|| Jai Sri Gurudev ||

Adichunchanagiri University

Adichunchanagiri School of Natural Sciences

M.Sc CHEMISTRY

SYLLABUS

Course Description

Atoms, particles, quarks—if your passion is to learn about everything that makes up everything, a master's in Chemistry is perfect for you. This degree at Adichunchanagiri University may prepare for a career in industry, teaching or graduate study in Chemistry, Biochemistry, Medicine and Dentistry or Pharmaceuticals. The course offerings for the graduate degree are structured to give a broad but thorough grounding in the elements of Chemistry. In fact, our graduate students can work in drug discovery, pharma industries, biophysical chemistry, nano materials, organic polymers, inorganic materials, and teaching faculty.

Adichunchanagiri School of Natural Sciences

2023-24

CHEMISTRY

The Choice Based Credit System (CBCS) comprises Hard Core, Soft Core subjects for Nanoscience Students and Open Elective for students other than Nanoscience. Following shall be the minimum and maximum subjects per semester.

The credit pattern is Lecture (L); Tutorial (T); Practical (P); (L:T:P) Pattern.

Lecture: One-hour session of theory class per week in a semester is 1 credit.

Tutorial and Practical: Two-hour session of tutorial or practical per week in a semester is 1 credit.

One semester period is **16 weeks** of teaching and learning.

Duration of semester is **20 weeks** that includes semester end examinations.

Credit Distribution:

Course Type	Credits
Hard Core	Minimum Credits - 48 and Maximum Credits - 56
Soft Core	Minimum Credits - 16
Open Elective	Minimum Credits - 8

SCHEME OF STUDY AND EXAMINATION
I to IV SEMESTER M. Sc. CHEMISTRY COURSE

Sl. No.	Semester	HCT	SCT	HCP	OE	Credits
1	Semester I	3	2	2	—	24
2	Semester II	3	2	2	—	24
3	Semester III	3	2	2	—	24
4	Semester IV	Complete semester is dedicated for Major project (MAP)			2	16
					Total	**88**

HCT = Hard Core Theory = Credits 4
SCT = Soft Core Theory = Credits 4
HCP = Hard Core Practical = Credits 2
OE = Open Elective = Credits 4
MAP = Major Project = Credits 8

Sl. No.	Course	L	T	P	[(No. of theory × (L+T)] + (No. of practical × P) + project work	Credits
1	Hard Core	3	1	2	(9×4) + (6×2) + 8	56
2	Soft Core	3	1	—	6×4	24
3	Open Elective	3	1	—	2×4	08
					Total	**88**

Continuous Assessment Pattern:

Continuous Assessment	Time Duration	Marks		Remarks
		max	min	
CA1	1st week to 8th weeks	40	20	Minimum 50% to write SEE
CA2	9th week to 16th weeks	40	20	
CA3	After complete 16 weeks	40	20	
	SEE	60	24	Minimum 40% in SEE and 45% Aggregate (CA+SEE)

Semester-wise distribution of the course structure

First Semester

Paper Code	HC/SC	T/P	Title of the Paper	Teaching hours /week	Exam hours	Marks			Credits
						IA	Exam	Total	
22CHHCT101	HC	T	Inorganic Chemistry I	3+1	3	40	60	100	4
22CHHCT102	HC	T	Organic Chemistry I	3+1	3	40	60	100	4
22CHHCT103	HC	T	Physical Chemistry I	3+1	3	40	60	100	4
Choose two among the three Soft Core subjects									
22CHSCT104	SC	T	Chromatographic Separation Techniques	3+1	3	40	60	100 100	4 4
22CHSCT105	SC	T	Chemistry of Carbohydrates & Photochemistry	3+1	3	40	60		
22CHSCT106	SC	T	Optical, Thermal and Kinetic Methods of Analysis	3+1	3	40	60		
22CHHCP107	HC	P	Chemistry Practical I	4	6	20	30	50	2
22CHHCP108	HC	P	Chemistry Practical II	4	6	20	30	50	2
							Total	**600**	**24**

Second Semester

Paper Code	HC/SC	T/P	Title of the Paper	Teaching hours /week	Exam hours	Marks			Credits
						IA	Exam	Total	
22CHHCT201	HC	T	Inorganic Chemistry II	3+1	3	40	60	100	4
22CHHCT202	HC	T	Organic Chemistry II	3+1	3	40	60	100	4
22CHHCT203	HC	T	Physical Chemistry II	3+1	3	40	60	100	4
Choose two among the three Soft Core subjects									
22CHSCT204	SC	T	Introduction to Nanoscience and Nanotechnology	3+1	3	40	60	100 100	4 4
22CHSCT205	SC	T	Modern Inorganic Chemistry	3+1	3	40	60		
22CHSCT206	SC	T	Polymer Chemistry	3+1	3	40	60		
22CHHCP207	HC	P	Chemistry Practical III	4	6	20	30	50	2
22CHHCP208	HC	P	Chemistry Practical IV	4	6	20	30	50	2
							Total	**600**	**24**

Third Semester

Paper Code	HC/SC	T/P	Title of the Paper	Teaching hours /week	Exam hours	Marks			Credits
						IA	Exam	Total	
22CHHCT301	HC	T	Advanced Inorganic Chemistry	3+1	3	40	60	100	4
22CHHCT302	HC	T	Advanced Organic Chemistry	3+1	3	40	60	100	4
22CHHCT303	HC	T	Advanced Physical Chemistry	3+1	3	40	60	100	4
Choose two among the three Soft Core subjects									
22CHSCT304	SC	T	Spectroscopic Technique	3+1	3	40	60	100 100	4 4
22CHSCT305	SC	T	Medicinal Chemistry	3+1	3	40	60		
22CHSCT306	SC	T	Organometallic Compounds	3+1	3	40	60		
22CHHCP307	HC	P	Chemistry Practical V	4	6	20	30	50	2
22CHHCP308	HC	P	Chemistry Practical VI	4	6	20	30	50	2
							Total	**600**	**24**

Fourth Semester

Paper Code	HC/SC	T/P	Title of the Paper	Teaching hours /week	Exam hours	Marks			Credits
						IA	Exam	Total	
22CHOET401	OE	T	MOOC/Swayam (Complete within 3 semesters) Environmental Chemistry	3+1	3	40	60	100	4
22CHOET402	OE	T	Research Methodology	3+1	3	40	60	100	4
22CHMAP403	HC	PR	Major Project			100	100	200	8
							Total	**400**	**16**

Hard Core Subjects

Sl. No.	Paper Code	T/P	Title of the Paper	Credits
1	22CHHCT101	T	Inorganic Chemistry I	4
2	22CHHCT102	T	Organic Chemistry I	4
3	22CHHCT103	T	Physical Chemistry I	4
4	22CHHCP107	P	Chemistry Practical I	2
5	22CHHCP108	P	Chemistry Practical II	2
6	22CHHCT201	T	Inorganic Chemistry II	4
7	22CHHCT202	T	Organic Chemistry II	4
8	22CHHCT203	T	Physical Chemistry II	4
9	22CHHCP207	P	Chemistry Practical III	2
10	22CHHCP208	P	Chemistry Practical IV	2
11	22CHHCT301	T	Advanced Inorganic Chemistry	4
12	22CHHCT302	T	Advanced Organic Chemistry	4
13	22CHHCT301	T	Advanced Physical Chemistry	4
14	22CHHCP307	P	Chemistry Practical V	2
15	22CHHCP308	P	Chemistry Practical VI	2
16	22CHMAP403	P	Major Project	8
			Total	**56**

Soft Core Subjects

Sl. No.	Paper Code	T/P	Title of the Paper Select any two (22CHSCT104, 22CHSCT105 &22CHSCT106) Select any two (22CHSCT204, 22CHSCT205 &22CHSCT206) Select any two (22CHSCT304, 22CHSCT305 &22CHSCT306)	Credits
1	22CHSCT104	T	Chromatographic Separation Techniques	4
2	22CHSCT105	T	Chemistry of Carbohydrates & Photochemistry	
3	22CHSCT106	T	Optical, Thermal and Kinetic Methods of Analysis	4
4	22CHSCT204	T	Introduction to Nanoscience and Nanotechnology	4
5	22CHSCT205	T	Modern Inorganic Chemistry	
6	22CHSCT206	T	Polymer Chemistry	4
7	22CHSCT304	T	Spectroscopic Technique	4
8	22CHSCT305	T	Medicinal Chemistry	
9	22CHSCT306	T	Organometallic Compounds	4
			Total	**24**

Open Electives Subjects

Sl. No.	Paper Code	T/P	Title of the Paper	Credits
1	22CHOET401	T	MOOC/Swayam/Environmental Chemistry	3
2	22CHOET402	T	Research Methodology	3
			Total	**8**

M.Sc. CHEMISTRY SYLLABUS
FIRST SEMESTER

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT101	**Inorganic Chemistry – I**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. Analyze the structure and energetics of Ionic crystals like NaCl, CsCl, ZnS, etc., and also studying the molecular orbital diagrams of homonuclear diatomic and hetero atomic diatomic molecules.
ii. Identify the synthesis, structure and properties of Non-transition elements of Boranes, carboranes, borazines, silicones, etc.
iii. Explain the modern concept of Acids and Bases like Arrhenius, Lewis, Bronsted Lowry, Lux-Flood and Usanovich concepts.
iv. Discuss the properties of Non-aqueous solvents like protic solvents (anhydrous H_2SO_4 and HF) aprotic solvents (liquid SO_2, BrF_3 and N_2O_4). Solutions of metals in liquid ammonia.
v. Discuss the properties of lanthanides and actinides on the study of Oxidation states, spectral, magnetic properties. Also discuss the applications of lanthanides.

Course Outcome:

By the completion of course student will be able to

CO1. Understand the structure and energetics of Ionic crystals like NaCl, CsCl, ZnS, and Molecular orbital diagrams of homo nuclear and hetero nuclear diatomic molecules.
CO2. Understand the concept of synthesis, structure and properties of Non-transition elements of Boranes, carboranes, borazines, silicones,
CO3. Understand the properties of Non-aqueous solvents like protic solvents (anhydrous H2SO4 and HF) aprotic solvents (liquid SO_2, BrF_3 and N_2O_4)
CO4. Understand the properties and applications of f-block elements.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT- I

16 hrs

Structures and Energetics of Ionic Crystals: Introduction and review of properties. Introduction of MX (NaCl, CsCl, ZnS) and MX_2 (fluorite, rutile, β-crystobalite and cadmium iodide) types.The perovskite and spinel structures.Lattice energy, Born-Haber cycle, Born-Lande equation.Applications of lattice energetics. Radius ratio rules

Structures and Energetics of Inorganic Molecules: Introduction, Energetics of hybridization. VSEPR model for explaining structure of AB, AB_2E, AB_3E, AB_2E_2, ABE_3, AB_2E_3, AB_4E_2, AB_5E and AB_6 molecules.M.O. treatment of homonuclear (H to O) andheteronuclear diatomic molecules (CO_2, CO, CO^+, CO^-, NO, NO^+).

UNIT- II

16 hrs

Chemistry of Non-transition Elements: General discussion on the properties of the non-transition elements; special features of individual elements; synthesis, properties and structure of their halides and oxides, polymorphism of carbon, Phosphorous and Sulphur.

Synthesis, properties and structure of boranes, carboranes, borazines, silicates, carbides, silicones, phosphazenes, sulphur-nitrogen compounds: peroxo compounds of boron, carbon and sulphur; oxy acids of nitrogen, phosphorous, sulphur and halogens and compounds of noble gas compounds.

UNIT-III

16 hrs

Modern Concept of Acids and Bases: Arrhenius, Lewis, Bronsted Lowry, Lux-Flood and Usanovich concepts, solvent system and leveling effect.

Non-aqueous Solvents: Classification of solvents, Properties of solvents (dielectric constant, donor and acceptor properties) protic solvents (anhydrous H_2SO_4 and HF) aprotic solvents (liquid SO_2, BrF_3 and N_2O_4). Solutions of metals in liquid ammonia.Super acids and bases.

UNIT-IV

16 hrs

Lanthanide Series: Review on electronic structure, oxidation states, spectral andMagnetic properties, lanthanide contraction.

Separation of Lanthanides: Solvent extraction and ion–exchange. Chemical properties ofcompounds of lanthanides in II, III, and IV oxidation states.

Actinides: Review on Electronic structure and position in the periodic table, Spectral and magnetic properties ofcompounds of actinides in comparison with those of lanthanides and d-block elements.

Applications: Lanthanides as shift reagents, Chemistry of trans-uranium elements, High temperature super conductors.

SUGGESTED BOOKS

1. Basic Inorganic Chemistry – 3rd edition. F.A. Cotton, G. Wilkinson and P.L. Gaus, John Wiley and Sons (2002).
2. Inorganic Chemistry, 3rd edition. James E. Huheey, Harper and Row Publishers (1983).
3. Inorganic Chemistry, 3rd edition. G.L. Miessler and D.A. Tarr, Pearson Education (2004).
4. Inorganic Chemistry, 2nd edition. D.F. Shriver, P.W. Atkins and C.H. Langford, Oxford University Press (1994).
5. Inorganic Chemistry, 2nd edition. C.E. Housecroft and A.G. Sharpe, Pearson Education Ltd. (2005).
6. Introduction to Modern Inorganic Chemistry, K.M. Mackay and R.A. Mackay, Blackie Publication (1989).
7. Concepts and Models of Inorganic Chemistry 3rd edition. B.E. Douglas, D.H. McDaniel and Alexander, Wiley (2001).
8. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
9. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
10. Concise Inorganic Chemistry, 5th edition; J. D. Lee (1996).

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT102	**Organic Chemistry – I**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

vi. Analyze the effect of acid, base, conjugation, hyperconjugation delocalization, resonance and aromaticity in organic molecules.
vii. Identify the reactive intermediates in the reaction mechanism and also examine the energy profile of the reactions.
viii. Explain the concept of electrophilic, nucleophilic substitution in aromatic and aliphatic compounds, and also the kinetic concepts of substitution and elimination reactions.
ix. Discuss the concept of electrophilic, nucleophilic addition to C-C multiple bonds, addition to carbonyl compounds and applications of these reactions.
x. Discuss the core concepts of stereochemistry in organic molecules.

Course Outcome:

By the completion of course student will be able to

CO5. Explain the concept of acid, base, effect of conjugation, hyperconjugation delocalization, resonance and aromaticity in organic molecules.Analyze role of reactive intermediates such as carbocations, carbanion, carbines, nitrenes and kinetics reaction.
CO6. Exploring the concept of Electrophilic, nucleophilic substitution in aromatic and aliphatic compounds. Comparison of competition between elimination and substitution reactions
CO7. Explaining the concept of addition of electrophile and nucleophiles to C-C multiple bonds, addition to carbonyl compounds and their applications
CO8. Predict R/S, E/Z configuration, chirality in molecules by applying concepts of stereochemistry

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT- I

16 hrs

Structure and Reactivity: Introduction to Acids and Bases, Structural effects on acidity and basicity of organic molecules, hydrogen bonding, resonance, inductive and field effects, hyper conjugation effects, steric effect, Bredt's rule.

Aromaticity: Huckel's rule of aromaticity, benzenoid and non-benzenoidaromatic compounds, Tropones, Tropolones, Pyrilium cation, ferrocene. Alternant and nonalternant hydrocarbons, aromaticity of charged rings (3-8 membered), non-aromatic, antiaromatic and homo aromatic systems, Annulenes and hetero annulenes (10-18).

Reaction Intermediates: Generation, structure, stability, reactivity and detection of classical and non-classical carbocations, carbanions, free radicals, carbenes andnitrenes including nitrogen,phosphorous and sulfur ylides.

UNIT- II

16 hrs

Electrophilic Substitution Reactions– Kinetics, mechanism and stereochemical factors affecting the rate of SE1 & SE2 reactions.

Aromatic Electrophilic Substitution Reactions: Mechanism of nitration, halogenation,sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction,

chloromethylation, VilsmeierHaack reaction, Diazonium coupling, Gattermann–Koch reaction, Mercurationreaction.

Aromatic NucleophilicSubstitution Reactions: SN^1, SN^2 and benzyne mechanism, Bucherer reaction and von Richter reaction.

Elimination Reactions: Mechanism and stereochemistry of eliminations–E1, E2, E1cb mechanism, cis-elimination, Hofmann and Saytzeff eliminations, competition between elimination and substitution, Chugaev reaction.

Substitution Reactions – Kinetics, mechanism and stereochemical factor affecting the rate of SN^1, SN^2, SRN^i, Neighbouring group participation.

UNIT- III

16 hrs

Addition Reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles and free radicals. Markownikoff's rule and Antimarkownikoff's rule, Hydroboration.

Typical Additions to Carbonyl Compounds: Addition of hydride, water, alcohol, thioalcohol, bisulphite, HCN, Grignard reagents and amino compounds to carbonyl compounds.

Aldol and Related Reactions: Keto-enoltautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Perkin reaction, Knoevenogel, benzoin, Schmidt reaction, Stobbe and Darzen'sglysidic ester condensation, Cannizaro reaction, Michael addition, Robinson's annulation reactions.

Mechanism of ester formation and their hydrolysis, formation and hydrolysis of amides, decarboxylation mechanisms.

UNIT-IV

16 hrs

Stereoisomerism: Projection formulae [fly-wedge, Fischer, Newman and saw horse].

Optical Isomerism: Conditions for optical isomerism, optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls, criteria for optical purity. enantiomorphs, diastereoisomers, racemic mixtures and their resolution, configurational notations of simplemolecules, DL and RS configurational notations**.**

Geometrical Isomerism: Isomorphism due to C=C, C=N and N=N bonds, E,Z conventions,

Conformational Analysis: Elementary account of conformational equilibria of ethane, butane and cyclohexane, Conformational analysis of 1,2-; 1,3-; 1,4disubstitutedcyclohexane derivatives.

Stereoselectivity: Stereoselective, diastereoselective&regioselective reactions.

SUGGESTED BOOKS

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. E. L. Elliel and S. H. Wilen, Stereochemistry of Organic Compounds, John Wiley and Sons, New York. 1994.
3. Introduction to stereochemistry – K. Mislow.
4. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
5. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
6. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart& Winston, New York, 964.
7. A Guide book to mechanism in Organic Chemistry – Petersykes
8. Stereochemistry and mechanism through solved problems – P. S. Kalsi.
9. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT103	**Physical Chemistry – I**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. It deals with discussion of surface mechanism of a particular reaction.
ii. It gives an idea about the catalytic process and the role of catalysts.
iii. How corrosion takes place and what are the types of corrosion.
iv. It gives an idea about the colloids and how to differentiate the colloidal solution.,
v. What is electrochemical power systems and its uses.

Course Outcomes:

By the completion of course student will be able to

CO1. To differentiate the type of reaction which takes place on the surface whether it is of chemical interaction or physical interaction.

CO2. Illustrate the reaction mechanism involved with the help of a catalyst and how catalytically does a reaction goes.

CO3. Analyze what type of corrosion has taken place and the reason for corrsosion nad how corrosion can be prevented.

CO4. Identify the type of battery whether it is primary or secondary battery and their working.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

Surface Chemistry and Catalysis

Surface Chemistry: Adsorption by solids, types of adsorption isotherms, chemisorptions and physisorption, adsorption of gasses by solids, factors influencing adsorption, Freundlich and Langmuir adsorption theories, BET theory of multilayer adsorption (Derivation of BET equation), Gibbs adsorption isotherm, Modern technique for investigating surfaces-LEED,PES and STM.

Catalysis: Introduction, characteristics of catalysts, acid-base catalysis- prototypic and protolytic mechanism. Enzyme catalysis, Michaelis-Menten equation, effect of temperature, pH and concentration on enzyme catalysis. Heterogeneous catalysis: surface reactions, kinetics of surface reactions, unimolecular and bimolecular surface reactions, pH-dependence of rate constants of catalyzed reactions and their applications.

UNIT-II

16 hrs

Colloids

Colloids: Colloidal systems, classification of colloids, lyophobic and lyophilic sols, preparation of lyophobic colloidal solutions (dispersion and condensation methods), purification of colloidal solutions, Properties of colloidal systems: Electrical properties – charge on colloidal particles, zeta potential, DLVO theory of the stability of lyophobic colloids, flocculation values, coagulation of colloidal solutions.

ElectrokineticProperties – electrophoresis and electro-osmosis streaming and sedimentation potential. Determination of size of colloidal particles, surfactants, hydrophile-lypophile balance (HLB). Emulsions, gels, elastic and non-elastic gels. Micelle formation – mass action model and phase separation model, shape and structure of micelles, micellar aggregation numbers, critical micelle concentration (CMC), factors affecting CMC in aqueous media,

thermodynamic approach to CMC, thermodynamics of micellization, micelle temperature range (MTR) or Krafft point.

UNIT-III

16 hrs

Corrosion: Introduction, Importance and principles, Forms of corrosion (Galvanic, Atmospheric, stress, microbial and soil). Techniques of Corrosion rate measurement (instrumental and non-instrumental). EMF series &Galvanic series and their limitations. Thermodynamics (Pourbaix diagram).Concept of mixed potential theory and its importance in terms of Kinetics (Tafel and Evans diagram), Effect of oxidizer and passivity of corrosion.Anodic and cathodic protection, inhibitors, coating).

Analytical Applications of Electrochemistry -Principles and Applications of Polarography, Cyclic voltammetry, Coulometry and Amperometry.

UNIT-IV

16 hrs

Electrochemical Power Sources - theoretical background, Properties of Electrochemical energy source, Characteristics of a Battery, Measure of battery performance, Charging and discharging of a battery, Storage Density. Types of battery, Primary battery, second battery and reserve battery. **Primary battery –** Alkaline zinc-carbon battery and zinc manganese battey

Secondary Batteries : (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc manganese dioxide and (iii) Lithium Battery.

Fuel cells - classification - chemistry of fuel cells - detailed description of hydrogen/oxygen fuel cells, alkaline fuel cell, Phosphoric and fuel cell, methanol - molten carbonate solid polymer electrolyte and applications of fuel cells

SUGGGESTED BOOKS

1. Physical Chemistry by P.W. Atkins, ELBS, 5th edition, Oxford University Press (1995).
2. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974). 3. Elements of Physical Chemistry by Lewis and Glasstone.
3. Fundamentals of physical chemistry – Maron and Lando (Collier Macmillan) 1974.
4. Thermodynamics for Chemists by S. Glasstone, Affiliated East-West Press, New Delhi, (1965).
5. Chemical Thermodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam (1964).
6. Chemical Kinetics by K.J. Laidler.
7. Chemical Kinetics by Frost and Pearson.
8. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose.
9. Chemical Kinetics by L.K. Jain.
10. Chemical Kinetics by Benson. 12. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
10. Elements of Physical Chemistry by Lewis and Glasstone.
11. Physical Chemistry by P.W. Atkins, ELBS, 4th edition, Oxford University Press (1990).
12. Physical Chemistry – G.M. Barrow, McGraw Hill International Service (1988).
13. Introduction to Electrochemistry by S. Glasstone.
14. Electrochemistry –Principles and Applications by E.G. Potter.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT104	**Chromatographic Separation Techniques**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. To know the limitations of analytical method.
ii. It gives an idea about what is chromatography and the terminology involved.
iii. It gives an idea about the mechanism of separation by using various analytical techniques.
iv. To know the different methods involved in the separation of the analyte and its instrumentation.
v. Also the advanced methods involved in the separation process.

Course Outcomes:

By the completion of course student will be able to

CO1. To know what is chromatography and its importance in separation.
CO2. Analyze the limitations and what treatment to be done in order to avoid the errors.
CO3. Analyze which method should be used for the separation of the analyte depending on the polarity and the volatility.
CO4. How purification and separation can be done by using various analytical techniques and hrte extraction process.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Errors and Treatment of Analytical Data: Limitations of analytical methods – Error: determinate and indeterminate errors, minimization of errors. Accuracy and precision, distribution of random errors, the normal error curve. Statistical treatment of finite samples - measures of central tendency and variability: mean, median, range, standard deviation and variance. Student's t-test, confidence interval of mean.Testing for significance - comparison of two means and two standard deviations.Comparison of an experimental mean and a true mean.Criteria for the rejection of an observation - Q-test.

UNIT-II

16 hrs

Techniques of Chromatography

Introduction, principle and Classification of chromatographic techniques, terms and definition.Differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity factor, selectivity factor.Plate theory and rate theory. Band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column, types of column,column efficiency, optimization column performance, selectivity factor, column resolution, distribution constant and applications of conventional column, advantages and limitations.

Thin layer chromatography (TLC): Definition, mechanism, efficiency of TLC plates, methodology –selection of stationary and mobile phases, preparation of micro and macro plates, development, spray reagents, identification and detection, reproducibility of Rf values, qualitative and quantitative analysis

UNIT-III

16 hrs

Paper chromatography (PC): Definitions, theory and principle, techniques; one, twodimensional and circular PC, mechanism of separation, types of paper, methodology-preparation of sample, choice of solvents, location of spots and measurement of Rf value, factors affecting Rf values, advantages and applications

High performance liquid chromatography (HPLC): Instrumentation, pumps, column packing, characteristics of liquid chromatographic detectors-UV, IR, refractometer and fluorescence detectors, advantages and applications.

Gas chromatography: Principle, types of gas chromatography, instrumentation, detectors-Thermal Conductivity Detector, Flame Ionization Detector, Electron capture detector.Factors affecting separation, temperature programming.Advantages, disadvantages and applications.

Ion exchange chromatography (IEC): Definitions, principle, requirements for ionexchange resin and its synthesis, types of ion-exchange resins, basic features of ionexchange reactions, resin properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes.

UNIT-IV

16 hrs

Solvent extraction: Definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH and oxidation state, masking and salting out agents, techniques-batch and continuous extraction, applications.

Gel permeation chromatography: Size exclusion chromatography (Gel filtration) with special reference to separation of protein, carbohydrates and nucleic acids. Preparation of medium, column, determination of void volume, sample application, detectors.

Affinity chromatography: Chromatographic matrix, ligand selection, linkage of ligands, absorbent derivatives. LC/MS, LC/MS-MS, GC/MS, GC/MS-MS for organic compound analysis.

Electrophoresis: Introduction, two-dimensional gel electrophoresis (ascending, descending), coomassie blue staining and silver staining, zone electrophoresis, capillary electrophoresis, isoelectric focusing.

Centrifugation: Introduction, high speeds centrifuges, ultracentrifuge, sedimentation coefficients, density gradient, sedimentation equilibrium, analytical centrifugation.

SUGGESTED BOOKS

1. Fundamental Analytical Chemistry, D.A. Skoog, D.M. West, Hollar and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G. D. Christian, 5th ed., 2001 John Wiley and Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, 1993 presence Hall, Inc. New Delhi.
4. Vogel‘s Text book of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D Barners and M.J.K. Thomas, 6th edition, Third Indian Reprint. 2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, Callifornia, 1990.
6. Instrumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean & Frank A. Settle, Jr., 6th edition, CBS Publishers & Distributors, Delhi, 1986.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT105	**Chemistry of Carbohydrates & Photochemistry**	SC	3	1	0	4	4

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Carbohydrates: Introduction, Ring size determination of monosaccharides, Configuration and conformation of monosaccharides, anomeric effect, epimerization and mutarotation. Chemistry of important derivatives of monosaccharides-, carboxylic acids, deoxysugars, cyclitols andaminosugars.Isolation, Importance, and Structure of disaccharides- sucrose, maltose, cellobiose. General methods of structural degradation of polysaccharides- methylation, partial hydrolysis, periodate oxidation, Smith degradation and alkaline degradation techniques. Structure and importance of cellulose, chitin, starch and glycogen.

UNIT-II

16 hrs

Fats and oils: Isolation, purification, structure and biological importance.
Essential oils: Source, constituents, isolation & uses.
Phospholipids: Isolation, structure and biological significance of lecithin and cephalin
Sphingolipids: Examples with structure and biological importance.
Prostaglandins: Classification, source, structure and its significance.
Anthocyanines: Introduction, General nature, properties and structure of anthocyanidines.Flavones and iso flavones.

UNIT-III

16 hrs

Photochemistry: Introduction to photochemistry- Laws of photochemistry and law of absorption of light. Experimental techniques to determine the intermediates in photochemical reactions. Photosensitization: by mercury, dissociation of H2. Photochemical kinetics of: Decomposition of CH_3CHO, formation of HI and HCl. Fluorescence and phosphorescence – theory and applications. Quenching of fluorescence, Kinetics of collisional quenching (Stern-Volmer equation).

UNIT-IV

16 hrs

Applications of Photochemistry: Introduction to semiconducting nano materials, classification of materials based on their dimensions (0D, 1D, and 2D materials) band gap, e^-/h^+ recombination, conversion of light to chemical (CO_2 reduction) and electrical energy (Solar cells). Photosplitting of water (H_2 and O_2 production) using colloidal suspensions (ZnO/TiO_2).Photocatalysis: Properties of photocatalyst, Photocleavage of waste (organic contents) which are environmentally hazardous by using ZnO/TiO_2 photocatalysts, Photooxidation and photoreduction reactions.

SUGGESTED BOOKS

1. Carbohydrate Chemistry and applications of carbohydrates, K. M. LokanathaRai.
2. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
3. K. Albert, L. Lehninger, D. L.
4. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT106	**Optical, Thermal and Kinetic Methods of Analysis**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. To know the atomic, molecular and flame spectroscopy techniques.
ii. It gives an idea about atomic absorption, X ray and fluorescence spectroscopy.
iii. It gives an idea about the thermal behavior of the materials.
iv. To study the kinetic method of analysis.

Course Outcomes:

By the completion of course student will be able to

CO5. To identify and analyze the ions using spectroscopic technique.
CO6. To detect the metal ion concentration and its measurement.
CO7. Will be able to know the degradation pattern and the total heat content of a system.
CO8. To study the reaction based on time and the reactants involved in a process.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Atomic and molecular spectrometry- Electromagnetic radiation, atomic energy levels, molecular energy levels, transitions, quantitative spectrometry, Beer-Lambert's law.

Atomic spectrometry- Atomic structure and spectra, intensity of spectral lines.

Arc/spark atomic (optical) emission spectrometry- Principles, instrumentation, sample preparation, qualitative and quantitative analysis, applications Glow discharge atomic emission spectrometry-principles, instrumentation, applications.

Plasma emission spectrometry- Principles, instrumentation, sample introduction, analytical measurements and applications.

Inductively coupled plasma-mass spectrometry (ICP-MS)-Principles, instrumentation and applications.

Flame emission spectrometry-principles, instrumentation, flame characteristics, flame processes, emission spectra. Quantitative measurements and interferences.Applications of flame photometry and flame atomic emission spectrometry.

UNIT-II

16 hrs

Atomic absorption spectrometry- Principles, absorption of characteristic radiation. Instrumentation-sharp line sources- hallow cathode lamps, electrodeless discharge tubes. Sample vaporization- flame vaporization, flameless vaporization, vaporization by reduction and hydride generation.Quantitative measurements and interferences.Applications of AAS.

Atomic fluorescence spectrometry-Principles, instrumentation and applications.

X-ray emission spectrometry- Principles, instrumentation and applications.

Molecular fluorescence spectrometry- Theory- relaxation processes, excitation and fluorescence spectra, fluorescent species, factors affecting fluorescence, effect of

concentration on intensity, fluorescence instruments, applications of fluorescence methods. Molecular phosphorescence- phosphorometry, chemiluminescence methods.

UNIT-III

16 hrs

Thermal methods of analysis:

Thermogravimetric analysis (TGA): Introduction, types of thermogravimetric analysis, principles. Factors affecting the results - heating rate, furnace, instrument control/data handling. Applications - purity and thermal stability, evaluation of correct drying temperature, analysis of complex mixture and determination of kinetic parameters of thermal degradation.

Differential thermal analysis (DTA): Theory - variables affecting the DTA curves. Differences between TGA and DTA.General principles.Instrumentation. Applications - analysis of the physical mixtures and thermal behaviour study. Determination of melting point, boiling point and decomposition point.

Differential scanning calorimetry (DSC): Basic principle. Differences between DTA and DSC. Instrumentation - power compensated DSC, Heat flux DSC. Applications - studies of thermal transitions and isothermal crystallization. Pharmaceutical industry for testing the purity of the samples.

UNIT-IV

16 hrs

Kinetic Methods of Analysis: Analytical uses of reaction rates relative, basis of reaction rate methods, rate laws-first and second order reactions relative rates of reactions, analytical utility of first or pseudo first order reactions, determination of reaction rates, types of kinetic methods–differential methods, integral methods, multicomponent analysis-neglect of reaction of slow-reacting component, logarithmic extrapolation method, reaction rate method, applications-catalyzed reactions, measurement methods for catalyzed reactions, micro determination of inorganic species like iodide, selenium, cobalt & mercury in complex materials, determination of organic species, non-catalytic reactions.

SUGGESTED BOOKS

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi. 4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.
5. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003, Pearson Education Pvt. Ltd., New Delhi.
6. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
7. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt and J.A. Dean, 7th Edition, (1988).
8. Principles of instrumental analysis. D.A. Skoog, D.M. West, Holler, Nieman
9. Introduction to instrumental methods of analysis. D. Braun.
10. Principles and practice of analytical chemistry. Fifield and Kealey.
11. H.H.Bauer, G.D. Christien, and J.E.O'Reilly, eds., Instrumental analysis. Boston:Allyl and Bacon, 1978, Chapter 18, "Kinetic methods" by H.B. Mark, Jr.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCP107	**CHEMISTRY PRACTICALS-I**	HC	0	1	2	3	4

Course Objectives:

The practical course on organic chemistry intends to

i. Develop scientific skills in qualitative and preparative techniques.
ii. Analyze the organic and inorganic compounds and conclude from the systematically recorded observations.
iii. Apply the experimental knowledge for analytical reasoning and rational improvisation.
iv. Evaluate the scientific data and transform into tangible outcomes.

Course Outcomes:

On successful completion of the course, the student will be able to

CO1. Develop proficiency to carry out conventional organic synthesis, reactions at inert atmosphere, low temperature, reflux conditions and develop a basic understanding of the reactivity of functional groups

CO2. Acquire skills to perform laboratory techniques such as distillation, re-crystallization, vacuum filtration, solvent extraction and chromatography.

CO3. Predict the mechanism of organic reactions, and characterize the molecules by physical methods such as Melting point or Boiling point.

CO4. Evaluate the spectral data to determine the identity and purity of the products.

PART-A

Multistep synthesis (Any 7 Synthesis)

1. Preparation p-bromoaniline from acetanilide.
2. Preparation of s-benzyl isothiouronium chloride
3. Oxidation of cyclohexanol to adipic acid.
4. Preparation of P-Iodonitrobenzene from p-Nitro aniline
5. Preparation benzilic acid from benzoin.
6. Biginelli Reaction (Preparation of dihydropyrimidine from benzaldehyde).
7. Preparation of benzanilide from benzophenoneoxime via Beckmannrearrangement.
8. Preparation of benzoic acid from benzaldehyde (Cannizzaro Reaction).
9. Preparation of 2,4-dinitrophenylhydrazine from 2,4-dinitrochlorobenzene.
10. Photo-redox catalyzed synthesis of benzimidazole

PART-B

Semimicro qualitative analysis of inorganic mixture containing four cations, out of which two will be rare earth metal ions such as W, Md, Se, Ti, Zr, Ce, Th and V

Part-C

Preparation of Inorganic Complexes

1. Preparation and quantitative analysis of hexamine cobalt(III) chloride
2. Cis- and trans- potassium dioxalatodiaquachromium(III) complex [analysis of oxalate andchromium]
3. Preparation of potassium trioxalatoferrate(III) trihydrate and its characterization by quantitative analysis

SUGGESTED BOOKS:

1. Vogel's textbook of practical organic chemistry, 5 th Edition
2. Vogel's Qualitative Inorganic Analysis- Svelha.
3. Semimicro Qualitative Analysis –F.J. Welcher and R. B. Halin.
4. Semimicro Qualitative Analysis – Ramanujam.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCP108	**CHEMISTRY PRACTICALS-II**	HC	0	1	2	3	5

Course Objectives:

This course aims to provide the student with

i. To estimate various ions using complexometric titration.
ii. To know about gravimetric estimation and estimation of various ions.
iii. To find the pH of various buffer solutions.
iv. To study the kinetics of a particular reaction.

Course Outcomes:

By the completion of course student will be able to

CO1. To know the importance of temperature in phase diagram.
CO2. Acquire knowledge on various estimation methods.
CO3. To handle the pH metric instruments and how to prepare buffer solutions.
CO4. To study the kinetics, order of a reaction and the energy of activation involved in a process.

PART-A

1. Estimation of the amount of Calcium and Magnesium ions present in the given solution complexometrically by using EDTA solution.
2. Estimation of copper ions complexometrically using EDTA solution.
3. Estimation of Lead ions complexometrically using EDTA solution.
4. Estimation of the amount of Fe (II) and Fe (III) present in the given solution using $K_2 Cr_2 O_7$.
5. Estimation of the amount of Fe (II) and Fe (III) present in the given solution by using ceric ammonium sulphate solution.
5. Estimation of copper as copper thiocyanate gravimetrically.
6. Estimation of Sulphate as Barium sulphate gravimetrically.

PART-B

1. Determination of composition of mixture by surface tension method.
2. Determination of pH of buffer and dissociation constant of weak acid.
3. Phase Diagram of two component system (Biphenyl and Naphthalene)
4. Determination of rate constant of acid catalyzed hydrolysis of an ester.
5. Kinetics of reaction between potassium persulfate and potassium iodide
6. Kinetics of reaction between iodine and sodium formate
7. Phase diagram of three component system
8. Comparison of detergent action of detergents and soaps
9. Determination of cryoscopic constant of solvent and molecular weight of non volatile substance by thermal method

SUGGETED BOOKS

1. Vogel's Textbook of Quantitative analysis, - J Mendham, R.C. Denney, J.D. Barnes M.J.K. Thomas, 3 rd , 4 th , 5 th and 6 th edition.
2. College practical Chemistry, - V K Ahulwalia
3. Analytical Chemistry, - G.D. Christian.
4. Practical Inorganic Chemistry, - K. SomashekaraRao.
5. Principles of Inorganic Chemistry- Puri, Sharma, Khalia.

SECOND SEMESTER

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT201	**Inorganic Chemistry – II**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

vi. Analyze the different preparation methods for co-ordination complexes by various methods.
vii. Learn the Crystal field theory of a various compounds with different d^n electrons.
viii. To bring the importance of factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory.
ix. Focuses on studies of Term symbols for d^n ions, Orgel diagrams, charge-transfer spectra of 3d metal-aqua complexes of trivalent and divalent metal complexes
x. To identify the Symmetry elements and symmetry operations. Concept of a group, definition of a point group, The Great Orthogonality theorem and its consequences. Character tables (Cs, Ci, C_2, C_2v, C_2h and C_3v). Symmetry and dipole moment.

Course Outcomes:

By the completion of course student will be able to

CO5. Learn the preparation methods for co-ordination complexes by various methods like addition, substitution, oxidation and reduction reactions.
CO6. Discus the Crystal field theory and John teller distortion of a various compounds with different dn electrons..
CO7. Explain the factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory.
CO8. Identify and inspect the Symmetry elements and symmetry operations. Concept of a group, definition of a point group, The Great Orthogonality theorem and its consequences. Character tables (Cs, Ci, C2, C2v, C2h and C3v). Symmetry and dipole moment.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Preparation of Coordination Compounds: Introduction, Preparative methods- simple addition reactions, substitution reactions, oxidation-reduction reactions, thermal dissociation reactions. Geometries of metal complexes of higher coordination numbers (2-12).

Crystal Field Theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, Jahn-Teller distortions, measurement of 10 Dq and factors affecting it. Evidences for metal-ligand covalency.

Molecular Orbital Theory: MOT to octahedral, tetrahedral and square planar complexes without and with pi-bonding.

UNIT-II

Metal- ligand bonding **16 hrs**

Applications of CFT- colours of transition metal complexes, magnetic properties of octahedral complex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory, MO theory: tetrahedral and octahedral complexes (including πbonding), angular overlap model. Stereochemical non-rigidity.

UNIT-III

16 hrs

Electronic spectra of coordination compounds

Introduction, selection rules and intensities, electronic spectra of octahedral and tetrahedral complexes, Term symbols for dn ions, Orgel diagrams, charge-transfer spectra of 3d metal-aqua complexes of trivalent V, Cr, divalent Mn, Co and Ni, $CoCl_4^{2-}$, calculation of Dq, B and β parameters, CT spectra. Spectral properties of Lanthanide and Actinide metal complexes.

UNIT-IV

16 hrs

Molecular symmetry and group theory: Symmetry elements and symmetry operations. Concept of a group, definition of a point group.Classification of 18 molecules into point groups.Subgroups.Schoenflies and Hermann-Maugin symbols for point groups. Multiplication tables (Cn, C_2V and C_3V). Matrix notation for the symmetry elements.Classes and similarity transformation.

Representation of groups: The Great Orthogonality theorem and its consequences. Character tables (Cs, Ci, C_2, C_2v, C_2h and C_3v). Symmetry and dipole moment.

Applications of group theory: Group theory and hybrid orbital. Group theory to Crystal field theory and Molecular orbital theory (octahedral and tetrahedral complexes).

SUGGESTED BOOKS

1. The Determination of Molecular Structure – P.J. Wheatley, Oxford University Press, Oxford (1969).
2. Advanced inorganic chemistry, (5th edition)- F.A. Cotton and G. Wilkinson: John Wiley and sons 1988.
3. Inorganic chemistry (3rd edition)-J.E. Huheey: Harper and Row, N.Y. 1983
4. Modern aspects of Inorganic chemistry (4th edition)-H.J., Emeleus and A.G. Sharpe: UBS 1989.
5. Coordination chemistry-S.F.A. Kettle, (1969)-Thomas Nelson and Sons Ltd., London.
6. Physical Inorganic Chemistry-A Coordination Chemistry Approach- S.F.A. Kettle, Spektrum, Oxford, 1996.
7. Chemical Applications of group theory, - F.A. Cotton, Wiley Eastern Ltd., 2nd Edition, New Delhi, (1971).
8. Group theory and Symmetry in Chemistry, -G. Raj, A. Bhagi and V. Jain, Krishna Prakashan Media (P) Ltd., Meerut, (1998).
9. Chemical Applications of Group Theory, 3rd edition, F.A. Cotton, John Wiley and Sons (2006).
10. Molecular Symmetry and Group Theory – Robert L Carter, John Wiley and Sons (2005).
11. Symmetry in Chemistry - H. Jaffe and M. Orchin, John Wiley, New York (1965).
12. Group Theory and its Chemical Applications - P.K. Bhattacharya, Himalaya Publications, New Delhi (1998).
13. Symmetry and spectroscopy of molecules, K. Veera Reddy, New-Age International, 2009.
14. Group theory and its chemical applications, P. K. Bhattacharya, Himalaya Publishers, Students Edition.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT202	**Organic Chemistry – II**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

xi. It deals with discussion of various oxidizing and reducing agents in organic synthesis.
xii. It deals with the relationships between Organic chemical structures and their reactivity.
xiii. Focuses on studies of reaction mechanisms in addition, elimination, substitution reactions
xiv. To bring the importance of mechanism in C-C and C-N containing organic compounds and rearrangement reactions
xv. To identify the suitable regent for organic reaction and to determine their reaction mechanisms.

Course Outcomes:

By the completion of course student will be able to

CO9. Analyze functional groups effect on electron density, properties and reactivity in organic compound.
CO10. Illustrate the reaction mechanical aspects in organic synthesis.
CO11. Explain the reaction mechanism involved in organic named reactions with respect to C-C and C-N bonding
CO12. Identify and inspect the mechanisms involved in named reactions, reagents, oxidations and reductions in solving chemistry problems.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Oxidation: Oxidation with chromium and manganese reagents (CrO_3, $K_2Cr_2O_7$, PCC, PDC, Sarret reagent, MnO_2, $KMnO_4$) ozone, peroxides and peracids, periodic acid, OsO_4, SeO_2, NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation, Fenton's reagent, Sharplessepoxidation.

Reduction: Catalytic hydrogenation (homogeneous and heterogeneous) – Metals catalysts and reduction of functional groups, catalytic hydrogen transfer reactions. Wilkinson's catalyst, $LiAlH_4$, $LiBH_4$, $NaBH_4$, DIBAL-H, Sodium cyanoborohydride, $NaBH_4$-$CeCl_3$.Lindlar'scatalyst, Rosenmund's reduction,Dissolving metal reductions (Birch reduction). Leukart reaction (reductive amination), diborane as reducing agent.

UNIT-II

Oxidizing Reagents inorganic synthesis16 hrs

Meerwein-Ponndorf-Verley reduction, Wolf-Kishner reduction, Clemmensen reduction.tributyltinhydride, stannous chloride, Bakers yeast, Organoboron compounds: Introduction and preparations. Hydroboration and its applications. Reactions of organoboranes: isomerization reactions, protonolysis, carbonylation, cyanidation. Reaction of nonallylic boron stabilized carbanions: alkylation reactions, acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes). dicyclohexylcarbodimide (DCC),Gilmann reagent, dichlorodicyanoquinone (DDQ)diisopropylamide (LDA).

UNIT-III

16 hrs

Named reactions

Use of following reagents in organic synthesis and functional group transformations: Lithium, Silane reagentstrialkylsilyl halides, trimethylsilyl cyanide, trimethylsilane, phase transfer catalyst, crown ethers, cyclodextrins, Ziegler-Natta catalyst, diazomethane, Woodward and Prevost hydroxylation, Stark enamine reaction, phosphorous ylides - Wittig and related reactions, sulphurylides – reactions with aldehydes and ketones, 1,3-dithiane anions - Umpolung reaction, Peterson reaction. Palladium reagents: Suzuki coupling, Heck reaction, Negishi reaction.

UNIT-IV

C-C and C-N bond forming reactions16 hrs Darzen's reaction, Use of acetylides in C-C bond formation reactions. Acid-catalyzed self condensation of olefins, Prins reaction, Shapiro reaction, Dieckmann cyclization, Robinson annulations, Hofmann-Loeffler-Freytag reaction.Hofmann-Martius reaction.Acyloin condensation.Stork-enamine synthesis.Meyer synthesis. Use of nucleophilic nitrogen and electrophilic carbon (NH_3, amines and nitrite as nucleophiles in substitution, NH_3 and amines in addition to ketones and aldehydes) and electrophilic nitrogen and nucleophilic carbon (nitration, nitrosation) for the bond formation reactions (including Chichibabin reaction, Skraup synthesis,N-Nitroaromatic amine rearrangement, Fisher-Hepp reaction. Japp- Klingemann reaction).

SUGGESTED BOOKS

1. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008. Organic synthesis, R.E.Ireland, Prentice-hall India, New Delhi, 1975.
2. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ Press, 1997.
3. Introduction to organic chemistry, A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.
4. Physical and mechanistic organic chemistry, R. A.Y. Jones, 1st Edn. Cambridge Univ Press, 1979.
5. Modern synthetic reactions, H. O. House, W. A. Benjamin, California, 2nd Edn. 1972.
6. Some modern methods of organic synthesis, W. Carruthurs, Cambridge Univ. Press, London, 2nd Edn. 1978.
7. Mechanisms of molecular migration, Vols I & II, B.S. Thyagarajan, Pergamon Press, Oxford, 1979.
8. Comprehensive organic chemistry, D. Barton and W. D. Wallis, Pergamon Press, Oxford, 1983.
9. Organic chemistry Vol. II, I. L. Finar 6th Edn. Longman, 1992.
10. Stereochemistry and Mechanism through Solved Problems by P.S Kalsi.
11. E.L. Eliel and S.H. Wilen, Stereochemistry of Organic Compounds, John Wiley and Sons, New York. 1994.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22 CHHCT203	**Physical Chemistry – II**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. To know the concept of thermodynamics and the parameters involved.
ii. It gives an idea about the phase diagram of a system.
iii. It gives an idea about the microstate properties of a system and also the various partition functions involved in a particular process.
iv. To study type of reactions whether it is consecutive, autocatalytic or oscillatory reactions.

Course Outcomes:

By the completion of course student will be able to

CO1. To identify and analyze the ions using spectroscopic technique.
CO2. To know what is component, degree of freedom and phase.
CO3. How the micro particles are responsible for a sytem.
CO4. To differentiate a reaction for a particular process.

Total number of lecture hours: 64 **Total number of credits: 04**

16 hrs

UNIT- I

16 hrs

Concepts of Entropy and Free Energy

Entropy as measure of randomness and unavailable energy. Entropy changes in reversible and irreversible process and during various processes. Variation of entropy with Temperature and Pressure.Variation of free energy with temperature and pressure. Helmholtz and Gibbs free energies. Gibbs-Helmholtz equation, Thermodynamic criteria of equilibrium and spontaneity.Maxwell's relations, Van't Hoff's reaction isotherm and isochore.Nernst heat theorem.

Partial molar Properties

Physical significance, Partial molar volume and partial molar free energy (chemical potential).Determination of partial molar quantities by intercept method and slope methods. Physical significance of chemical potential.

UNIT- II

16 hrs

Fugacity: Determination of fugacity of gases. Variation of fugacity with temperature and pressure.Activity and activity coefficients.Determination of activity coefficients by vapour pressure, depression in freezing point, solubility measurements.

Thermodynamics of dilute solutions: Ideal and non-ideal solutions, Raoult's law, Henry's law.. Discussion and derivation of the laws of osmotic pressure, cryoscopy and ebullioscopy and Determination of molecular weights. Liquid mixture

Partially miscible liquids: classification based on solubility, Critical solution temperature, types-Phenol water system, Aniline-Hexane system.

Phase Rule Studies: Thermodynamic derivation of phase rule, application of phase rule to the two component systems, simple eutectic type, compound formation with congruent melting point and incongruent melting points, Application of phase rule to three component systems. System of three liquids and systems of two salts and a liquid.

UNIT- III

16 hrs

Statistical Thermodynamics: Thermodynamic Probability, phase space, micro and macrostates, statistical weight factor, assembly, ensemble-significance, classification and comparison. Distribution laws – Boltzmann law, Maxwell-Boltzmann distribution law. BoseEinstein and Fermi-Dirac statistics, Limit of applicability of various laws. Relationship between partition function and thermodynamic functions- Average energy, heat capacity, Free energy. Thermodynamic quantities in terms of partition function of particles- Evaluation of Translational, vibrational, rotational, electronic partition functions. Law of equipartition principle.Sackur-tetrode equation.

UNIT-IV

16 hrs

Chemical Kinetics:

Composite reactions: Rate equation for composite reaction mechanisms (simultaneous and consecutive reactions, steady state treatment, rate determining steps and microscopic reversibility), Chain reactions (hydrogen-halogen reactions with comparison). Auto catalytic reactions (Hydrogen-Oxygen reaction) and Oscillatory reactions.

Reactions in solution: Solvent effects on the reaction rates, Factors determining reaction rates in solution, reaction between ions (effect of dielectric constant and ionic strength), substitution and correlation effects (Hammet and Taft equations-linear free energy relations.) Ion-dipole and dipole-dipole reactions (Pre exp factors and influence of ionic strength) and diffusion-controlled reactions.

Fast reactions-Introduction, Study of fast reactions by-flow method, relaxation method, pulse method, molecular beam, flash photolysis and pulse radiolysis.

SUGGGESTED BOOKS

11. Physical Chemistry by P.W. Atkins, ELBS, 5th edition, Oxford University Press (1995).
12. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974). 3. Elements of Physical Chemistry by Lewis and Glasstone.
13. Fundamentals of physical chemistry – Maron and Lando (Collier Macmillan) 1974.
14. Thermodynamics for Chemists by S. Glasstone, Affiliated East-West Press, New Delhi, (1965).
15. Chemical Thermodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam (1964).
16. Chemical Kinetics by K.J. Laidler.
17. Chemical Kinetics by Frost and Pearson.
18. Kinetics and Mechanism of Chemical Transformation by J. Rajaram and J.C. Kuriacose.
19. Chemical Kinetics by L.K. Jain.
20. Chemical Kinetics by Benson. 12. Text Book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., 2nd edition (1974).
15. Elements of Physical Chemistry by Lewis and Glasstone.
16. Physical Chemistry by P.W. Atkins, ELBS, 4th edition, Oxford University Press (1990).
17. Physical Chemistry – G.M. Barrow, McGraw Hill International Service (1988).

Statistical Thermodynamics, M. C. Gupta (New Age International, Delhi)2007.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHSCT204	**INTRODUCTION TO NANO-SCIENCE AND NANO-TECHNOLOGY**	SC	3	1	0	4	4

Total number of lecture hours: 64 **Total number of credits: 04**

Course Objectives:

This course aims to provide the student to

i. Introduction to nanotechnology.
ii. Classification of nanostructures and the methods of synthesizing.
iii. The various Nanomaterials characterization techniques nanomaterials and Carbon nanomaterials.
iv. The applications of nanomaterials in nanoelectronics and Biochemical sensor.

Course Outcomes:

By the completion of course student will be able to:

CO1. Explain the methods of synthesis of nanomaterials with properties and applications.

CO2. Categorize the Types of Nanostructures includes carbon nanomaterials and discuss the preparation, properties and applications.

CO3. Describe the various types of nanomaterials characterization techniques like imaging techniques and Spectroscopic techniques.

CO4. Apply the acquired theoretical knowledge to classify as nanocatalysts, chemical sensors, biosensors, drug delivery, Biochemical sensor, Biophysical sensor and nano electronics.

Course Content:

UNIT-I

Introduction to Nanotechnology: Atom, molecules and nanoscale materials, Electrons in nanostructures, Quantum size effects. Size effects on surface energy, surface area, optical, electrical, magnetic, thermal properties.

Synthesis approaches, Physical methods, Chemical methods, Functionalization of nanostructures, Self-assembly of nanostructures, Nano Lithographic techniques, Electrodeposition.

[12 hrs]

UNIT-II

Types of Nanostructures: Definition of a Nano system – Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) –Three Dimensional (3D) nanostructured materials – Quantum dots – Quantum wire, Quantum wells, Core/Shell structures,their electronic properties, Physical and chemical methods for preparation of nanomaterials.

Carbon nanomaterials: Fullerenes and other bucky balls. Carbon nano-tubes: Fabrication structure, electrical properties, vibrational properties, mechanical properties. Graphene, graphite and diamond and their applications.

UNIT-III

16 hrs

Methods of Preparation: Plasma arc, Chemical vapour deposition (CVD), sol-gel, silicagel, hydrolysis, condensation, polymerization of monomers to form nanoparticles, solvothermal, and hydrothermal methods, electrochemical, ball milling and pulsed laser methods.

Nanomaterials characterization techniques:

Imaging techniques: Scanning Electron Microscope (SEM) – Field Emission scanning Electron microscope(FESEM)-Atomic force microscopy (AFM), X-Ray Diffraction (XRD) and Transmission Electron Microscopy (TEM).

Spectroscopic techniques: Infra-red spectroscopy (FT-IR)- UV-visible-Absorption and Photoluminescence (PL)

UNIT-IV **16 hrs**

Applications of Nanomaterials: Molecular electronics and nanoelectronics – Quantum electronic devices - CNT based transistor and Field Emission Display – Nano magnetics, nanophotonicsnanospintronics.Biological applications –Antibacterial, antifungal and anticancer.Drug delivery targeting and medical applications.

References:

1. Nanotechnology: Basic science and Emerging technologies,1st Edition,M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Overseas Press India Pvt Ltd, New Delhi, (2005).
2. The Chemistry of Nanomaterials: Synthesis, properties and applications, C.N.R. Rao, A.Muller, A.K.Cheetham (Eds), Wiley VCH VerlagGmbh&Co, Weinheim, (2004).
3. Nanoscale Materials Science, Kenneth J. Klabunde (Eds), John Wiley & Sons, Inc, (2001).
4. Nanofabrication towards biomedical applications, C.S.S.R. Kumar, J.Hormes, C.Leuschner, Wiley – VCH Verlag GmbH & Co, Weinheim, (2004).
5. Nano Electronics and information Technology,W. Rainer, Wiley, (2003).
6. Nano systems, K.E. Drexler, Wiley, (1992).
7. Nanostructures and Nanomaterials: Synthesis, properties and applications,G. Cao, Imperical College Press, (2004).

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHSCT205	**Modern Inorganic Chemistry**	SC	3	1	0	4	4

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Organometallic chemistry: Introduction, 16 and 18 electron rule, classification of organometallic compounds by bond type, nomenclature.

Chemistry of organometallic compounds: synthesis and reactions of organozinc and organolithium reagents (n-BuLi, PhLi).

Metal Carbonyls Complexes: Preparation, Structure, chemical bonding in metal carbonyls, physical evidence related to M-CO bonding. Preparation of anionic metal carbonyl complexes and substituted metal carbonyl complexes.

Metal nitrosyls: Preparation, linear and bent nitrosyls.

Cyclopentadienyl Metal Complexes: Preparation, structures of Cyclopentadienyl Metal Complexes. M. O diagram for ferrocene. Reactions and aromaticity of ferrocene.

UNIT-II

16 hrs

Ligand substitution reactions of complexes: Labile, inert, stable and unstable complexes, classificationof mechanisms - associative (A), dissociative (D) and interchange (Ia and Id).Mechanism of ligand substitution in octahedral complexes- kinetics, factors affecting substitution in octahedral complexes: Leaving group, chelate and metal effects. Mechanism of ligand substitution in square planar complexes- factors affecting substitution, trans-effect and its theories, cis-effect, esigning synthetic routs to cis-platin and other complexes of Pt group elements. Metal exchange and ligand exchange reaction, and reaction of the coordinated ligand.

UNIT-III

16 hrs

Metal complexes as drugs and therapeutic agents: Introduction, antimicrobial agents, antiviral agents,antiarthritis agents and anticancer agents. Antidote complexes.Medicinal Bioinorganic Chemistry: Bioinorganic Chemistry of quintessentially toxic metals. Lead,Cadmium, Mercury, Aluminium, Chromium, Iron, Copper, Plutonium. Toxic effects-Mechanism of toxiceffects.Detoxification by metal chelation - Chelating agents for Hg, Pb, Cd, As toxicity. Drugs that act bybinding at the metal sites of Metalloenzymes.Chemotherapy: Chemotherapy with compounds of certainnon-essential elements. Platinum complexes in cancer therapy – Cisplatin and its mode of action and side effects.

UNIT-IV

16 hrs

Electron Spin Resonance Spectroscopy: Basic principles- intensity-width-position and multiple structure. General rules for the interpretation of the spectra. Zero field splitting and Kramer‘s degeneracy rule. Factors affecting the magnitude of ‗g‘ value. Double

resonance-ENDOR and ELDOR.Applications-study of free radicals-structure determination-biological study-coordination compound and analytical applications.

Mossbauer spectroscopy: Theoretical basis. Interpretation of Mossbauer spectraisomer shift- Quadrupole splitting and magnetic hyperfine structure, time and temperature effects.Instrumentation. Applications-structure deducetion-$I_2Br_2Cl_4$, $Fe_3(CO)_{12}$

SUGGESTED BOOKS

1. Inorganic Chemistry- F. A. Cotton and G .Wilkinson (2nd edition)
2. Organometallic Chemistry- R. C. Mehrothra and A. Singh
3. Spectroscopy by B P Stranghan and S Walker, John Wiley and Sons, Inc., New York, Vol. I and 2, 1976
4. Organic spectroscopy by Willaa Kemp, ELBS Society, MacMillan, 1987.
5. Application of absorption spectroscopy of organic compounds by JohnR. Dyer, Prentice-Hall of India Pvt. Ltd., New Delhi.1974.
6. Organic spectroscopy by V.R. Dhani, Tata McGrow-Hill Publishing company Ltd., New Delhi, 1995.
7. 7. Spectometric identification of organic compounds, 4th edition, Robert M, Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley and Sons Inc., New York, Vol.1, 1981
8. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
9. Instrumental method of analysis, Hobart H, Willard, Lynne L, Merritt, Jr., John A. dean and franmk A Settle, Jr., 6th edition, CBS Publishers and Distributors, Delhi, 1986.
10. Physical methods for chemists by R.S. Drago, Sunders College publishing, New York.
11. Quantitative Analysis, R. A Day and A./L Underwqood, 6th edition, prentice Hall, Inc., 1999.
12. Principles of instrumental Analysis, D.A.Skoog, F.J Holler and T.A. Nieman, 5th edition, Thomson Asis Pvt. Ltd. Singapore,1998.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHSCT206	**Polymer Chemistry**	SC	3	1	0	4	4

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Terminology and basic concepts: Monomers, Functionality, repeatingUnits, degree of polymerization. Classification based on various considerations-source, preparation methods, thermal behavior, chain structure etc.

Types –Homopolymers and copolymers; Linear, branched and network polymers.

Techniques of polymerization: Techniques of preparation of addition and condensation polymers.

Stereochemistry of polymers: Geometric and optical isomerism in polymers. Structure, properties and preparation of stereoregular polymers.Expressions for average molecular weighs. Molecular weight distribution and Polydispersity

Determination of molecular weight: Osmometry, viscometry, ultracentrifugation and GPC methods

UNIT-II

16 hrs

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Mechanisms and Methods of Polymerization - Step (condensation) polymerization - Description - Reactivity Functional Groups - Kinetic and thermodynamic considerations - Molecular weight distribution. Chain polymerization, controlled radical polymerizations (INIFERTER, ATRP, RAFT). Living Polymerizations. Ziegler-Natta (Mono and bimetallic) and metathesis polymerizations.Kinetics and mechanism of addition and condensation polymerization.

Polymer Characterization: Polymer crystallinity, analysis of polymers using IR, XRD (Degree of Crystallinity, Lamellar Thickness, Crystalline Composition and Orientation), thermal (DSC, DMTA, TGA), microscopic (optical and electronic) techniques

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UNIT-III

16 hrs

Structural features, properties and uses of commercial polymers: polyethylene, polypropylene, polystyrene, PVC, polyesters, polyamides, polyurethanes and polycarbonates.

Conducting Polymers: Synthesis of conducting polymers (Poly aniline, polythiophene, polyphenylene sulfide, polypyrrole and their applications.

Biomedical Polymers: Criteria for the Selection of Biomedical Polymers Physicochemical Aspects of the Blood Compatibility of Polymeric Surface. Biomedical Polymers from biological source, Poly hydroxyl Alkanoic Acids, Microbial polysaccharides, Silk, Collagen.Microbial Cellulose, Hyaluronic Acid and Hydrogels.

UNIT-IV

16 hrs

Blends and Composites- Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, thermodynamics, phase morphology. Composites: production of composite, Fibre Reinforced Plastics, particulate, long and short fibre reinforced composites. Nanocomposites: Types and applications of nanocomposites.

Polymer processing Techniques- Introduction Compounding-, Compression molding, transfer molding, injection molding, blow molding, extrusion, rotational molding, thermoforming and 3D Printing techniques.

Degradation of polymers- Recycling, Incineration and biodegrdation.

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SUGGESTED BOOKS

1. Text book of Polymers- F.W. Billmeyer (Wiley)
2. Contemporary Polymer Chemistry-H.R. Allcock and F.W. Lampe (Prentice Hall).
3. Polymer Science and Technology-J.R. Frird (Prentice Hall).
4. Polymer Science: V.R. Gowariker, N.V. Viswanathan& T. Sreedhar
5. Principles of Polymer Science- P. Bahadur and N.V. Sastry (Narosa Publishers)

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCP207	**CHEMISTRY PRACTICALS -III**	HC	0	1	2	3	4

PART-A

1. Estimation of calcium carbonate in limestone by oxalate method.
2. Estimation of amount of iron present in hematite ore.
3. Estimation of Chromium and manganese in steel sample
4. Estimation of amount of copper present in $CuSO_4$ solution.
5. Separation and estimation of Copper and Iron in a solution mixture.
6. Separation and estimation of Nickel and Iron in a solution mixture.
7. Estimation of Chlorate in potassium chlorate solution.
8. Synthesis and characterization of ZnO nanoparticles
9. Photocatalytic degradation of organic dyes using nanomaterials
10. Photochemical conversion of coumarin to7-hydroxycoumarin

PART-B

QUALITATIVE ANALYSIS

Systematic separation of organic binary mixtures of solid type using chemical and physical methods. At least eight experiments from the following combinations,

Acid + Phenol Phenol + Base Base + Neutral
Acid + Base Phenol + Neutral
Acid + neutral

SUGGESTED BOOKS

Advanced Practical Organic Chemistry

1. N K Vishnoi , Second edition, Vikas Publishing House Pvt. Ltd, 1996
2. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis
3. RenuAggarwal, V. K. Ahluwalia, Universities press (India), 2001
4. Systematic Laboratory Experiments in Organic Chemistry
5. Comprehensive Practical Organic Chemistry: Qualitative Analysis
6. Ahluwalia V.K. SunithaDhingra, First edition, Orient Longman, 2004
7. Practical Organic Chemistry: Qualitative Analysis
8. Bhutani S.P. Chhikara A, First edition, ANE books-new Delhi, 2009
9. Vogel's Textbook of Practical Organic Chemistry
10. Laboratory techniques in Organic chemistry
11. V.K. Ahluwalia, PoojaBhagat&RenuAggarwal, I.K. International Publishing House Pvt.Ltd.
12. Laboratory Manual of Organic Chemistry
13. Raj K. Bansal. 5th edition, New Age international, 2008
14. Practical Organic Chemistry
15. F.G. Mann, B.C Saunders, Fourth edition, Pearson India,2009.
16. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
17. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
18. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCP208	**CHEMISTRY PRACTICALS -IV**	HC	0	1	2	3	4

Course Objectives:

This course aims to provide the student with

v. How to handle various instruments for carrying out the titrations.
vi. To know how two different solvents gets associated or how a dimer is formed in between two solvents(aqueous and organic solvents).
vii. To determine the equivalence conductance of weak electrolyte.
viii. How the electrode potential will changes with respect to different electrode system.

Course Outcomes:

By the completion of course student will be able to

CO5. To know how the potential developed between two electrodes helps in finding the end pint.
CO6. Acquire knowledge on acid dissociation constant and also how temperature helps in increasing the solubility..
CO7. How the conductance varies for different electrolytic system..
CO8. To handle pH metric and conductometric instruments.

1. Determination of mean ionic activity co-efficient of weak acid (formic acid and Acetic acid).
2. Determination of pK_avalue of polybasic acid by Potentiometric titration.
3. Determination of isoelectric point of aminoacid by using pH metric method
4. Potentiometric titration of halide mixture
5. Determination of association constant of Benzoic acid in organic solvent
6. Verification of Nernst Equation and determination of thermodynamic property
7. Conductometric titration of mixture of a strong acid + weak acid and strong base.
8. Heat of solution of benzoic acid.
9. Determination of Molecular weight of Polymer by Viscometric method
10. Determination of strength of $ZnSO_4$ solution using $BaCl_2$ solution conductometrically.
11. pH titration of CH_3COOH v/s NaOH.
12. pH titration $CuSO_4$ v/s NaOH.
13. Determination of equivalent conductance at infinite dilution for strong electrolyte (KCl).
14. Colorimetric estimation ($K_2Cr_2O_7$).

SUGGESTED BOOKS

1. Advanced Practical Physical Chemistry, J.B.Yadav.
2. College Practical Chemistry, V.K. Ahulwalia, SunithaDhigraAdarshGulati.
3. Experimental Physical Chemistry, V.D.Athawale, ParulMathur.
4. Practical Physical Chemistry, B. Vishwanathan, P.S.Raghavan
5. Experimental Physical Chemistry: Laboratary Text, Arthur Halpern, GeogeMcBane, 3rd Edition.
6. Physical Chemistry Practical, Saroj Kumar Maity, Naba Kumar Ghosh.
7. Vogel's Quantitative ChemicalAnalysis, J Mendham.
8. Practical Physical chemistry, Findlay Alexander, 17th Edition.
9. A Text book of Practical Physical Chemistry, K Fajan, J Wust.
10. Experiments in Physical Chemistry, Carl Garland Joseph Nibler, David Shoemaker, 8th Edition.
11. Practical Physical chemistry, James Brierley firth.
12. Findlay's Practical Physical chemistry, B.P. Levitt, 9th Edition.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT301	**ADVANCED INORGANIC CHEMISTRY**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. Discuss the introduction to organometallic chemistry, 16 and 18 electron rule, metal carbonyl complexes and preparation of linear and bent Nitrosyls.
ii. Discussion of Bioinorganic aspects of sodium and Potassium, Calcium and chlorophyll, Vitamin B12 and Nitrogen fixation.
iii. Discuss the Oxygen carrying proteins, transport and storage of iron, iron transport in microbes and electron transport proteins.
iv. Discuss the basic principle of ESR, interpretation of spectra, Zero filed splitting, Krammers degeneracy rule and determination of the free radical structures.

Course outcome:

By the completion of course student will be able to

CO1. Analyze and understand the organometallic chemistry, 16 and 18 electron rule, metal carbonyl complexes and prepraration of linear and bent Nitrosyls.
CO2. Understand the concepts of bioinorganic aspects of sodium and Potassium, Calcium and chlorophyll, Vitamin B12 and Nitrogen fixation.
CO3. Acquire the knowledge of oxygen carrying proteins, transport and storage of iron, iron transport in microbes and electron transport proteins
CO4. understand the basic principle of ESR, interpretation of spectra, Zero filed splitting, Krammers degeneracy rule and determination of the free radical structures.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Organometallic Chemistry: Introduction, 16 and 18 electron rule, classification of organometallic compounds by bond type, nomenclature.

Chemistry of Organometallic compounds: synthesis and reactions of organozinc and organolithium reagents (n-BuLi, PhLi).

Metal Carbonyls Complexes: Preparation, Structure, chemical bonding in metal carbonyls, physical evidence related to M-CO bonding. Preparation of anionic metal carbonyl complexes and substituted metal carbonyl complexes.

Metal Nitrosyls: Preparation of linear and bent nitrosyls.

Cyclopentadienyl Metal Complexes: Preparation, structures of Cyclopentadienyl Metal Complexes. M. O diagram for ferrocene. Reactions and aromaticity of ferrocene.

UNIT-II

16 hrs

Bioinorganic aspects of sodium and Potassium: Sources, absorption, distribution and functions. The transport mechanism, Na^+, K^+transporting ATP_{ase}(The Na^+/K^+pump)

Bioinorganic chemistry of calcium and Magnesium.Binding, transport and accumulation of Ca^{2+}, calcium and muscle contraction, calcium in blood cloting mechanism.Chlorophyll and its role in photosynthesis.

Chemistry of Vitamin $B_{12}$and model compounds.Structure of Vitamin B_{12}, Derivatives of B_{12}, Biochemical functions of B_{12}model compounds.

Biochemical aspects of Molybdenum.Aspectsof molybdenum chemistry, Molybdenum containing enzymes -xanthine oxidase, aldehyde oxidase, sulphite oxidase, nitrogenase and nitrate reductase.Nitrogen fixation.

UNIT-III

16 hrs

Oxygen carrying proteins: Introduction to porphyrin system, substituent effects on porphyrin rings, hemoglobin and myoglobin, model compounds for oxygen carriers (cobalt, iridium, iron and nickel). Hemerythrin and hemocyanin.
Transport and Storage of Iron; Ferretin, transferrin, phosvitin, and gastroferrin.
Iron transport in microbes: Siderophores, *in vitro*microbial transport of iron.
Electron transport Proteins: Iron-Sulphur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P_{450}.
Iron and Copper containing redox enzymes: Catalase and peroxidase. Superoxide dismutase.

UNIT-IV

16 hrs

Electron Spin Resonance Spectroscopy: Basic principles- intensity-width-position and multiple structure. General rules for the interpretation of the spectra. Zero field splitting and Kramer‘s degeneracy rule. Factors affecting the magnitude of ‘g’value.Double resonance-ENDOR and ELDOR.Applications-study of free radicals-structure determination- biological study-coordination compound and analytical applications.

SUGGESTED BOOKS

13. Inorganic Chemistry- F. A. Cotton and G .Wilkinson (2nd edition)
14. Organometallic Chemistry- R. C. Mehrothra and A. Singh
15. Spectroscopy by B P Stranghan and S Walker, John Wiley and Sons, Inc., New York, Vol. I and 2, 1976
16. Organic spectroscopy by Willaa Kemp, ELBS Society, MacMillan, 1987.
17. Application of absorption spectroscopy of organic compounds by JohnR. Dyer, Prentice-Hall of India Pvt. Ltd., New Delhi.1974.
18. Organic spectroscopy by V.R. Dhani, Tata McGrow-Hill Publishing company Ltd., New Delhi, 1995.
19. 7. Spectometric identification of organic compounds, 4th edition, Robert M, Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley and Sons Inc., New York, Vol.1, 1981
20. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
21. Instrumental method of analysis, Hobart H, Willard, Lynne L, Merritt, Jr., John A. dean and franmk A Settle, Jr., 6th edition, CBS Publishers and Distributors, Delhi, 1986.
22. Physical methods for chemists by R.S. Drago, Sunders College publishing, New York.
23. Quantitative Analysis, R. A Day and A./L Underwqood, 6th edition, prentice Hall, Inc., 1999.
24. Principles of instrumental Analysis, D.A.Skoog, F.J Holler and T.A. Nieman, 5th edition, Thomson AsisPvt. Ltd. Singapore,1998.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT302	**ADVANCED ORGANIC CHEMISTRY**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

v. The advanced lineup in organic synthesis provides a deeper understanding of the reactivity and properties of the organic compounds and emphasis on the applications of important reagents and reactions in organic synthesis.

vi. Discussion of newer methods for the stereoselective formation of carbon-carbon double bonds, and the modern application of the Diels Alder reaction, particularly its use in the control of stereochemistry in the synthesis of natural products.

vii. Determine which strategic bond constructions can be used most effectively to obtain synthetic targets with high selectivity.

Course outcome:

By the completion of course student will be able to

CO5. Analyze Molecular Orbital (HOMO-LUMO) symmetry concepts and pericyclic reactions.
CO6. Differentiate the products by photochemical and thermal reactions.
CO7. Differentiate the products by Sigmatropic and dipolar addition.
CO8. Discuss the type of reactions occur in organic synthesis.

Total number of lecture hours:64 **Total number of credits: 04**

UNIT-I

16 hrs

Photochemistry and concerted reactions: Introduction, light absorption and electronic transitions, Franck Condon principle, internuclear distance, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers Photochemistry of olefins,cis-trans isomerization, photoisomerization, dimerization of olefins, conjugated dienes, aromatic compounds includes benzene, o-xylene, m-xylene, p-xylene, ketones, enones, dienones, photooxidations, photoreductions Norrish type I and II reactions, Paterno-Buchi reaction, Barton reaction, Di-pi-methane rearrangements

UNIT-II

16 hrs

Pericyclic reactions: Classification of pericyclic reactions. Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system.

Electrocyclic reactions: Woodward-Hofmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadiene and cyclohexadiene systems.

Cycloaddition reactions: [2+2], [3+2] and [4+2] cycloadditions, analysis by FMO and correlation diagram method. Cycloadditions - antarafacial and suprafacial additions, [2+2] additions of ketenes.

UNIT-III

16 hrs

1,3-dipolar cycloadditions: involving nitrile oxide, nitrile imine, nitrile ylidecycloaddition. Intra and intermolecular 3+2 cycloaddition and their application in organic synthesis.**[4+2] cycloaddition reactions:**Deil's-Alder reaction, hetero Diel's-Alder reaction and their applications. **Sigmatropic rearrangements** - Classification, stereochemistry and mechanisms.suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties. [3,3]- and [5,5]- sigmatropic rearrangement, Claisen, Cope and aza-Cope rearrangements.

UNIT-IV

Molecular rearrangements: 16 hrs

Introduction, Carbon to carbon migrations: Pinacol-pinacolone,Wagner-Meerwein, Benzidine, Demyanov, Benzylic acid, Favorskii, Arndt-Eistert synthesis,Fries rearrangement, Stevens rearrangement. Carbon-to nitrogen migrations: Hofmann, Curtius,Lossen, Schmidt and Beckmann rearrangement. Miscellaneous rearrangement: SommeletHauser, Wittig, Smiles, Neber, Rupe, Jap-Klingermann rearrangement, Meisenheimerrearrangements, Bayer-Villeger rearrangement. Allylic rearrangements.

SUGGESTED BOOKS

1. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
2. Dupey and Chapmann, Molecular reactions and Photochemistry, PrenticHallInternational, Tokyo, 1972.
3. Introduction to physical organic chemistry – Kosower
4. Molecular orbital calculations – J. D. Roberts
5. N. J. Turro, Modern molecular photochemistry, The Benzamin Cummings Publishing Co. Ltd, Menlo Park, 1978.
6. K. Yates, Huckel's Molecular Orbital Theory, Academic Press, New York, 1978.
7. T. L. Gilchrist & R. C. Storr, Organic reaction and orbital symmetry, Cambridge Univ. Press, London, 1979.
8. D. C. Neckers, Mechanistic Organic Photochemistry, Reinhold, New York, 1967.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT303	**ADVANCED PHYSICAL CHEMISTRY**	HC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

v. To know the rotation spectra of a molecules
vi. It gives an idea about how to elucidate structure using raman spectroscopy.
i. To know the basics of X-ray crystallography and microscopic techniques.
i. To study theory of electrolyte and various models involved in electrochemistry.

Course Outcome:

By the completion of course student will be able to

CO1. To identify the diatomic and polyatomic molecules and its rotation spectra.
CO2. To deduce the structure using the spectrographic pattern.
CO3. Will be able to analyse the nature of the material and the surface morphology of a sample.
CO4. To know the electrochemistry of solution and the role of electrolytes.

Total number of lecture hours:64 **Total number of credits: 04**

Unit-I

Introduction to spectroscopy- intensity of spectral lines, Rotational, vibrational and electronic energy levels, selection rules. Microwave Spectroscopy- The rotation and classification of molecules, rotation spectra of diatomic and polyatomic molecules. Rigid and non-rigid rotator models.Determination of bond length, isotope effect on rotation spectra. Stark effect, nuclear and electron spin interaction. Microwave Spectrometer.

Vibration Spectroscopy: Vibration spectra of diatomic molecules - linear harmonic oscillator, vibrational energies, zero-point energy, force constants & bond strengths; anharmonicity of molecular vibrations- Morse PE diagram, selection rules, fundamental, overtones and hot bands. Vibrations of polyatomic molecules- normal modes of vibrations & nature of molecular vibrations (Ex-CO2& H2O).

UNIT-II

Raman Spectroscopy: Classical and quantum theories of Raman effect, concept of polarizability and polarizability ellipsoid. Rotational and vibrational Raman spectra, selection rules, Raman activity of vibrations, vibrational- rotational Raman spectra, selection rules, mutual exclusion principle, polarization of Raman lines.An introduction to Laser Raman Spectroscopy.Raman Spectrometer – instrumentation.Applications of IR and Raman spectroscopy in elucidation of molecular structure (Ex - H_2O, N_2O & CO_2 molecules).

UNIT–III:,

Diffraction Techniques: Introduction, production of X-ray, Bragg`s law, Laue equations, Ewald's diagram, X-Ray diffraction experiments – diffraction of X-rays by a crystalline powder (Debye-Scherrer and flat plate camera), powder diffractometer. Interpretation of power patterns (analytical technique). Single crystal technique - Laue and Rotation photographic methods.

Electron Diffraction: Introduction, Theory of electron diffraction, Wierl equation and its significance (qualitatively), Elucidation of structure of simple gas molecules. Structure of surfaces -(Low and high Energy Electron Diffraction, Transmission electron microscopy (TEM), SEM. Theory and applications of Neutron diffraction.Comparison between X-ray, electron and Neutron diffractions.

UNIT IV

Electrochemistry of solutions: Arrhenius theory of strong and weak electrolytes and its limitations. Factor effecting electrolytic conductance, Debye-Huckel theory - concept of ionic atmosphere.Debye-Huckel-Onsager equation of conductivity and its validity.Debye-Huckel limiting law (DHL), its modification for appreciable concentrations.A brief survey of Helmholtz-Perrin, Guoy-Chapman and Stern electrical double layer (no derivation).Determination of transference number by emf and Hittorf's methods.True and apparent transference numbers. Abnormal transference numbers, effect of temperature on transference numbers. Liquid junction potential-determination and minimization.

SUGGESTED BOOKS

1. Statistical Thermodynamics, M. C. Gupta (New Age International, Delhi)2007.
2.Principles of Physical chemistry; B.R. Puri, L.R. Sharma and M.S. Pathania, Vishal Publishers (2014)
3.Atomic Structure and Chemical Bond, ManasaChanda, Tata McGraw Hill Publishers (1991).
4.Fundamentals of Molecular Spectroscopy, Banwell&McCash (Tata McGraw Hill, New Delhi) 2007. 5. Spectroscopy, H. Kaur (PragathiPrakashana, Meerut), 2012.
6. Spectroscopy, Donald L. Pavia (Cengage learning India Pvt. Ltd., Delhi), 2007.
7. Spectroscopy, B.K. Sharma (Goelprakashan, Meerut), 2013.
8.A Basic Course in Crystallography, JAK Tareen and TRN Kutty, University Press, Hyderabad (2001). 9. Essentials of Crystallography, M.A. Waheb, Narosa Publishing House, New Delhi (2009),
10. X-ray methods, Clive Whiston, (John Wiley & Sons, New York) 1987.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT304	**SPECTROSCOPIC TECHNIQUES**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. Discuss the UV visible spectroscopy to understand the prediction of organic molecule, types of transition probability, types of absorption bonds, solvent effects, effect of polarity on various type of bonds, Woodward's empherical rules for predicting the wavelength of maximum absorption.

ii. Discussion of FTIR Principles, Hook's law, Theory- Molecular vibrations, Number of fundamental vibrations, sampling techniques, Finger print region. Identification of functional groups: Alkenes, alkynes, aromatics.

iii. Discuss the Magnetic properties of nuclei, Principles of NMR Instrumentation, CW instrumentation, equivalent and non-equivalent protons, enantiotopic and diastereotopic protons and predict the structure of organic molecules.

iv. Determine the principles of EI mass spectrometer. Types of fragments: odd electron and even electron containing neutral and charged species (even electron rule), Nitrogen rule, isotopic peaks, determination of molecular formula.

Course outcome:

By the completion of course student will be able to

CO1. Analyze the principle of UV Visible spectroscopy by studying various factors like bathochromic shift and hipsochromic shift etc.

CO2. Understand the principle and structure prediction of organic molecules by studying the FTIR spectroscopy.

CO3. Get the knowledge on the NMR spectroscopy to solve the structure of organic molecules by proton NMR and C13 NMR

CO4. Acquire the knowledge on the Mass spectrophotometer to know the molecular weight of an organic molecule.

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

UV-Visible spectroscopy: Modes of electronic excitations, simple chromophoric groups– systems of extended conjugation, aromatic systems. Types of auxochromes– functions of auxochromes, absorption and intensity shift. Types of transition probability, types of absorption bonds, solvent effects. Effect of polarity on various type of bonds, Woodwardsempherical rules for predicting the wavelength of maximum absorption: - conjugated dienes, and α,β-unsaturated aldehydes and ketones.

UNIT-II

16 hrs

IR spectroscopy: Principles, Hook's law, Theory- Molecular vibrations, Number of fundamental vibrations, sampling techniques, Finger print region. Identification of functional groups: Alkenes, alkynes, aromatics, carbonyl compounds (aldehydes and ketones, esters), halogen compounds, sulphur and phosphorous compounds, amides, amino acids, and imines. Factors affecting group frequencies and band shapes- conjugation, resonance and

inductance, hydrogen bonding and ring strain, tautomerism, cis-trans isomerism. Application of IR spectroscopy; predicting the structure and structure for simple organic compounds.

UNIT-III

16 hrs

^{1}H NMR Spectroscopy: Magnetic properties of nuclei, Principles of NMR Instrumentation, CW instrumentation, equivalent and non-equivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Nuclear overhauser effect (NOE).

Applications of 1H NMR spectroscopy: prediction of spectrum and structure for aliphatic and aromatic compounds containing different functional groups (Ester, alcohol, ether, carboxylic acid, aldehydes, ketones, etc.,)

^{13}C NMR spectroscopy: ^{13}C NMR: Resolution and multiplicity of ^{13}C NMR, fluorine and phosphorus coupling; proton decoupling,

Applications of ^{13}C NMR spectroscopy: prediction of spectrum for compounds containing different functional groups (Alkanes, alkenes, alkynes, Ester, carboxylic acid, aldehydes, ketones, cyano, etc.,)

UNIT-IV

16 hrs

Mass spectrometry: Origin of mass spectrum, principles of EI mass spectrometer. Types of fragments: odd electron and even electron containing neutral and charged species (even electron rule), Nitrogen rule, isotopic peaks, determination of molecular formula, metastable ion peaks. Salient features of fragmentation pattern of organic compounds including β-cleavage, Mc-Lafferty rearrangement, retro Diels – Alder fragmentation and ortho effect. Principle of Fast Atom Bombardment (FAB), Secondary Ion Mass Spectrometry (SIMS), (MALDI), problems with all spectroscopic data.

SUGGESTED BOOKS

1. Organic Spectroscopy-3rd Ed.-W. Kemp (Pagrave Publishers, New York), 1991.
2. Spectrometric Identification of Organic Compounds - Silverstein, Bassler&Monnill (Wiley) 1981.
3. Spectroscopy of Organic Compounds-3rd Ed.-P.S. Kalsi (New Age, New Delhi) 2000.
4. E.A.V. Ebsworth, D.W.H. Ranklin and S. Cradock: Structural Methods in Inorganic Chemistry, Blackwell Scientific, 1991.
5. J. A. Iggo: NMR Spectroscopy in Inorganic Chemistry, Oxford University Press, 1999.
6. C. N. R. Rao and J. R. Ferraro: Spectroscopy in Inorganic Chemistry, Vol I & II (Academic) 1970.
7. Spectroscopy, B. P. Straughan and S. Salker, John Wiley and Sons Inc., New Yourk, Vol.2, 1976.
8. Application of Absorption Spectroscopy of Organic Compounds, John R. Dyer, Prentice/Hall of India Private Limited, New Delhi, 1974.
9. Organic Spectroscopy, V. R. Dani, Tata McGraw-Hall Publishing Company Limited, New Delhi. 1995.
10. Interpretation of Carbon-13 NMR Spectra, F.W. Wehrli and T. Wirthin, Heyden, London, 1976.
11. NMR spectroscopy-Powai.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT305	**MEDICINAL CHEMISTRY**	SC	3	1	0	4	4

Course Objectives:

i. This course will deal with the topics which provide insights on how the different substrates act as drug targets.
ii. Various aspects of the drug discovery such as pharmacokinetics and structure-activity relationships.
iii. Synthesis of Various drugs
iv. The mechanism of action of drugs will be explored

Course Outcomes:

On successful completion of this course the student shall be able to:

CO1. Understand the importance of drug targets and its relevance for drug discovery.
CO2. Analyze the concepts of pharmacokinetics and structure-activity relationships.
CO3. Identify the mechanism of action of antibacterial agents, and the causes of bacterial resistance.
CO4. Evaluate the therapeutic applications and mode of action.

Total number of lecture hours: 64 **Total number of credits: 04**

16 hrs

UNIT – I

Introduction to Medicinal Chemistry: Characteristics of drug-Prodrug – biotransformation of drugs- Routes of drug administration, Dosage forms, drug binding, drug toxicity, drug addiction, development of synthetic drugs. Some important terms used in chemistry of drugs, Medicinal chemistry, Pharmacy, Pharmacology, molecular pharmacology, Pharmacodynamics, Pharmacophore, Pharmacodynamic agents.

UNIT – II **16 Hrs**

Classification and Nomenclature of drugs: Importance and Classification of drugs based on the chemical Structure

History of drug discovery and developments: Historical outline, Pharmacodynamics vs. Chemotherapeutic drugs, Accomplishment and challenges in drug development, Sources of drugs: Natural products, Drugs from organic synthesis, drug discovery and developments, Chemistry of drug metabolism.

UNIT – III **16 Hours**

Synthesis of selected class of drug: Anti-bacterial –Sulphamethizole, Sulfasalazine. Analgesics and Anti-inflammatory – Aspirin, Antibiotics – Benzylpenicilline. Hypnotics and Sedatives – Phenobarbital. Antineoplastics – 5-Fluorouracil. Cardiovascular agents – Propanolol, Timolol.

UNIT – IV **16 Hours**

Mode of action of Analgesics, Antipyretics, Antacids or gastrointestinal agents, sulpha drugs, Antibiotics, Antimalarials, Antidepressents, Antihistamines, Antiinflammatory agents, and cardiovascular agents

REFERENCES:

1. Burgers medicinal chemistry M. E. Welly Medicinal Chemistry M.E. Walffed John willey and sons, Vo 1, 2 and 3.
2. Wilson and Giswold's, Text Book of Organic and Medicinal Chemistry.
3. William. O. Foye, Princiles of Medicinal chemistry, Lea amd Febiger, Philadelphia.
4. Martindale, the extra pharmacopoeia, J.E. Reynolds. The Pharmaceuticals Press, London.
5. A. M. Beckett and J.B. Stanlake and Garrel, Practical Pharmaceutical chemistry, the Sthalone Press, University of London, London.
6. I. P 85 and 96, Govt. of India, Ministry of India.
7. B.D. Furniss, A.J. Hannaford, V.Regers, P.W.G. Smith and A.R. Tachell, Vogels textbook of practical organic chemistry, including quantitative analysis ELBS Longman, London.
8. J.G.Mann and S.C.Saunders, Practical organic chemistry, Longmann Green and Co. Ltd.,London.
9. Organic drug synthesis-LediserMitzsher Vol. 1 and 2.
10. Current index of medical specialties (CIMS).

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT306	**ORGANOMETALLIC COMPOUNDS**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student to

i. Discuss the Synthesis and reactions of organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium (Grignard reagent), organoselenium,organotellurium and organocopper reagents.

ii. Discussion of Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic,propargylic zinc reagents and organoboron compounds.

iii. Aalyze the Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic,propargylic zinc reagents and organosamarium reagents.

iv. Determine the Organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction (BartonMcCombie reaction), Stille coupling, Stille-Kelley coupling reactions.

Course outcome:

By the completion of course student will be able to

CO1. Analyze the Synthesis and reactions of organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium (Grignard reagent), organoselenium, organotellurium and organocopper reagents.

CO2. Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic, propargylic zinc reagents and organoboron compounds.

CO3.oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic, propargylic zinc reagents and organosamarium reagents

CO4. Acquire the knowledge on organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction (BartonMcCombie reaction), Stille coupling, Stille-Kelley coupling reactions

Total number of lecture hours: 64 **Total number of credits: 04**

UNIT-I

16 hrs

Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium (Grignard reagent), organoselenium and organotellurium.

Organocopper reagents: Gilman reagent, preparation, reactions with aldehydes, ketones and imines. Application in the synthesis of brevicomin.

UNIT-II

16 hrs

Organoaluminium reagents: Preparation, site selective and stereoselctive additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products.

Organoboron compounds: Introduction and preparations. Hydroboration and its applications. Reactions of organoboranes: isomerization reactions, oxidation, protonolysis, carbonylation, cyanidation. Reaction of nonallylic boron stabilized carbanions: Alkylation reactions, Acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes).

UNIT-III

16 hrs

Organozinc reagents: Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic and propargylic zinc reagents, diastereoselective and enantioselective addition reaction with aldehydes, Reformatsky reaction.
Organosamarium reagents: Reactions promoted by samarium diiodide and dicyclopentadienyl samarium – Barbier type reaction, Reformatsky type reactions, ketyl-alkene coupling reactions, pinacolic coupling reactions, acyl anion reactions.

UNIT-IV

16 hrs

Organotin reagents:tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction (BartonMcCombie reaction), Stille coupling, Stille-Kelley coupling reactions, , Heck stereoselectiveallylation and other applications.
Organosilicon compounds: Introduction, preparations and reactions, Peterson reaction.
Organophosphorous compounds: Nomenclature, synthesis and reactions of trialkyl phosphine, triarylphosphine, trialkylphosphite, triarylphosphite, trialkyl phosphate, triaryl phosphates. Wittig reaction and WittigHorner reactions: - mechanisms and synthetic uses. Arbasov reaction, transesterification.Organofluorine compounds.

SUGGESTED BOOKS

1. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.
2. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3 rd edition, Plenum Press, New York, 1990.
3. Comprehensive Organic Chemistry, Pergamon Press, New York, Vol 1, 1996,
4. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
5. I. I. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984
6. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
7. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998
8. Heterocyclic Chemistry –Joule & Smith
9. Heterocyclic chemistry – Achaeson
10. Basic Principles of heterocyclic chemistry – L. A. Pacquette

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT307	**CHEMISTRY PRACTICALS-V**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student with

ix. Synthesis, separation, purification, characterization and property measurements of Organic compounds with an emphasis on different techniques of reaction set-up.
x. Exposure to various spectroscopic characterization techniques.
xi. Formulate the scheme for an organic chemical reaction and record the systematic procedure.
xii. Analyze the spectral data to obtain the structure of the organic compound.

Course Outcomes:

By the completion of course student will be able to

CO9. Apply the knowledge on Synthesis, separation, purification, characterization.
CO10. Acquire knowledge on various spectroscopic characterization techniques.
CO11. Design and research problems in organic synthesis.
CO12. Solve the analytical data obtained and interpret the structure of the organic compound.
CO13. the analytical data obtained and interpret the structure of the organic compound.

PART-A

1. Structural elucidation of compound-1.
2. Structural elucidation of compound-2
3. Structural elucidation of compound-3.
4. Green synthesis of azalactone from glycine
5. Preparation para nitro aniline from acetanilide.
6. Isolation of caffin from tea leaves
7. Preparation of parabromo acetanilide from acetanilide using ceric ammonium nitrate.
8. Isolation of piperine from pepper.

PART-B

Complexometric titrations

1. Determination of total hardness of water by complexation titration using EDTA.
2. Determination of calcium in milk powder by EDTA titration.
3. Determination of calcium in calcium gluconate / calcium carbonate tablets or injections by EDTA titration.
4. Determination of chloride content of an industrial effluent by conductometric titration with silver nitrate.
5. Analysis of an industrial effluent for sulphate by conductometric titration with BaC1
6. Kinetics of Methylene blue dye degradation using nanomaterials

SUGGESTED BOOKS

1. Manual of Organic Chemistry - Dey and Seetharaman.
2. Modern Experimental Organic Chemistry by John H. Miller and E.F. Neugil, p 289.
3. An Introduction to Practical Organic Chemistry - Robert, Wingrove etc.
4. A Text Book of Practical Organic Chemistry – A.I. Vogel, Vol. III.
5. Practical Organic Chemistry - Mann & Saunders.
6. Semimicro Qualitative Organic Analysis by Cheronis, Entrikin and Hodnet.

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT308	**CHEMISTRY PRACTICALS-VI**	SC	3	1	0	4	4

Course Objectives:

This course aims to provide the student with

xiii. To determine the end point using potentiometric titrations.
xiv. To know how the solubility increases with increasing temperature.
xv. To know about the polymerization process.
xvi. The role of conductivity using conductometric titration, how the conductivity varies when a acid or base is added.

Course Outcomes:

By the completion of course student will be able to

CO14. To know how the potential developed between two electrodes helps in finding the end pint.
CO15. Acquire knowledge on various titrations methods.
CO16. How the solubility increases for a sparingly soluble salt.
CO17. To prepare various resin matrix by using polymerization procedure.

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1. Determination of the composition of Zinc Ferrocyanide complex by Potentiometric titrations.
2. Determination of degree of hydrolysis of CH_3CO_2Na and NH_4Cl by conductivity method.
3. Determination of Critical Micelle concentration by conductometric method
4. Determination of solubility of lead iodide at different T & hence molar heat of solution
5. Potentiometric titration of (a) Non aqueous system and (b) mixture of strong (HCl) and weak (HAC) acid with NaOH / NH4OH and find the strength of the acids in mixture.
6. Determination of pKa of an indicator..
7. pH titration of (a) HCl versus NaOH, (b) HOAC versus NaOH and (c) lead nitrate versus potassium chromate, and Titration of mixture of bases (Na2CO3& NaHCO3) with standard HCl.
8. Preparation of Polymethylmethacrylate by suspension polymerization / polystyrene by free radical polymerization / Nylon by interfacial polymerization.
9. Preparation of phenol formaldehyde/ urea formaldehyde resins.
10. Polyacrylamide by solution polymerisation method.

FOURTH SEMESTER

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT401	**Environmental Chemistry**	OE	3	1	0	4	4

Total number of lecture hours: 64 **Total number of credits: 04**

Course Objectives:

This course aims to provide the student to

i. Demonstrate a knowledge and understanding of the basic facts and experimental basis of environmental chemistry.
ii. Develop an understanding of how chemists approach and attempt to solve environmental problems.

Course Outcomes:

By the completion of course student will be able to

CO1. To create environmental awareness to understand the vulnerability and sensitivity of environment. To promote a sense of responsibility and proactive citizenship.

CO2. Recognize different types of toxic substances, their responses and analyze toxicological information and implement pollution monitoring techniques.

Course Content:

UNIT – I

Environmental Chemistry: Introduction: Environmental chemistry, environmental segments classification of environmental pollution.

Air Pollution: Introduction, Air pollutants, Primary pollutants, Sources (CO, NOx, HC, SO_2, and particulates). Particulates–Sources (Inorganicandorganicparticulate matters).

Effects on: Humans, materials, vegetationand animals. Air quality standards, Sampling, monitoring and analysis: CO by gas chromatography, NOx by Spectrophotometric method using sulphanilamide and NEDA, SO_2 by pararosaniline (PRA), H_2S by colorimetric using ethylene blue.

UNIT – II

Radioactive Pollution: Introduction, Sources, Radiation from natural and manmade activities, radioactive effects on human and plants, Storage and disposal of radioactive waste, Detection and monitoring of radioactive pollutants. **[12 hrs]**

UNIT-III

Water Pollution: Introduction, Sources, Water pollutants classification: Organic pollutants – Pesticides, insecticides, detergents. Inorganic pollutants, Sediments, Radioactive materials and Thermal pollutants. Drinking water supplies, Trace elements in water. COD, BOD, TOC-definitions. Monitoring techniques and methods: Determination of pH, conductance, dissolved oxygen by Winkler's method, nitrate/nitrite by diazo coupling, chloride by Mohrs and Volhard's method, and fluoride by Alizarin Visual method, Water contamination with cyanide, sulfide, sulphate, phosphate and total hardness. Analysis of Arsenic by Atomic absorption spectroscopy (AAS), cadmium and mercury by dithizone method, chromium by diphenyl carbazide method, lead by polarographic method. Water pollution control and management.

UNIT-IV

Soil Analysis: Introduction, Origin and nature of soil, Sources of soil pollution and explanation in brief, Purpose of soil analysis, Techniques for the analysis of soil Lime Potentials: Moisture measurement by

gravimetric method, pH using calomel glass electrode method, total nitrogen by kjeldhal method, determination of nitrate nitrogen by Bratton and Marshal method, determination of potassium and sodium by Flame photometry, calcium by EDTA titration ,organic matter by combustion, total sulphur by oxidation as sulphate.

References

1. Environmental Chemistry,Dr. H. Kaur, (2010).
2. Environmental pollution- monitoring and control, Khopkar. S. M, IIT Mumbai, (2004).
2. Environmental Chemistry with Green Chemistry,Asim K. Das, (2010).
3. A text book of Soil Chemical Analysis,P. R. Hesse, (2002).
4. Environmental Chemistry, 7thEdition, A. K. De, Uttarpara West Benga,l (2010).
5. Physico chemical examination of water - sewage and industrial effluents, 6th Edition,N. Manivasakam, (2010).

Course Code	Course Title	Type	L	T	P	C	Hrs/Week
22CHHCT402	**Research Methodology**	OE	3	1	0	4	5

Total number of lecture hours: 64 **Total number of credits: 04**

Unit-1

Research Basics: Definition, purpose and types (qualitative, quantitative, cross-sectional, longitudinal, pure, applied, action, evaluation, historical, survey, exploratory and case study); Significance of research in applied sciences; Process of research;
Objectives and dimensions of research; Research Problem, Research questions, Research design.

Unit-II

Tools of research: Library, Field; Laboratory Methods of research: Qualitative and Quantitative; Systematic review of literature in applied sciences; Features of good study Preparations of Research proposal/Synopsis; Research Ethics (Issues relating to referencing and documentation, copyrights, plagiarism etc.), Impact Factor, H-Index, Citation Index, References/ bibliography.

Unit-III

Data: Types (primary and secondary data), collection methods; presentation (graphical and diagrammatical); relevance, limitations and cautions; Data Processing: checking, editing, coding, transcriptions, classifications and tabulation.

Data Analysis: meaning and methods; quantitative and qualitative analysis; Basics of Regression Analysis: linear and multilinear analysis; introduction to PCA and PLS; Theoretical Distribution: normal, Poisson, binomial with application in various area/disciplines.

Unit-IV

Scientific Writing
Research survey pertaining to Chemical Sciences, primary sources of literature survey including journal and patents etc.,
secondary sources of literature survey including books, reference books and text books.

Structuring the Research Thesis: Chapter format, pagination, identification, using quotations, footnotes, abbreviations, presentation
of tables and figures, referencing, documentation, use and format of appendices, indexing.

References

1. Anand Thakur. Research Methodology, Excel Books Private Limited.
2. Dunleavy P (2003). Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation. Palgrave Macmillan.
3. Kothari C R (2004). Research Methodology- Methods and Techniques. New Age International (P) Limited Publishers.
4. Marder M P (2011). Research Methods for Science, Cambridge University Press.
5. Rosner B (2010). Fundamentals of Biostatistics, 7th Edition, Brooks/Cole Cengage Learning Publication.

20 CHMAP403 – Major Project
(Hard core)

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Adichunchanagiri University
Adichunchanagiri School of Natural Sciences
Question Paper Pattern for Internal Assessment

Time: 1.30 Hours **Max Marks: 30**

I. Answer **any Five** of the following 2× 5 = 10

1.
2.
3.
4.
5.
6
7

II. Write notes on **any two** of the following 2 × 10 = 20

6.
7.
8.

Notes

Three tests to be conducted for 30 marks each and the average of the best two will be considered. In Addition, Marks allotted for Assignments shall be 5 and for Seminars shall be 5 in respective courses – Finally accounted to 40 (30+5+5) Marks as Internal Assessment.

Adichunchanagiri University
Adichunchanagiri School of Natural Sciences
Question Paper Pattern for University Examination

Time: 3 Hours **Max Marks: 60**

I. Answer **any Five** of the following 2 × 5 = 10

1.
2.
3.
4.
5.
6.
7.

II. Answer **any Four** of the following 5 × 4 = 20

8.
9.
10.
11.
12.

III. Answer **any Three** of the following 10× 3 = 30

13.
14.
15.
16.

Note: While setting question paper equal weightage will be given to all the units of the paper