

**DEPARTMENT OF CHEMISTRY**  
**Pre - Ph.D. Chemistry (One Semester Course)**  
**Scheme of Examination**

Paper No.	Nomenclature	Time	Full Marks	Pass Marks	Credit
Paper-II (Core Paper)	1. Written (ESE)	3 Hrs	75	41	3
	2. Seminar / project	Allotted by the Department	25	14	1

**Pre-Ph.D (Chemistry)**  
**Paper – II (Group-A)**  
**Techniques in Chemistry**

**Time : 3 Hrs**  
**Credit : 3 Pass**

**Full Marks : 75**  
**Pass Marks : 41**

*Note: Six Questions to be set from Group A in which minimum two questions from each unit & three questions to be answered from group A. Four questions to be set from group B containing two questions from each unit & the candidates will required to attempt two questions from any section of group B. All questions will carry equal marks*

**Group - A**

**Unit - I**

**Purification of Organic Compounds                      9 Hrs**

Isolation and purification of organic compounds (solids and liquids) with special emphasis on chromatographic techniques: TLC, column chromatography and HPLC. Drying and dehydrating agents.

**Unit - II**

**Spectroscopic Techniques & Analysis                      9 Hrs**

Theory and applications of NMR spectroscopy of H-1, C-13, N-15, P-31 nuclei, two– dimensional NMR spectroscopy, theory and applications of infrared and mass spectrometry, UV Visible spectrophotometer, theory & application of TGA & DTA, Flame photometer

**Unit – III**  
**Green Chemistry**

**9 Hrs**

Basic principles of green chemistry, Application of non-conventional techniques in organic synthesis (ultrasonic, microwave and grinding). Solid state synthesis and synthesis under solvent free conditions. Use of ionic liquids.

**Books suggested:**

1. A textbook of Quantitative Inorganic Analysis, A.I. Vogel, ELBS, London.
2. Dynamics of Chromatography- Part I; J.C. Gidding; Dekker, New York.
3. Vogel's textbook of practical Organic Chemistry, B.S. Furhen ey. al. Longman Group.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill.
5. Spectrometric Methods in Organic Chemistry, D.H. Williams and I. Fleming.
6. Organic Spectroscopy, William Kemp, John Wiley.

**Group – B**

**Section – I (Physical Chemistry)**

**Unit – I Electro analytical Techniques**

**9 Hrs**

Polagraphy:- Introduction and Basic Principles, Polarograph, Polarographic cells, Half wave Potential and its significance. DME:- Advantages and Disadvantages of DME, SCE Carbon electrodes-Carbon paste Electrode Types of Currents:- Diffusion Current, Migration Current, Kinetic Currents, Catalytic Currents, Limiting Currents Amperometry :- Principles and Applications Square Wave Polarography, Voltametry, Coulometry, Superimposed AC Polarography:- Principles, theory and applications of these techniques.

**Unit - II**

**Thermodynamics of liquid mixtures**

**9 Hrs**

Molecular interactions in liquid mixtures: Ion-ion interactions, Ion-dipole interactions, Dipole-dipole interactions, Ion-induced dipole interactions, Dipole- induced dipole interactions, Quadruple-octuple interactions; specific interactions, hydrogen bonding, charge-transfer interactions and contact charge-transfer interaction. Thermodynamic of excess functions; excess molar volumes, excess molar enthalpies, excess isentropic compressibilities, excess Gibbs free energy, excess heat capacity and their significance. Statistical theories of liquid mixtures;

(i) Cell model (ii) Flory's theory (iii) Sanchez and Lacombe's theory.

## **Section – II (Inorganic Chemistry)**

### **Unit - I**

#### **Synthesis, Characterisation of metal complexes & Schiff Base metal complexes**

**9 Hrs**

Metal alkoxides – Synthesis, Structure elucidation by IR & NMR Spectroscopy and biological applications

Metal acetylacetonates – Synthesis, structure elucidation by IR & NMR Spectroscopy and biological application

Schiff's Base Metal complex – Synthesis, structure elucidation by UV, IR & NMR Spectroscopy and biological applications

### **Unit – II**

#### **Organometallic Compounds of Main Group Elements**

**9 Hrs**

General characteristics of different types of main group organometallics, stability, routes of M-C bond formation: Oxidative addition, transmetallation, Carbanion halide exchange, metal-hydrogen exchange, metal hydride addition to alkenes, methylenations and by Aryl diazonium salts. Structure elucidation by spectral techniques like IR, NMR, Mossbauer for compound of Si, Ge, Sn, Pb, As, Sb, Bi and Te.

## **Section – III (Organic Chemistry)**

### **Unit – I Organic Synthesis**

**9 Hrs**

General organic principle of organic synthesis

Principle of stereo selectivity, 1,2- and 1,3-asymmetric induction, acyclic stereoselection, distereoselection in cyclic systems.

Enantioselective synthesis: Enantioselective hydroboration, hydrogenation, epoxidation, enantioselective synthesis via hydrazones.

Role of enzymes in chiral synthesis, Bio production of organic compound Schiff Base reagent.

### **Unit – II**

#### **Heterocyclic compounds**

**9 Hrs**

General Synthesis of

- (a) compounds with three or more heteroatoms in the ring (1,2,3)- and (1,2,4)-triazoles (1,2,4)- and (1,3,4)-oxadiazoles (1,2,5)- and (1,3,4)-thiadiazoles (1,2,3)-, (1,2,4)- and (1,3,5)-triazines. Tetrazoles and tetrazines.

(b) Bridgehead nitrogen containing compounds: Indolines  
Imidazo [1,2-a] and [1,5-a]pyridines Triazolo [1,5-a] pyridines S-  
triazolo [3,4-b] [1,3,4] thiadiazoles Imidazo [2,1-b] [1,3,4] thiadiazoles  
S- triazolo [3,4-b] [1,3,4] thiadiazines Thiazolo [3,2-b] [1,2,4] triazoles.

(c) Drug discovery and Development

A rational approach to drug design and drug development of  
following drugs: cimetidine oxamniquine.

**Books recommended:**

1. Asymmetric Synthesis Ed. J, D. Morrison, vol. 1-5. Academic Press.
2. Stereochemistry of Organic Compounds by D. Nasipuri.
3. Designing organic synthesis by S. Waren.
4. Heterocyclic Chemistry by T. L. Gilchrist.
5. Comprehensive Heterocyclic Chemistry by A. R. Katritzky and  
C. W. Rees.
6. Green Chemistry by M. Kidwai and V. K. Ahluwalia.
7. Wilson and Gisvold's Text Book of organic medicinal and  
pharmaceutical chemistry Ed. R. F. Dorge.

**Seminar / Project**

**Full Marks: 25**

**Pass Marks: 14**

- b). Seminars of the candidates on the relevant research theme  
c). Preparation and submission of review report based upon the relevant  
papers addressing to the research problem chosen by the candidate