ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

MINOR

Subject: Organic Chemistry

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Fundamentals in Organic Chemistry	3	3
			Fundamentals in Organic Chemistry Practical Course	2	1
II	III	2	Organic Chemistry	3	3
			Organic Chemistry Practical Course	2	1
	IV	3	Spectroscopy	3	3
			Spectroscopy Practical Course	2	1
		4	Organic Chemistry	3	3
			Organic Chemistry Practical Course	2	1
III	V	5	Green Chemistry & Nanotechnology	3	3
			Green Chemistry & Nanotechnology Practical Course	2	1
		6	Analysis of Organic Compounds	3	3
			Analysis of Organic Compounds Practical Course	2	1

SEMESTER-II

COURSE 1: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of alkanes, alkenes and alkynes

2.Understand the concept of Benzene.

UNIT-I:

STRUCTURAL THEORY IN ORGANIC CHEMISTRY 9h

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents including neutral molecules like H_2O,NH_3& $AlCl_3$).

Inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes, carbanions..

Types of Organic reactions : Addition - electrophilic, nucleophilic and free radical. Substitution - electrophilic, nucleophilic and free radical. Elimination- Examples.

UNIT-II:

ACYCLIC HYDROCARBONS 9h

Alkenes - Preparation of alkenes. Properties: Addition of hydrogen - heat of hydrogenation and stability of alkenes. Addition of halogen and its mechanism. Addition of HX, Markonikov's rule, addition of H_2O, HOX, H_2SO_4 with mechanism and addition of HBr in the presence of peroxide (anti - Markonikov's addition). Dienes - Types of dienes, reactions of conjugated dienes - 1,2 and 1,4 addition of HBr to 1,3 - butadiene and Diel's - Alder reaction.

UNIT-III: 9h

Alkynes - Preparation by dehydrohalogenation of dihalides, dehalogenation of tetrahalides, Properties; Acidity of acetylenic hydrogen (formation of Metal acetylides). Preparation of higher acetylenes, Metal ammonia reductions, Physical properties. Chemical reactivity - electrophilic addition of X_2, HX, H_2O (Tautomerism), Oxidation with $KMnO_4$, OsO_4, reduction and Polymerisation reaction of acetylene.

UNIT-IV

ALICYCLIC HYDROCARBONS (CYCLOALKANES) 9h

Nomenclature, Preparation by Freunds method, Wislicenus method. Properties - reactivity of cyclopropane and cyclobutane by comparing with alkanes, Stability of cycloalkanes - Baeyer's strain theory, Sachse and Mohr predictions and Pitzer's strain theory. Conformational structures of cyclobutane, cyclopentane, cyclohexane.

UNIT-V:

BENZENE AND ITS REACTIVITY 9h

Concept of aromaticity - aromaticity (definition), Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation)

Reactions - General mechanism of electrophilic substitution, mechanism of nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens

(Explanation by taking minimum of one example from each type)

List of Reference Books

1. Organic Chemistry by Morrisson and Boyd

2. A Text Book of Organic chemistry by I L Finar Vol I

SEMESTER-II
COURSE 1: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Organic Functional Group Reactions

(At the end of Semester)

Reactions of the following functional groups present in organic compounds (at least **4**)
Alcohols ,phenols, aldehydes, ketones,c arboxylic Acids and Amines

SEMESTER-III

COURSE 2: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1. Understand the basic concepts of Hydroxy Compounds

2. Understand the basic concepts of carbonyl and carboxylic Acids

UNIT – I

HALOGEN COMPOUNDS: 9h

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aryl alkyl, allyl, vinyl, benzyl halides.

Nucleophilic aliphatic substitution reaction- classification into SN^1 and SN^2 – reaction mechanism with examples – Ethyl chloride, t-butyl chloride and optically active alkyl halide 2-bromobutane.

UNIT-II

HYDROXY COMPOUNDS 9h

Nomenclature and classification of hydroxy compounds.

Alcohols: Preparation with hydroboration reaction, Grignard synthesis of alcohols. Phenols: Preparation i) from diazonium salt, ii) from aryl sulphonates, iii) from cumene. Physical properties- Hydrogen bonding (intermolecular and intramolecular). Effect of hydrogen bonding on boiling point and solubility in water.

Identification of alcohols by oxidation with $KMnO_4$, Ceric ammonium nitrate, Luca's reagent and phenols by reaction with $FeCl_3$.

Chemical properties:

a) Dehydration of alcohols.

b) Oxidation of alcohols by CrO_3, $KMnO_4$.

C) Special reaction of phenols: Riemer-Tiemann reaction Pinacol-Pinacolone rearrangement.

UNIT-III

CARBONYL COMPOUNDS 9 h

Nomenclature of aliphatic and aromatic carbonyl compounds, structure of the carbonyl group. Synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties: Reactivity of carbonyl group in aldehydes and ketones.

Nucleophilic addition reaction with a) $NaHSO_3$, b) HCN, c) RMgX, d) NH_2OH, e)$PhNHNH_2$, f) 2,4 DNPH, g. Base catalysed reactions: a) Aldol, b) Cannizzaro's reaction, c) Perkin reaction, d) Benzoin condensation, e) Haloform reaction, f) Knoevenagel reaction. Oxidation of aldehydes- Baeyer-Villiger oxidation of ketones.Reduction: Clemmensen reduction, Wolf-Kishner reduction, MPV reduction, reduction with $LiAlH_4$ and $NaBH_4$. Analysis of aldehydes and ketones with a) 2,4-DNPH test, b) Tollen's test, c) Fehling test, d) Schiff's test e) Haloform test (with equation)

UNIT-IV

CARBOXYLIC ACIDS 9 h

Nomenclature, classification and structure of carboxylic acids. Methods of preparation by a) Hydrolysis of nitriles, amides b) Hydrolysis of esters by acids and bases with mechanism c) Carbonation of Grignard reagents.

Special methods of preparation of aromatic acids by a) Oxidation of side chain. b) Hydrolysis by benzotrichlorides. c) Kolbe reaction. **Physical properties**: Hydrogen bonding, dimeric association, acidity-strength of acids with examples of trimethyl acetic acid and trichloroacetic acid. Relative differences in the acidities of aromatic and aliphatic acids. **Chemical properties**: Reactions involving H, OH and COOH groups-salt formation, anhydride formation, acid chloride formation, amide formation and esterification (mechanism). Degradation of carboxylic acids by Huns-Diecker reaction, decarboxylation by Schimdt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction.

UNIT-V:

ACTIVE METHYLENE COMPOUNDS 9h

ACETOACETIC ESTER: keto-enol tautomerism, preparation by Claisen condensation, Acid hydrolysis and ketonic hydrolysis. Preparation of a) monocarboxylic acids b) Dicarboxylic acids. c) Reaction with urea

MALONIC ESTER: preparation from acetic acid. **Synthetic applications**: Preparation of a) monocarboxylic acids (propionic acid and n-butyric acid). b) Dicarboxylic acids (succinic acid and adipic acid) c) α,β-unsaturated carboxylic acids (crotonic acid).

d) Reaction with urea.

List of Reference Books

1) A Text Book of Organic Chemistry by Bahl and Arun bahl
2) A Text Book of Organic chemistry by I L Finar Vol I
3) Organic chemistry by Bruice
4) Organic chemistry by Clayden

SEMESTER-III

COURSE 2: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- Organic Qualitative Analysis

(At the end of Semester)

Systematic qualitative analysis of organic compounds

phenols,carbonyl compounds like Aldehyde,and ketone,carboxylic acid, amine,carbohydrate,amide and Urea

SEMESTER-IV

COURSE 3: SPECTROSCOPY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Beer-Lambert's Law.

2.understand the concept of Spectroscopy.

UNIT-I

GENERAL FEATURES OF ABSORPTION 9h

- Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity. Single and double beam spectrophotometers. Application of Beer-Lambert law for quantitative analysis of 1. Chromium in $K_2Cr_2O_7$ 2. Manganese in Manganous sulphate

UNIT-II

ELECTRONIC SPECTROSCOPY: 9h

Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect of conjugation. Concept of chromophore and auxochrome.

UNIT-III

INFRA RED SPECTROSCOPY: 9h

Different Regions in Infrared radiations. Modes of vibrations in diatomic and polyatomic molecules. Characteristic absorption bands of various functional groups. Interpretation of spectra-Alkanes, Aromatic, Alcohols carbonyls, and amines with one example to each.

Functional group and finger print Region

UNIT-IV

PROTON MAGNETIC RESONANCE SPECTROSCOPY (^{1}H-NMR) 9h

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants.

UNIT-V

APPLICATIONS OF NMR 9h

Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Applications of UV-Visible and IR-Spectroscopy

List of Reference Books

1. Spectroscopy by William Kemp

2. Spectroscopy by Pavia

3. Organic Spectroscopy by J. R. Dyer

4 .Elementary organic spectroscopy by Y.R. Sharma

5. Spectroscopy by P.S.Kalsi

SEMESTER-IV
COURSE 3: SPECTROSCOPY

Practical Credits: 1 2 hrs/week

Practical- IR-Spectral Analysis

IR spectral analysis of the following functional groups with examples

(a) Hydroxyl Groups

(b) Carbonyl Groups

(c) Amino Groups

(d) Aromatic Groups

SEMESTER-IV

COURSE 4: ORGANIC CHEMISTRY

Theory Credits: 3 3 hrs/week

Course outcomes:

At the end of the course , the students will be able to

1.Understand the basic concepts of Amines,Nitrocompounds

2.understand the concept of Carbohydrates,Amino Acids.

UNIT- I

NITRO HYDROCARBONS: **9h**

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity -halogenation, reaction with HONO (Nitrous acid),Nef reaction and Mannich reaction leading to Micheal addition and reduction.

UNIT – II

NITROGEN COMPOUNDS **9h**

ALIPHATIC AMINES: Nomenclature, Classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods –

1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).

Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine

UNIT-III

AROMATIC AMINES: **9h**

introdution comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects. Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation of aryl and Tertiary amines, Diazotization.

UNIT-IV

CARBOHYDRATES **9h**

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose – Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to

D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry de bruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to

D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose

[(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

UNIT- V

AMINO ACIDS **9h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic

and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage).

List of Reference Books

1. Organic Chemistry by G.Mare loudan, Purdue Univ
2. A Text Book of Organic Chemistry by Bahl and Arun bahl
3. A Text Book of Organic chemistry by I L Finar Vol I

SEMESTER-IV

COURSE 4: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Practical- Organic Chemistry Lab

(A) Give a brief introduction on

(1) Re-crystallisation(ii) sublimation © distillation (d) M.P & B.P

(B) Single step preparations

1. Preparation of P-Nitro acetanilide

2. Preparation of Aspirin

SEMESTER-V

COURSE 5: GREEN CHEMISTRY AND NANOTECHNOLOGY

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the importance of Green chemistry and Green synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis .
5. Analyse alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nanomaterial synthesis.

UNIT-I Green Chemistry: I 9hrs

Introduction-Definition of green Chemistry,Need for green chemistry, Goals of Green chemistry Basic principles of green chemistry. Green synthesis- Evaluation of the type of thereaction i) Rearrangements (100% atom economic),ii)Addition reaction(100% atom economic). Organic reactions by Sonication method: apparatus required and examples of sono chemical reactions (Heck, Hundsdiecker and Wittig reactions).

UNIT- II Green Chemistry : Part- II 9hrs A)

Selection of solvent:

i) Aqueous phase reactions ii) Reactions in ionic liquids, Heck reaction,Suzuki reactions,epoxidation.

iii)Solid supported synthesis

B) Supercritical CO_2:Preparation, properties and applications,(decaffeination, drycleaning)

C) Green energy and sustainability.

UNIT-III Microwave and Ultrasound assisted green synthesis: 9hrs

Apparatus required, examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones)-Advantages and disadvantages of MAOS. Aldol condensation –Cannizzaro reaction - Diels-Alder reactions- Strecker's synthesis

UNIT-IV Green catalysis and Green synthesis 9hrs

Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis-biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

1. Green synthesis of the following compounds : adipic acid, catechol, disodium imino diacetate (alternative Strecker's synthesis)

2. Microwave assisted reaction in water –Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols–microwave assisted reactions in organicsolvents. Diels-Alder reactions and decarboxylation reaction.

3. Ultrasound assisted reactions–sonochemical Simmons–Smith reaction(ultrasonic alternative to iodine)

UNIT – V Nanotechnology in Green chemistry 9hrs

Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top down approaches with examples – Synthesis of Nano materials – Classification of Nanomaterials – Properties and Application of Nanomaterials. Chemical and Physical properties of

Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method - Chemical Synthesis of nanoparticles – precipitation and co-precipitation method,sol-gel method.

List of Reference books:

1. Green Chemistry Theory and Practical. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London)
5. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., JohnWiley
6. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.MSrivastava, Narosa Publications
7. Nanotechnology: Health and Environmental Risks, Jo Anne Shatkin, CRC Press(2008).
8. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
9. Web related references suggested by teacher.

SEMESTER-V

COURSE 5: GREEN CHEMISTRY AND NANOTECHNOLOGY

Practical Credits: 1 2 hrs/week

Laboratory course Syllabus:

1. Identification of various equipment in the laboratory.
2. Acetylation of 1^0 amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
   7.Preparation and characterization of Nanoparticles of gold using tea leaves.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Photoreduction of Benzophenone to Benzopinacol in the presence of sunlight.

List of Reference books:

1)Green Chemistry Theory and Practical. P.T.Anatas and J.C. Warner

2)Green Chemistry V.K. Ahluwalia Narosa, New Delhi.

3) Real world cases in Green Chemistry M.C. Cann and M.E. Connelly

4) Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London)

5) Web related references suggested by teacher.

SEMESTER-V

COURSE 6: ANALYSIS OF ORGANIC COMPOUNDS

Theory Credits: 3 3 hrs/week

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1) Identify the importance of mass spectrometry in the structural elucidation of organic compounds.
2) Acquire the knowledge on structural elucidation of organic compounds.
3) Understand various chromatography methods in the separation and identification oforganic compounds.
4) Demonstrate the knowledge gained in solvent extraction for the separate the organic compounds.

Unit-I: Nuclear Magnetic Resonance (NMR) spectroscopy 9 h

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position ofsignals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2tribromo ethane, ethyl acetate, toluene and acetophenone.

Unit II Mass Spectrometry 9hrs

A brief introduction to analysis of organic compounds
Basic principles, Instrumentation - Mass spectrometer, electron Ionization (Electron Impactionization, EI), Molecular ions, metastable ions, Isotope abundance. Basic fragmentation types. Fragmentation patterns in Toluene, 2-Butanol, Butaldehyde, Propionicacid.

Unit-III : Structural elucidation of organic ompounds using IR,NMR & mass spectraldata- 9 hours

2,2,3,3-Tetramethyl butane,Butane-2,3-dione,Propionicacid and methyl propionate.Phenyl acetylene, acetophenone, cinnamic acid and p-nitroaniline.

Unit-IV: Separation techniques-1 9 hours

Solvent extraction-Principle and theory, Batch extraction technique, application of batch extraction in the separation of organic compounds from mixture- acid & neutral, base &neutral.

Chromatography – Principle and theory, classification, types of adsorbents, eluents, Rfvaluesand factors affecting Rfvalues. Thin layer chromatography - principle, experimental procedure, advantages and applications.

Unit-5:Separation techniques - 2 9 hours

Paper chromatography- Principle, experimental procedure, ascending, descending, radial andtwo dimensional, applications.

Column chromatography - Principle, classification, experimental procedure and applications.HPLC-

Principle, Instrumentation – block diagram and applications.

List of Reference books:

1) Organic Spectroscopy by William Kemp,Third Edition, Palgrave USA.
2) Introduction to Spectroscopy by Pavia, Lamp man, Kriz and Vyvyan, Fifth edition,

Cengage.
3) Organic Spectroscopy: Principles and Applications by Jag Mohan, Second edition,Alpha Science.
4) Spectroscopy of Organic Compounds by P.S.Kalsi, Seventh edition, New Age International.
5) Spectroscopic Methods in Organic Chemistry by Ian Fleming and Dudley Williams, Seventh edition, Springer.
6) Fundamentals of Analytical Chemistry by F.James Holler, Stanley R Crouch, DonaldM.West and Douglas A.Skoog, Ninth edition, Cengage.
7) Analytical Chemistry by Gary D.Christian, PurnenduK.Dasgupta and KevinA.Schug, Seventh edition, Wiley.
8) Quantitative analysis by R.A.DayJr.andA.L.Underwood, Sixth edition, Pearson.9)Text book of Vogel's Quantitative Chemical Analysis, Sixth edition, Pearson.

SEMESTER-V

COURSE 6: ANALYSIS OF ORGANIC COMPOUNDS

Practical Credits: 1 2 hrs/week

Prepare acetanilide using the green synthesis.

1) Demonstrate the preparation of an azo dye.
2) Acquire skills in the separation of organic compounds in the given mixture usingsolvent extraction

VI. Laboratory course Syllabus:

1) Identification of various equipment in the laboratory.
2) Acetylating of 1^0amine by green method : Preparation of acetanilide
3) Rearrangement reaction in green conditions :Benzil-Benzilic acid rearrangement
4) Radical coupling reaction : Preparation of 1,1-bis-2-naphthol
5) Green oxidation reaction: Synthesis of adipic acid
6) Preparation and characterization of biodiesel from vegetable oil/waste cooking oil.
7) Photo reduction of Benzophenone to Benzopinacol in the presence of sunlight.
8) Separation of organic compounds in a mixture(acidic compound + neutral compound)using solvent extraction.
9) Separation of organic compounds in a mixture (basic compound+ neutral compound)using solvent extraction.

VII. List of Reference books :

1) Vogel A.I.Practical Organic Chemistry, Longman Group Ltd.
2) Bansal R.K. Laboratory Manual of Organic Chemistry, Wiley-Eastern.
3) Ahluwalia V. K. and Aggarwal R. Comprehensive Practical Organic Chemistry,University press.MannF.G and Saunders B.C, Practical Organic Chemistry, Pearson Education.