrical isomers for the following compounds and assign Z or E designation to each of them. [2 x 3 = 6]

    I) 2-Chloro-3-methyl-2-pentene

    II) 2-Bromo-2-butene

    III) 3-methyl-3-octene
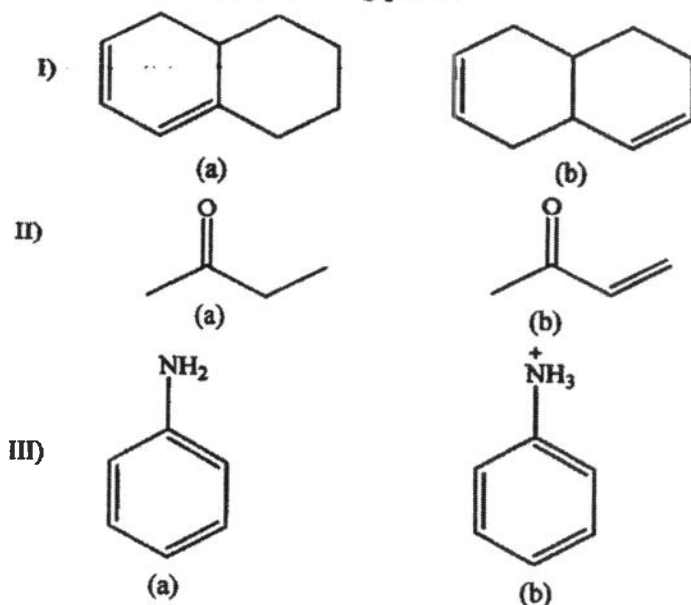
C) Classify the following compounds as optically active or optically inactive. Justify your answer. [1 x 5 = 5]

(I) (II) (III) (IV) (V)
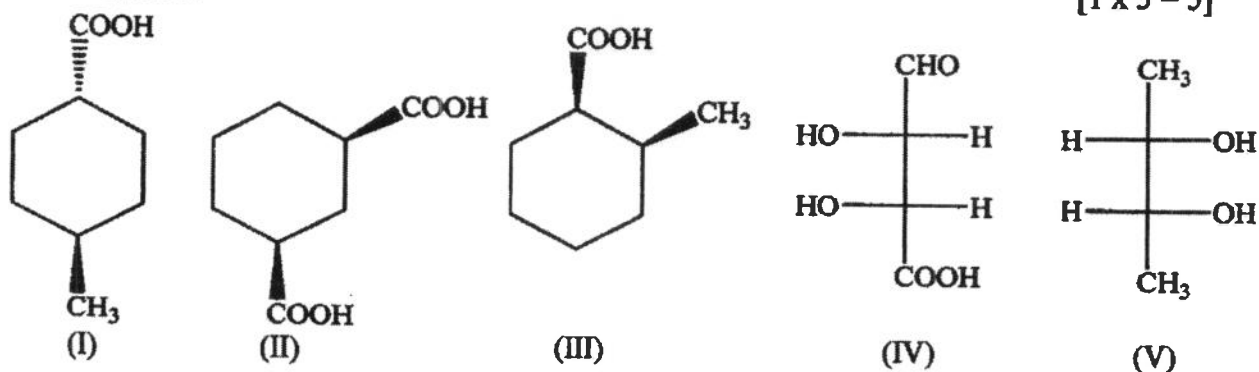
Q. NO. 8.

A) How could you use UV / visible spectroscopy to distinguish between the compounds in each of the following pairs? [4 x 3 = 12]

I) (a) (b)

II) (a) (b)

III) (a) (b)

B) Briefly answer the following questions [2 x 4 = 8]

I) How can we use UV / VIS spectroscopy for the determination of ionization constant of an acid or a base?

II) What is difference between transmittance and absorbance?

III) What is fine structure in the UV spectrum of benzene?

IV) Why saturated hydrocarbons show no absorption in the UV / VIS region (200-800 nm)?

Q. NO. 9.

A) Briefly answer the following questions [2 x 5 = 10]

I) What is necessary condition for absorption of IR radiation by a molecule?

II) Compare the stretching frequency of O —D and O —H bonds.

III) What are near infrared region and far infrared region?

IV) Determine the total number of possible vibrational modes for carbon dioxide.

V) What is difference between fundamental vibrations and overtones?

B) How will you distinguish between the following pairs of compounds with the help of IR spectroscopy? [2.5 x 4 = 10]

I) Propanone and Propanoic acid

II) Methyl alcohol and dimethyl ether

III) Methylamine and dimethylamine

IV) 2-Methyl Cyclohexanol and 2-methyl Phenol

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q.1:

a) Write down a description on isolation of the cellular components. **(12)**

b) Define Buffer solution. Explain the importance of buffers in biological system. **(13)**

Q.2:

a) Differentiate between an Acid and a Base. Classify weak acids and weak bases. **(10)**

b) Write a note on optical isomerism and mutarotation in glucose. **(15)**

Q.3:

a) Explain in detail the structure and functions of common disaccharides and polysaccharides. **(15)**

b) Write down the sensory properties of the monosaccharaides. **(10)**

Q.4:

a) Write a note on pH and buffer systems. **(10)**

b) Draw structure of DNA and explain its functions. **(10)**

c) Differentiate between various types of RNA. **(05)**

Q.5:

a) What is the difference between fibrous proteins and globular proteins? Explain with examples. **(15)**

b) Write a detailed note on the chemical properties of the triglycerides. **(10)**

Q.6:

a) Describe the structure of the plasma membrane as a mosaic of its components. **(12)**

b) What is a peptide? Explain its structure and biological importance with examples. **(13)**

Q.7: Write short notes on any two of the followings. **(25)**

a) D and L configurations of monosaccharaides

b) Structure and functions of a cell

c) Energy values of food

d) Kinetics of single substrate reactions

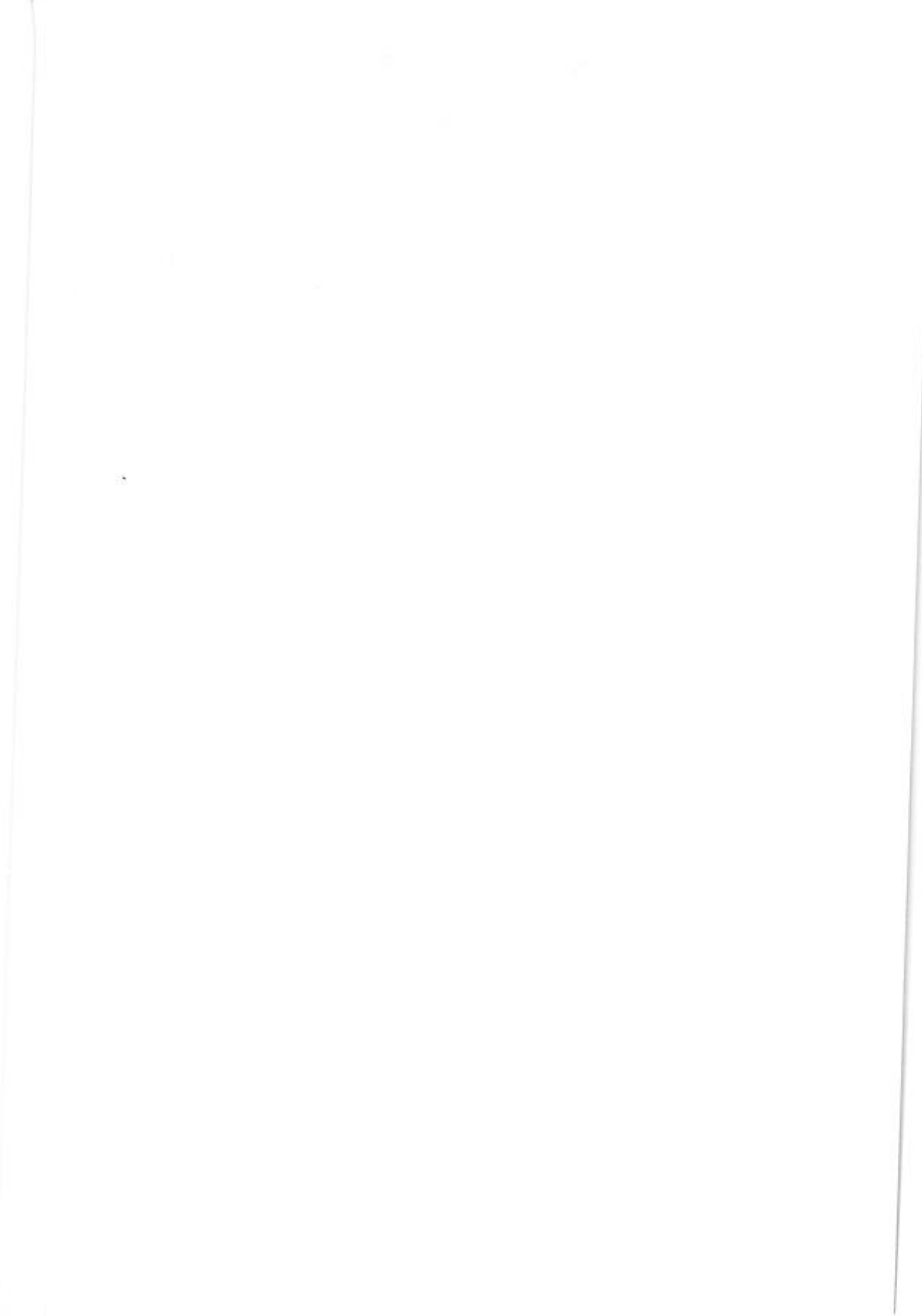**NOTE: Attempt any FOUR questions. All questions carry equal marks.**

Q1. a) What is meant by the analytical method? Explain its steps in the correct order. 10, 10, 5.
   b) What is meant by student t-test? Give its various forms. Also give its significance.
   c) Explain the "Indeterminate errors".

Q2. a) Discuss the terms Distribution coefficient and Distribution ration with the help examples.
   10, 7, 8

   b) How does pH affect the efficiency of extraction?
   c) Discuss the working principle of solid phase extraction

Q3
   a. Explain thin layer chromatography. Explain the factors affecting R_f value.   10, 8, 7
   b. Write a note on at least 2 stationary phases used in column chromatography.
   c. How are theoretical plates important in describing the efficiency of the column?

Q4
   a. Compare the furnace type atomic absorption spectroscopy with Flame type atomic absorption
   spectroscopy.   9, 8, 8
   b. Explain the principle of Hydride generation AAS with the help of a diagram. What are its specific
   advantages?
   c. Give the possible reactions when a sample is subjected to flame for analysis in flame emission
   spectroscopy.

Q5   a) Discuss the interaction of UV /Vis radiation with organic molecules.   12
      b) Discuss the applications of Beer Lambert Law in UV/Vis Spectroscopy   07
      c) Discuss Bathochromic shift with the help of examples.   06

Q6
   a. What is the basic principle of ion exchange chromatography? Write a note on cation and anion
   exchangers.   10, 9, 6
   b. How amino acids can be separated using ion exchange chromatography?
   c. What is the basic principle of gel chromatography?

Q7
   a. Draw the optical layout of flame photometer. Briefly discuss its components.   8, 10,7
   b. What is the basic principle of atomic absorption spectroscopy? Explain the hollow cathode lamp.
   c. How do emission spectra is used quantitative and qualitative analysis, briefly explain with example?

UNIVERSITY OF THE PUNJAB

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q. No.1   (a)   Distinguish between safety glass and photochromic silicate glasses.   **12**

(b)   Discuss the importance of pot furnace and tank furnace in glass manufacturing.   **13**

Q. No.2   (a)   With the help of flow sheet diagram describe the production of phthalic anhydride.   **12**

(b)   Explain with the help of flow sheet diagram the electrolytic process of caustic soda manufacturing.   **13**

Q. No.3   (a)   Describe different steps involved in setting of cement along with principal chemical reactions.   **12**

(b)   With the help of flow sheet diagram, explain the production of cement by wet process.   **13**

Q. No.4   (a)   What is evaporation; explain the mechanism of multiple effect evaporation?   **12**

(b)   What do you understand about chlorination process, write down some important chlorinating agents and their applications as well.   **13**

Q. No. 5   (a)   Write down different types of additives/builders used during soap manufacturing.   **12**

(b)   Describe the method for the manufacturing of alkylbenzenesulfonates with the help of flow sheet diagram.   **13**

Q. No. 6   (a)   Give the role of Aeration, Coagulation and Flocculation in water treatment.   **12**

(b)   Describe the cleansing action of detergents in detail, why they are preferred over soaps?   **13**

Q. No.7   Write short notes on any three of the following   **25**

(a)   Hydrogenation

(b)   Oxalic acid

(c)   Boiler scale and sludge

(d)   Types of Portland cement

(e)   Reverse Osmosis