Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Two Year M.Sc. Chemistry

Department Specific Course (DSC)

Semester II courses

Syllabus under Autonomy

(Draft discussed and approved in BOS Meeting 08-July-2023 to be implemented from Academic Session 2023-24)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of M.Sc. I Semester II

DSC V (Theory)

PGCH2T1: Organic Chemistry

[60 Hrs] **[4 Credits]**

Course Objectives

To learn

1. various addition reactions across C-C, C-O and C-N multiple bonds.
2. basic concepts in molecular rearrangement & elimination reaction.
3. types and mechanism of free radical reactions.
4. principles and advantages of green chemistry.

Course Outcomes

Students will gain an understanding of:

1. various addition reactions across C-C, C-O and C-N multiple bonds.
2. basic concepts in molecular rearrangement & elimination reaction.
3. types and mechanism of free radical reactions.
4. principles and advantages of green chemistry.

Contents:-

Unit-I Addition reactions:

A. Addition to carbon-carbon multiple bond: Mechanistic and stereochemical aspects of addition reaction involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, Orientation and stereochemistry, Addition to cyclopropanes, Hydrogenation of double bond and triple bonds. Hydrogenation of aromatic rings, hydroboration..

B. Addition to carbon-hetero atom multiple bond: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters, and nitriles, Addition of Grignard reagents, organozinc and organolithium reagents to carbonyls and unsaturated carbonyl compounds, Wittig reaction, Mechanisms of condensation reactions involving enolates- Aldol, Knoevengel, Claisen, Mannich, Benzoin, Perkin, Stobbe reaction, Michael reaction and Robinson annulations. Hydrolysis of esters and amide

Unit-II Molecular rearrangements:

A. Molecular rearrangements: Classification and General mechanistic treatment of electrophilic, nucleophilic and free radical moleculer rearrangement. Mechanism and synthetic applications of Wagner-Meerwin, Pinacol-Pinacolone, Tiffenev-Demjnov ring expansion,

benzil-benzilic acid, Favorski, Baeyer Villiger, Wolff, Arndt-Eistert synthesis, Curtius Lossen, Beckman, Hoffman, Schmidt rearrangement.

B. Elimination reactions: E1, E2, E1CB mechanisms, orientation and stereochemistry in elimination reaction, Saytzeff and Hoffman's rule, Effect of substrate structure, attacking base, leaving group and medium, competition between elimination and substitution, syn eliminations, pyrolytic elimination.

Unit-III Free radical reactions:

Generation of free radicals, types and mechanism of free radical reactions, free radical substitution mechanism at an aromatic substrate, aliphatic substrate, reactivity at a bridgehead position, Neighbouring group assistance, reactivity for aliphatic and aromatic substrates, reactivity in attacking radicals, effect of solvent on reactivity, Halogenation at an alkyl carbon, allylic carbon (NBS), hydroxylation at an aromatic carbon by means of Fenton's reagent. Auto-oxidation, chlorosulphonation (Reed Reaction) Coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, Free radical rearrangement: Hunsdiecker reaction, Iododecarboxylation, Barton reaction, Hoffmann-Loefler-Freytag reaction.

Unit-IV Green chemistry:

Twelve basic principles of green chemistry, calculation of atom economy of rearrangements, addition, substitution and elimination reaction with suitable examples, Case study of Bhopal gas tragedy and Seveso disaster, Synthesis involving basic principles of green chemistry-paracetamol, Ibuprofen, hydroquinone, adipic acid, ε-caprolactum, styrene, urethanes, Free radical bromination, Multi-component reactions (Biginelli, Ugi and Passerini reaction), Prevention or minimization of hazardous products, choice of solvents. Sonochemistry, microvave induced reactions, polymer supported reagents, reactions in aqueous medium, zeolites and ionic liquid supported reaction, Solvent free reactions, electrochemical reactions, Biocatalysts in Organic synthesis.

Reference books:

1) Advanced Organic Chemistry –Reaction mechanism and structure. Jerry March, John Wiley
2) Advanced Organic Chemistry- Part-A- F.A. Carey and R. J. Sunberg, Plenum
3) A Guidebook to Mechanism in Organic Chemistry-Peter Skyes, Longman
4) Structure and Mechanism in Organic Chemistry-C.K. Gold, Cornell University Press
5) Organic Chemistry, R.T. Morrison Boyd. Prentice Hall
6) Modern Organic Chemistry-H.O. House, Benjamin
7) Principal of Organic Chemistry-R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional
8) Reaction Mechanism in Organic Chemistry-S.M. Mukharji and S.P. Singh, Macmilan
9) Advanced Organic Chemistry – L. F. Fieser and M. Fieser.
10) Organic Chemistry Vol. I and II - I. L. Finar
11) Frontier Orbitals and Organic Chemical Reactions-I. Fleming
12) Orbital Symmetry – R. E. Lehr and A. P. Marchand
13) Reactive Intermediate in Organic Chemistry-N. S. Isaacs
14) A Textbook of organic chemistry- R.K. Bansal
15) Some Modern Methods of Organic Synthesis-W. Carruthers
16) Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press

17) Modern Synthetic Reaction. H. O. House and W. A. Benjamin
18) Designing Organic Synthesis-S. Warren
20) Organic Reaction and their Mechanism-P. S. Kalsi
21) New trends in green chemistry –V.K. Ahluwalia and M. Kidwai, Anamaya publishers New Delhi

DSC VI (Theory)

PGCH2T2: Analytical Chemistry

[60 Hrs] **[4 Credits]**

Course Objectives

The primary objective of this course is to acquire basic concepts, principles, and techniques of modern analytical chemistry that would empower students with an analytical mind set and the abilities to solve diverse analytical problems in an efficient and quantitative way that conveys the importance of accuracy and precision of the analytical results. The Course is aimed at-

1. Studying Introduction to analytical chemistry.
2. Gaining knowledge of classical methods of analysis.
3. Understanding Separation Techniques, Chromatography, Ion exchange and Solvent extraction.
4. Knowing Electroanalytical Methods of Analysis – conductometry & Potentiometry.
5. Knowing optical methods of Analysis – Spectrophotometry and Colorimetry

Course Outcomes

1. Express the role of analytical chemistry in science.
2. Explain the fundamentals of analytical chemistry and steps of a characteristic analysis.
3. Compare & express qualitative and quantitative methods.
4. Understanding fundamentals of Separation techniques like Chromatography & solvent extraction.
5. Explain the theoretical principles and important applications of classical analytical methods within titration (acid/base titration, complexometric titration, redox titration, precipitation titration), and various techniques within gravimetric methods.
6. Realize the theoretical principles of electroanalytical & optical techniques conductometry, Potentiometry, Spectrophotometry and Colorimetry

Content

Unit-I

Introduction to analytical chemistry: Types of analysis-qualitative and quantitative. Classification of analytical methods- classical and instrumental, basis of their classification with examples.

Classical Methods of Analysis:

a) Volumetric analysis: General principle. Criteria for reactions used in titrations. Primary standards and secondary standards. Theory of indicators. Types of titrations with examples- Acid-base, precipitation, redox and complexometric. Titration curves for monoprotic and polyprotic acids and bases. Indicators used in various types of titrations. Masking and demasking agents.

b) Gravimetric analysis: General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibria. Steps involved in gravimetric analysis. Purity of precipitate: Co-precipitation and post-precipitation.

Fractional precipitation. Precipitation from homogeneous solution. Particle size, crystal growth, colloidal state, aging and peptization phenomena. Ignition of precipitates.

Unit-II

Separation Techniques:

a) Chromatography: Definition and Classification. Techniques used in Paper, Thin Layer and Column chromatography. Applications in qualitative and quantitative analysis.

b) Ion exchange: Principle and technique. Types of ion exchangers. Ion exchange equilibria. Ion exchange capacity. Effect of complexing ions. Zeolites as ion-exchangers. Applications.

c) Solvent extraction: Principle and techniques. Distribution ratio and distribution coefficient. Factors affecting extraction efficiency: Ion association complexes, chelation, synergistic extraction, pH. Numericals based on multiple extractions. Role of chelating ligands, crown ethers, calixarenes and cryptands in solvent extraction. Introduction to Solid phase extraction (SPE) and Microwave assisted extraction (MAE), Applications.

Unit-III

Electroanalytical Method-I

Conductometry: Concepts of electrical resistance, conductance, resistivity and conductivity. Specific, molar and equivalent conductance and effect of dilution on them. Measurement of conductance. Kohlrausch's law, Applications of conductometry in determination of dissociation constant, solubility product. Conductometric titrations. High frequency titrations. Numerical problems.

Potentiometry: Circuit diagram of simple potentiometer. Indicator electrodes: hydrogen electrode, quinhydrone electrode, antimony electrode and glass electrode. Reference electrodes: Calomel electrode and Ag/AgCl electrode. Theory of potentiometric titrations. Acid-base, redox, precipitation and complexometric titrations. Nernst equation, standard electrode potential, Determination of cell potential, n, Kf and Ksp. pH titrations. Buffers and buffer capacity. pH of buffermixtures based on Henderson-Hasselbalch equation.

Unit-IV

Optical Methods of Analysis-I:

a) Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification, and deviations. Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity and analytical significance of molar extinction coefficient and λmax. Comparison method, calibration curve method and standard addition method for quantitative estimation. Role of organic ligands in spectrophotometric analysis of metal ions. Ringbom plot and Sandell's sensitivity. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Composition and stability constant of complex by Job's and mole ratio methods. Derivative spectrophotometry. Numerical problems.

Reference books:

1] Quantitative analysis: Day and Underwood (Prentice-Hall of India)
2] Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
3] Analytical Chemistry: Gary D. Christian (Wiley, India).
4] Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
5] Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
6] Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
7] Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
8] Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
9] Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
10] Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
11] An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
12] Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
13] Instrumental Methods of Chemical Analysis: G. W. Ewing

DSC VII (Practical)

PGCH2P1: Organic Chemistry Practical

[60 Hrs] **[2 Credits]**

Course Objectives

To learn the purification techniques (solvents & reagents), qualitative analysis of two component mixture & organic preparation of single step & two step synthesis.

Course Outcomes

Students will gain an understanding of:

1) Separation and analyze the different component mixtures of simple organic compounds.
2) Purification, Crystallization, and different Distillation processes.
3) How to calculate a limiting reagent, yield, and percent yield
4) Synthesis using substitution and condensation reactions.
5) Single step & multistep synthesis.

Contents:-

I. Purification techniques (Demonstrations):

a) Purification of solvents and reagents using techniques like crystallization, distillation, steam distillation, vacuum distillation etc.

b) Chromatography: TLC, Column, paper

c) Solvent extraction using soxhlet extractor

II. Qualitative Analysis:

Two component mixture separation using chemical and physical techniques and using solvents.

(8 mixtures minimum)

III. Organic Preparations (minimum 8 preparations):

Spectral characterization of prepared compounds wherever possible**:**

1. Single step preparation

a) Aldol condensation: Benzaldehyde →Dibenzal acetone (chalcone)

b) Benzophenone → benzhydrol

c) Nitrobenzene → m-di-nitrobenzene

d) m-di-nitrobenzene → m-nitroaniline

e) Methyl acetoacetate → 5-methyl-isoxazol-3-ol

f) Ethyl acetoacetate → 4-aryl-6-methyl-3,4-dihydro-2(1H)-pyrimidinone ester

g) Ethyl acetoacetate→Diethyl 1,4-dihydro-2,6-dimethyl-4-phenylpyridine-3,-5dicarboxylate

h) Sulphanilic acid → Methyl orange

i) p-nitroaniline → p-red

2. Two step preparation

a) Acetanilide → p-nitroacetanilide → p-nitroaniline
b) Aniline → 2,4,6-tribromo aniline → 2,4,6-tribromoacetanilide
c) Nitrobenzene → m-dinitrobenzene → m-nitroaniline
d) benzophenone→ benzophenoneoxime→ Benzanilide
e) Chlorobenzene→ 2,4-dinitrochlorobenzene → 2,4-dinitrophenylhydrazine
f) Glycine → Benzoyl glycine(hippuric acid) → 4-benzilidene-2-phenyl oxazole

Reference Books:-

- A Textbook of Practical Organic Chemistry, 4th Edn., A. I. Vogel, ELBS.
- Laboratory Techniques in Organic Chemistry, V. K. Ahluwalia, Pooja Bhagat, Renu Agrawal, I. K. International
- Practical Organic Chemistry: Qualitative Analysis, Ane's Student Edition, S. P. Bhutani, Aruna Chhikara, Ane Books India
- Advanced Practical Organic Chemistry, John Leonard, Barry Lygo, Garry procter, CRC Press, Special Indian Edition
- Organic Chemistry – A Lab Manual, Pavia, Lampman, Kriz, Engel, Cengage learning
- Practical Organic Chemistry, F. G. Mann and B. C. Saunders, English language Book Society
- Organic Chemistry: Laboratory Course book, Dr. P. V. Tekade, Selective and Scientific books, New Delhi

DSC VIII (Practical)

PGCH2P2: Analytical Chemistry Practical

[60 Hrs] **[2 Credits]**

Section (A):

I. Classical methods and separation techniques: Calibration, validation, and computers

1) Calibration of pipette and burette.
2) Statistical analysis of data.
3) Use of MS-Excel in statistical analysis of data and curve fitting.

II. Volumetry

1) Determination of Na_2CO_3 in washing soda.
2) Determination of NaOH and Na_2CO_3 in a mixture.
3) Estimation of nickel in given solution by direct complexometric titration with EDTA using bromopyrogallol red.
4) Estimation of nickel in given solution by complexometric back-titration with EDTA.
5) Estimation of chloride in given solution by Mohr's titration.
6) Estimation of chloride in given solution by Volhard's titration.
7) Determination of volume strength of commercial hydrogen peroxide by redox titration with $KMnO_4$.
8) Estimation of phenol/ aniline by bromination method.
9) Estimation of glucose.
10) Estimation of acetone.
11) Estimation of formaldehyde.
12) Estimation of Mn in the presence of Fe using masking phenomenon (ferromanganese alloy).

III. Gravimetry

1) Estimation of barium as barium sulphate.
2) Estimation of calcium as calcium oxalate/ calcium carbonate/ calcium oxide.

IV. Separation techniques

1) Qualitative separation of metal ions by paper chromatography for 2/3 components.
2) Determination of ion-exchange capacity of resin.
3) Separation of ions by ion exchange.

Section (B): Instrumental techniques

I. Electroanalytical techniques

1) Analysis of commercial vinegar by conductometric titration.
2) Estimation of phenol by conductometric titration with NaOH.

3) Determination of strength of HCl and CH_3COOH in a mixture conductometrically.
4) Determination of strength of HCl and oxalic acid in a mixture conductometrically.
5) Determination of strength of oxalic acid and CH_3COOH in a mixture conductometrically.
6) Determination of degree of dissociation and dissociation constant of acetic acid conductometrically.
7) Estimation of phenol in dilute solution by conductometric titration with NaOH.
8) Determination of strength of HCl and CH_3COOH individually and in a mixture potentiometrically.
9) Determination of Fe(II) by potentiometric titration with $K_2Cr_2O_7$.
10) Determination of three dissociation constants of H_3PO_4 by pH-metric/potentiometric titration

II. Optical methods

1) Determination of pK of indicator by colorimetry.
2) To estimate the amount of NH_4Cl colorimetrically using Nesseler's Reagent.
3) To study the complex formation between Fe(III) and salicylic acid and find the formula and stability constant of the complex colorimetrically (Job's method).
4) To determine the dissociation constant of phenolphthalein colorimetrically.
5) Estimation of iron in wastewater sample using 1,10-phenanthroline.

(Note: One experiment from each section should be performed in the examination.)

Reference books:

- Quantitative analysis: Day and Underwood (Prentice-Hall of India)
- Vogel's Text Book of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS)
- Analytical Chemistry: Gary D. Christian (Wiley, India).
- Instrumental Methods of Analysis: Willard, Merrit, Dean, Settle (CBS Publishers, Delhi, 1986)
- Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
- Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
- Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
- Analytical Chemistry: Problems and Solution- S. M. Khopkar (New Age International Publication)
- Basic Concepts in Analytical Chemistry: S. M. Khopkar (New Age International Publication)
- Advance Analytical Chemistry: Meites and Thomas: (Mc Graw Hill)
- An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
- Fundamentals of Analytical Chemistry: S. A. Skoog and D. W. West
- Instrumental Methods of Chemical Analysis: G. W. Ewingeriments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
- Merits And Thomas: Advanced Analytical Chemistry

- Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
- Khopkar S.M.:Basic Concept of Analytical Chemistry
- Wlehov G. J: Standard Methods Of Chemical analysis 6th Ed
- Braun:Instrumental Methods of Chemical Analysis

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Two Year M.Sc. Chemistry

ELECTIVE

Semester II courses

Syllabus under Autonomy

(Draft to be discussed and approved in BOS Meeting 08-July-2023 to be implemented from Academic Session 2023-24)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of M.Sc. I Semester II

ELECTIVE - I

PGCH2E1: Reaction Mechanism, π-Complexes and Clusters

[60 Hrs] **[4 Credits]**

Course Objectives

1. Analyse the reactivity of transition metal complexes.
2. Analyse the reaction pathways of complex formation understand its reaction mechanism.
3. Study the preparation, structures and properties of metal carbonyls and metal nitrosyls and the chemistry of dioxygen and dinitrogen complexes.
4. Understand the classification of metal clusters containing metal-metal bonds.
5. Learn about the isopolyacids and heteropolyacids and their structures.

Course Outcomes

The learner will gain knowledge of:

1. Reaction mechanism governing the substitution reaction substitution and electron transfer reactions in transition metal complexes.
2. Structure and bonding in metal carbonyls and metal nitrosyls.
3. Occurrence of metal-metal bonds in metal clusters and its significance.

Contents:-

Unit-I Reaction mechanism of transition metal complexes-I:
Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetics of octahedral substitution: Acid hydrolysis, factors affecting acid hydrolysis, stereochemistry of intermediates in SN^1 and SN^2, Base hydrolysis, Conjugate base mechanism, Direct and indirect evidences in favour of conjugate mechanism, anation reaction, reaction without metal-ligand bond breaking.

Unit-II Reaction mechanism of transition metal complexes –II:
Substitution reaction in square planar complexes: trans effect, cis effect, steric effect, solvent effect, effect of leaving group, effect of charge, effect of nucleophile, effect of temperature. Trans effect theories, use of trans effect, mechanism of substitution reaction of Pt(II) Complexes, electron transfer reactions. Types of electron transfer reaction, conditions of electron transfer and mechanism of one electron transfer reaction, outer sphere and inner sphere mechanism, two electron transfer reactions, complementary and non-complementary reaction , tunneling effect, cross reactions.

Unit-III Metal π-Complexes:

a) Metal carbonyls

Structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Metal carbonyl clusters with reference to classification, EAN rule, synthesis and structures.

b) Metal nitrosyls

Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra, and X-ray diffraction studies of transition metal nitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyls, structure and bonding. Dinitrogen and dioxygen complexes. Wilkinson's catalyst and Vaska's compound.

Unit-IV Metal cluster:

Occurrence of metal-metal bonds, Classification of metal cluster: binuclear, trinuclear, tetranuclear, pentanuclear, and hexanuclear with reference to halide, oxide, alkoxide and acetate clusters. Isopoly, heteropoly acids and their anions.

Reference books:

- S. F. A. Kettle, J. N. Murral & S. T. Teddler: Valency Theory
- C. A. Coulson: Valency
- J. E. Huheey : Inorganic Chemistry
- F .A. Cotton & G. Wilkinson: Advanced Inorganic Chemistry 3rd, 5th& 6th Editions.
- F. Willims: Theoretical Approach in inorganic chemistry.
- Mannas Chanda: Atomic Structure and chemical Bonding
- L. E. Orgel: An introduction to transition metal chemistry, Ligand field theory, 2nd Edition.
- J. J. Logowski: Modern Inorganic Chemistry
- B.Durrant and P.J.Durrant: Advanced Inorganic Chemistry
- J. C. Bailar: Chemistry of co-ordination compounds.
- W. L. Jolly: Modern Inorganic Chemistry
- R. S. Drago: Physical methods in inorganic chemistry.
- Waddington: Nonaqueous solvents.
- Sisler: Chemistry of non-aqueous solvents.
- K. Barnard: Therotical Inorganic Chemistry
- Emeleus and Sharpe: Modern Aspect of Inorganic Chemistry.
- F. A. Cotton: Chemical Applications of Group theory.
- Jones: Elementary Co-ordination chemistry.
- N. Figgis: Introduction to Ligand field.
- S. F. A. Kettle: Co-ordination chemistry.
- M. C. Day and J. Selbin: Theoretical Inorganic Chemistry.
- J. Lewin and Wilkins: Modern Co-ordination chemistry.
- Gowarikar, Vishwanathan and Sheedar: Polymer science.
- R. L. Dutta and A. Symal: Elements of magneto chemistry

- P. Atkins: Inorganic Chemistry 4th Edition, Oxford University Press.
- D.M.P.Mingos: Essential Trends in Inorganic Chemistry, Oxford University Press
- Bertini, et al: Bioinorganic Chemistry (Viva)
- Fenton, David E.: Biocoordination chemistry, Oxford

ELECTIVE - II

PGCH2E2: Polymer Chemistry II

[60 Hrs] **[4 Credits]**

Course Objectives

- To reinforce the basic concepts of polymer chemistry including polymerization processes and techniques, polymer architectures, configuration and conformation of polymers etc.
- To learn the spectroscopic, thermal and thermochemical techniques for characterization of polymers.
- To study briefly few examples of biomedical, inorganic, coordination and diene based polymers

Course Outcomes

On successful completion of this course, student should

- Understand the important basic concepts of polymer chemistry
- Know the types and techniques of polymerization processes
- Gain knowledge about important polymer characterization techniques

Know synthesis and application of some important biomedical, inorganic, coordination and diene based polymers

Course Contents

Unit-I: Polymerization

Importance, basic concepts, raw materials for polymers, concept of functionality, comparison of chain and step-growth, examples of polymerization reactions (polyadditions, polycondensations) constitution of polymers, homopolymers and copolymers, polymer architectures (graft copolymers, star-branched, hyperbranched and dendrimers), configuration and conformation of polymers, coil formation, mobility in polymers, glass transition temperature, rubber elasticity, molecular weight distribution.

Unit-II: Techniques of Polymerization

Techniques of polymerization-suspension, emulsion and bulk polymerization, coordination, polymerization mechanism of Ziegler Natta polymerization, stereospecific polymerization, interfacial polycondensation, mechanism of polymerization.

Unit III: Characterization of Polymers

Spectroscopic techniques: Fundamentals, experimental and applications to polymers of the following techniques: UV-visible spectroscopy, IR and Raman spectroscopy, Nuclear Magnetic (proton, carbon), resonance spectroscopy, NMR of polymers in the solid state, two dimensional NMR spectroscopy, pyrolysis GC-MS.

Thermal methods-TGA, DTA, DSC,

Thermomechanical and X-ray diffraction study, Block and Graft copolymers, random, block, graft co-polymers, methods of copolymerization.

Unit IV: Specific Polymers

A) Biomedical polymers: Contact lens, dental polymers, artificial heart, kidney and skin.

B) Inorganic polymers: Synthesis and application of silicon, phosphorous and sulphur

containing polymers.

C) **Coordination polymers**: Synthesis and applications of coordination polymers.
D) **Diene-based polymers**: Polyisoprene, polybutadiene.

Reference books:

1. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
2. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
4. Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
5. Principles of polymer Chemistry: Flory, Cornell Univ. press.
6. Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.
7. Principles of polymerization: Odian.
8. A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.
9. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
10. A practical course in polymer chemistry: S. J. Punea , Pergamon Press.