MEDI-CAPS UNIVERSITY

Knowledge is Power

मेडी-केप्स विश्वविद्यालय, इंदौर

Medi-Caps University, Indore

Syllabus

M.Sc. CHEMISTRY

SCHEME AND SYLLABUS

CURRICULUM AND SYLLABUS (2024-2028)

M. Sc. CHEMISTRY

Vision of the University:
Be an internationally acclaimed University recognised for its excellent teaching, research, innovation, outreach and creating top class technocrats and professionals who can serve the mankind as multi skilled global citizen.

Mission of the University:

- Establish state-of-the-art facilities for world class education and research.
- Conduct scholarly research and creative endeavours that impact quality of life.
- Attract quality staff and students to cater for diverse needs and preferences and widen participation.
- Build a foundation for students to be successful at all levels through high-quality, innovative programs.
- Collaborate with institute, industry, and society to address current issues through research and align curriculum.
- Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.

Vision of the Department:
Inculcate the innovative thinking in Computer Science and Engineering graduates with domain knowledge and skills to address contemporary industrial and social requirements.

Mission of the Department:

1. Provide an environment to the students to learn with passion and equip with proper skill set to address current problems.
2. Provide maximum exposure to innovative techniques available to cater industrial needs by maintain the best Industry- Academia relation.
3. Imparting best problem-solving strategies in students to work in a team.
4. Develop leadership qualities in Computer Science graduates to work for the society.
5. Attract experienced and expert faculty members and create an enthusiastic academic environment.

Department of Chemistry

Program Education Objectives (PEOs)

PEO_{01}: To develop professionals who will be able to nurture the needs of industries/laboratories related to chemistry and related areas.

PEO_{02}: To develop professionals who will be able to demonstrate skills for acquiring knowledge of chemistry, as a chemist/researcher and also as a life-long learner.

PEO_{03}: To develop professionals who will be able to communicate effectively the scientific information and research results in written and oral formats, to both scientific communities as well as public.

MEDI-CAPS UNIVERSITY
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Department of Chemistry

PROGRAMME OUTCOMES (POs)

After completion of the Program, the students shall be able to:

PO_{01}	Understand, analyze and critically evaluate the scientific problems.
PO_{02}	Design and conduct experiments to generate, analyze and interpret data of a system and process.
PO_{03}	Model, simulate and use the techniques, skills and modern scientific tools to solve the real-life problems.
PO_{04}	Understand the impact of scientific solutions in a global, economic, environmental and societal context.
PO_{05}	Adopt ethical practices in developing scientific solutions.
PO_{06}	Acquire analytical skills in organizing data or studying patterns and making decisions.
PO_{07}	Adapt for changes and innovations in technology and products.
PO_{08}	Function individually as well as in multidisciplinary teams.
PO_{09}	Establish effective communication with leadership quality within their profession their communities.
PO_{10}	Engage in life-long learning by adapting knowledge of contemporary issues.

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Department of Chemistry

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After completion of the Program of M.Sc. Chemistry, students shall be able to:

PSO_{01}	Have knowledge, understanding and expertise in their chosen field of chemical science.
PSO_{02}	Have an understanding of eco-friendly chemical processes and impact of chemistry on health and environment.
PSO_{03}	Understand theoretical concepts of instruments that are commonly used in most chemistry fields as well as interpret and use data generated in instrumental chemical analyses.
PSO_{04}	Have opportunities to excel in academics, research or industry in the area of chemical science.

Medi-Caps University Indore (M.P.)
Department of Chemistry

Choice Based Credit System- Scheme of M. Sc. Chemistry (2024 Batch)

SCHEME - M.Sc. Chemistry, I SEMESTER

Code	Course	Core/Elective	Teaching Hours		Max. Marks					Credits
					Theory		Practical		Total	
			Th	Pr	Sess	End Sem	Sess	Ext		
CH5CO01	Inorganic Chemistry-I	Core	4	4	40	60	40	60	200	6
CH5CO02	Organic Chemistry-I	Core	4	4	40	60	40	60	200	6
CH5CO03	Physical Chemistry-I	Core	4	4	40	60	40	60	200	6
CH5CO04	Group Theory & Spectroscopy-I	Core	3	0	40	60	-	-	100	3
CH5BS01	Mathematics for Chemist	BS	2	0	40	60	-	-	100	2
CH5BS02	Biology for Chemists			0	40	60	-	-		
Total			17	12	240	360	120	180	800	23

Medi-Caps University, Indore
Department of Chemistry
SCHEME - M.Sc. Chemistry, II SEMESTER

Code	Course	Core/Elective	Teaching Hours		Max. Marks					Credits
					Theory		Practical		Total	
			Th	Pr	Sess	End Sem	Sess	Ext		
CH5CO05	Inorganic Chemistry-II	Core	4	4	40	60	40	60	200	6
CH5CO06	Organic Chemistry-II	Core	4	4	40	60	40	60	200	6
CH5CO07	Physical Chemistry-II	Core	4	4	40	60	40	60	200	6
CH5CO08	Group Theory & Spectroscopy-II	Core	3	0	40	60	-	-	100	3
CH5SE01	Computer for Chemist	SE	3	2	40	60	40	60	200	4
Total			18	14	200	300	160	240	900	25

Medi-Caps University, Indore

Department of Chemistry

SCHEME - M.Sc. Chemistry, III SEMESTER

Code	Course	Core/Elective	Teaching Hours		Max. Marks				Credits	
					Theory		Practical		Total	
			Th	Pr	Sess	End Sem	Sess	Ext		
CH5CO09	Applications of Spectroscopy	Core	4	4	40	60	40	60	200	6
CH5CO10	Photochemistry	Core	2	4	40	60	40	60	200	4
CH5CO14	Environmental Chemistry	Core	3	4	40	60	40	60	200	5
CH5EL05	Polymers	Elective	3	0	40	60	-	-	100	3
CH5EL06	Industrial Chemistry	Elective	3	0	40	60	-	-	100	3
Total			15	12	200	300	120	180	800	21

Medi-Caps University, Indore
Department of Chemistry
SCHEME - M.Sc. Chemistry, IVSEMESTER

Code	Course	Core/Elective	Teaching Hours		Max. Marks					Credits
					Theory		Practical		Total	
			Th	Pr	Sess	End Sem	Sess	Ext		
CH5CO12	Solid State Chemistry	Core	2	0	40	60	-	-	100	2
CH5CO15	Bio Organic, Bio inorganic, Bio Physical Chemistry	Core	3	0	40	60	-	-	100	3
CH5EL07	Analytical Chemistry	Elective	3	0	40	60	-	-	100	3
CH5EL08	Chemistry of Materials	Elective	3	0	40	60	-	-	100	3
CH5PC03	Project Work	PC	0	12	-	-	40	60	100	6
CH5CV01	Comprehensive Viva	SS	0	4	-	-	40	60	100	2
Total			11	16	160	240	120	180	700	19

Medi-Caps University Indore (M.P.)
Department of Chemistry

Choice Based Credit System- Scheme of M. Sc. Chemistry (2024 Batch)

SEMESTER I						
S.N.	Course Code	Courses	L	T	P	Credit
1	CH5CO01	Inorganic Chemistry-I	4	0	4	6
2	CH5CO02	Organic Chemistry-I	4	0	4	6
3	CH5CO03	Physical Chemistry-I	4	0	4	6
4	CH5CO04	Group Theory & Spectroscopy-I	3	0	0	3
5	CH5BS01	Mathematics for Chemist	2	0	0	2
6	CH5BS02	Biology for Chemists		0	0	
		Total	**17**	**0**	**12**	**23**
		Total Contact Hours	**29**			

I Semester

Course Code	**Course Name**	**Hours Per Week**				
		L	T	P	Hrs.	Credits
CH5CO01T	**Inorganic Chemistry-I**	4	0	4	4	6

Course Objectives:

1. To understand about Stereochemistry.
2. To know about metal ions and ligands.
3. To understand about Reaction Mechanism.
4. To study about electron transfer reactions.
5. To gain the knowledge of HSAB concept.

Prerequisites: B.Sc. pass

Co-requisites: Nil

Curriculum:
Unit-I: Stereochemistry and Bonding in Main Group Compounds:

(A) VSEPR, Walsh diagram (triatomic and penta-atomic molecules), dπ-pπ bond.
(B) Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

Unit-II: Metal-Ligand Equilibrium in Solution

(A) Stepwise and overall formation constants and their interaction, trends in stepwise constant.
(B) Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand.
(C) Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry and spectrophotometry.

Unit-III: Reaction Mechanism of Transition Metal Complexes

(A) Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution.
(B) Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anion reactions, reactions without metal ligand bond cleavage.
(C) Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction.

Unit-IV: Electron transfer reactions and Metal-Ligand bonding

(A) Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.
(B) Crystal field theory and Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral, and square planar complexes.
(C) Bonding and molecular orbital theory.

Unit-V: HSAB Theory

(A) Classification of acids and bases as hard and soft; HSAB principle.
(B) Theoretical basis of hardness and softness; Lewis-acid base reactivity approximation; donor and acceptor numbers.
(C) E and C equation; applications of HSAB concept.

Case Studies: Optional

Project: Optional.

Course Outcomes:

After completion of the course

A. The students will be able to know about Bonding in Main Group Compounds.

B. The students will gain the knowledge of metal complexes and the nature of metal ion and ligand.

C. The students will understand about Reaction Mechanism of Transition Metal Complexes.

D. The students will study about Crystal field theory and molecular orbital theory.

E. The students will gain importance of HSAB principle.

Text Books:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.

Reference Books:

1. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
2. Magnetochemistry, R. l. Carlin, Springer Verlag.
3. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J. A. Mc Cleverty, Pergamon.

Web Source:

https://www.wiley-vch.de/de/
https://www.researchgate.net/

Open Learning Source:

https://swayam.gov.in/
https://nptel.ac.in/course.php

Course Code	Courses	Hours Per week				
		L	T	P	Hrs	Credit
CH5CO02T	Organic Chemistry- I	4	0	4	4	4

Course Objectives:

The student will be able to

1. Understand nature of bonding in organic molecules.
2. Provide brief description of different types of reaction and mechanisms.
3. U nderstand symmetry elements, Chirality, optical activity, Stereochemistry & their rules.

4. Have advanced knowledge of aromaticity.
5. Have basic idea about aliphatic nucleophilic substitution reactions and their mechanisms.

Prerequisites: B.Sc.

Co-requisites: Nil

Curriculum:
Unit-I Nature of Bonding in Organic Molecules

Delocalized chemical bonding-conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerences, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, Energy level of -molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent-addition compounds, crown-ether complexes and cryptands, inclusion compounds, catenanes and rotaxanes.

Unit-II Stereochemistry

Strain due to unavoidable crowding Elements of symmetry, chirality, molecules with more than one chiral center, threo and ertythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), Chirallity due to helical shape. Stereochemistry of compounds containing nitrogen, sulphur and phosphorus.

Unit-III Conformational analysis and linear free energy relationship

Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituents and reaction constants, Taft equation.

Unit-IV Reaction Mechanism: Structure and Reactivity

Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects

Unit-V Aliphatic Nucleophilic Substitution

The SN2, SN1 mixed SN1 and SN2 and SET mechanism. The neighbouring group mechanism, neighbouring group participation by o and % bonds, anchimeric assistance. Classical and nonclassical carbocations, phenomium ions, norbornyl systems, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The SNi mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.

Case Studies: Not applicable

Project: Optional.

Course outcomes:

After completion of this course, the student will acquire knowledge of:

1. Mechanism of aliphatic nucleophilic Substitution.
2. Conformational analysis of cycloalkanes, reactivity, chirality, interconversion, resolution.
3. Aromaticity, non-aromaticity and anti-aromaticity in carbocyelic and heterocyclic compounds.
4. Stereochemistry and its importance.
5. Various types of aliphatic nucleophilic substitution.

Text books:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
3. Modern Organic Reactions, H.O. House, Benjamin.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & professional.
5. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
6. Pericyclic Reactions, S.M. Mukherji, Macmillan, India
7. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
8. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

References:

1. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

Web Source:

https://application.wiley-vch.de
www.researchgate.net

Open Learning Source:
https://swayam.gov.in/courses/public
http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week				
		L	T	P	Hrs	Credit
CH5CO03T	Physical Chemistry- I	4	0	4	4	6

Course Objectives:
The student will be able to
1. Understand about the quantum mechanics.
2. Have an idea of variation principle, perturbation theory and molecular orbital theory.
3. Understand about angular momentum, spin, anti-symmetry and Pauli exclusion principle.
4. Understand about the classical thermodynamics.
5.Have advanced knowledge of statical thermodynamics.

Prerequisites: B.Sc.

Co-requisites: Nil

Curriculum:
Unit-I Introduction to Exact Quantum Mechanical Results
Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom.

Unit-II Approximate Methods and Molecular Orbital Theory
The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate).
Applications of variation method and perturbation theory to the Helium atom. Hickel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc. Introduction to extended Huckel theory.

UNIT- III Angular Momentum
Ordinary angular momentum generalized angular momentum, eigen functions for angular momentum, eigenvalues of angular momentum operator using ladder operators addition of angular momenta, spin, anti-symmetry and Pauli exclusion principle.

Unit-IV Classical Thermodynamics
Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess function s for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems; second order phase transitions.

Unit-V Statistical Thermodynamics
Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro-canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition. Application of partition functions. Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics distribution Law and application to helium.

Case Studies: Not applicable

Project: Optional.

Course outcomes:
The student will acquire knowledge of:
1.Schrodinger equation, particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom and helium atom.
2. Variation principle, perturbation theory and molecular orbital theory.
3. Eigen functions and eigen value for angular momentum.
4. Laws of thermodynamics, Partial molar free energy, fugacity, and activity.
5. Thermodynamic probability and most probable distribution.

Text Books:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.

Reference Books:

1.Coulson's Valence, R. Mc Ween y, ELBS.

2. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week				
		L	T	P	Hrs	Credit
CH5CO04	Group Theory & Spectroscopy-I	3	0	0	3	3

Course Objectives:
1. To Explain and represent Symmetry and Group theory with related symmetry operations, matrices/ point group representations of molecules in Chemistry.
2. To understand Microwave Spectroscopy with the help of theoretical model.
3. To attain knowledge of different aspects elated to principle of IR spectroscopy
4. To define and understand Classical and quantum theories of Raman effect.
5. To Learn principles & applications of Molecular spectroscopy viz. electronic spectroscopy and Photoelectron spectroscopy**.**

Prerequisites: B. Sc**.**

Co-requisites: Nil

Curriculum:
Unit-I Symmetry and Group theory in Chemistry

Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes. Point symmetry group. Schonfilies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} group to be worked out explicity). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use; spectroscopy. Derivation of character table for C_{2v} and C_{3v} point group Symmetry aspects of molecular vibrations of H_2O molecule.

Unit-II Microwave Spectroscopy

Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications.

Unit-III Infrared-Spectroscopy

Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. P.Q.R. branches, Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis.

Unit-IV Raman Spectroscopy

Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS).

Unit-V Molecular Spectroscopy

Electronic Spectroscopy: Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radio-active and non-radioactive decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra.

Photoelectron Spectroscopy: Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy-basic idea.

Case Studies: Not applicable

Project: Optional.

Course outcomes:
After completion of this course, the students will be able to:
1. Explain and represent Symmetry and Group theory with related symmetry operations, matrices/ point group representations of molecules in Chemistry.

2. Draw representations of groups by matrices
3. Know rigid rotor models
4. Define P.Q.R. branches
5. Understand Electronic spectroscopy and Photoclcctron Spectroscopy

Text books:

1. Group Theory and Its Chemical Applications, P.K. Bhattacharya, Himalaya Publishing House.
2. Modern Spectroscopy, J.M. Hollas, John Viley.
3. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience.
4. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
5. Physical Methods in Chemistry, R.S. Drago, Saunders College.
6. Chemical Applications of Group Theory, F.A. Cotton.
7. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
8. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
9. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH Oxford.
10.Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
11.Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, Harper & Row.

References:

1.R. Carter, “Molecular Symmetry and Group Theory” Wiley.
2.P.S. Kalsi, “Stereochemistry: Conformation and Mechanism”, New Age International Publishers.
3.Donal Pavia, “Introduction to Spectroscopy”, Cengage Learning

Web Source:

https://application.wiley-vch.de
www.researchgate.net

Open Learning Source:

https://swayam.gov.in/courses/public
http://nptel.ac.in/course.php

Course Code	Course Name	Hours Per week				
		L	T	P	Hrs	Credit
CH5BS01	Mathematics for Chemist	2	0	0	2	2

Course Objectives:
The student will be able to
1. Understand the basic concept of vectors, matrices.
2. Understand the concept of continuity, differentiability and its application.
3. Understand the concept of basic integration and partial differentiation.
4. Understand the concept of Elementary Differential equations and its application to chemistry.
5. Understand the basic concept of Permutation and Combination.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:
Unit-I, Vectors: Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus. **Matrix Algebra:** Addition and multiplication; inverse, adjoint and transpose of matrices.

Unit-II Differential Calculus

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.)

Unit-III Integral Calculus

Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).

Unit-IV Elementary Differential equations

First-order and first-degree differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions.

Unit-V Permutation and Probability

Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit.

Case Studies: Not applicable

Project: Optional.

List of Practical's: Not applicable

Course outcomes: The student will acquire knowledge of

1. Basic mathematical methods for solving chemical theory.
2. Basic types of modelling problems
3. Strong background of matrices which has diverse application in the areas of Chemistry

Text books:

1.The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2.Mathematics for chemistry, Doggett and Suiclific, Logman.
3.Mathematical for Physical chemistry: F. Daniels, Mc. Graw Hill.
4.Chemical Mathematics D.M. Hirst, Longman.

References:

1.Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.
2.Basic Mathematics for Chemists, Tebbutt, Wiley.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5BS02	Biology for Chemist	2	0	0	2	2

Course Objectives:

1. To know the chemical basis for biological phenomena and cellular structure
2. To make the students aware of Carbohydrates, Nucleic acids, proteins, Amino acids and Nucleic acids,
3.To make them know that how physiological conditions influence the structures and reactivities of biomolecules.
4. To enhance student's ability of dealing with Chemistry with reference to biology
5.To inspire students for chemical logic of metabolism

Prerequisites: 12th

Co-requisites: Nil

Curriculum:

Unit-I Cell Structure and Functions

Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Ove4rview and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP – the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to bio-molecules, building blocks of biomacromolecules.

Unit-II Carbohydrates

Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Nacetylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Unit-III Lipid

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Liproproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism boxidation of fatty acids.

Unit-IV Amino-acids, Peptides and Proteins

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. force responsible for holding of secondary structures. ahelix, -b-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domina structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination. chemical/enzymatic/mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

Unit-V Nucleic Acids

Purine and pyrimidine bases of nucleic acids, base pairing via H bounding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation, and genetic code. Chemical synthesis of mono and trinucleoside.

Case Studies: Not applicable

Project: Optional.

Course outcomes:

Student will be able to:

1. Have knowledge of cell structure and functions.
2. Have basic idea of carbohydrate and their functions.
3. Have knowledge of lipids, lipids metabolism.
4. Acquire knowledge of amino acids, proteins.
5. Have idea of role of nucleic acids.

Practical I Semester

Course Code	Course Name	Hours Per Week				
		L	T	P	Hrs.	Credits
CH5CO01P	Inorganic Chemistry-I	4	0	4	4	6

Course Objectives:

1.To understand about separation and determination of metal ions
2. To understand about volumetric and gravimetric methods
3. To know about chromatography.
4. To prepare inorganic compounds.
5. To study about different spectra.

Prerequisites: B.Sc. pass.

Co-requisites: Nil

Case Studies: Not applicable

Project: Optional.

Curriculum:

Quantitative Analysis

Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods. Quantitative with rare elements, volumetric analysis ($KMnO_4$, $K_2Cr_2O_7$, etc.)

Chromatography Separation of cations and anions by Paper Chromatography and TLC

Preparations

Preparation of selected inorganic compounds and their studies by 1.R. electronic spectra, Mossbauer, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds.

1. $VO(acac)_2$:
2. $TiO(C_9H_8NO)_2$: H_2O
3. $Na[Cr(NH_3)_2:(SCN)_4]$
4. $Ni(acac)_2$
5. $K_3[Fe(C_2O_4)_3]$
6. Prussian Blue, Turnbull's Blue.
7. Oxalate Complexes of Copper-II
8. Pyridine complexes

List of Experiments:

1. To prepare potassium dichromate.
2. To prepare tetraamine cupric sulphate monohydrate.
3. Separation of Cu^{+2}, Fe^{+3}, Ni^{+2} by paper chromatography.
4. To estimate gravimetrically barium as barium sulphate and volumetrically estimation of copper by iodometric method in the given solution by barium chloride and copper sulphate.

Course Outcome

A. The students will be able to know about Separation and determination of two metal ions.

B. The students will be able to know about gravimetic and volumetric analysis

C. The students will gain the knowledge of different types of chromatography and its practical utility.

D. The students will understand about preparation of inorganic compounds.

E. The students will study about interpretation of spectra

Books Suggested:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly. Prentice Hall.

Web Source:

1. https://www.wiley-vch.de/de/

2.https://www.researchgate.net/

Course Code	Courses	Hours Per week				
		L	T	P	Hrs	Credit
CH5CO02P	Organic Chemistry- I	4	0	4	4	4

Course Objectives:

The student will be able to
1. Understand qualitative analysis of organic molecules.
2. To understand about separation, purification and identification of compounds of ternary mixture by chromatography.
3. Interpretation of IR spectra.
4. Understand about organic synthesis.
5. Get skill of synthesis of some organic compounds.

Curriculum:

Qualitative Analysis

Separation, purification and identification of compounds of ternary mixture (three solids, one liquid and one solid) using TLC and columns chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis Acetylation, Nitration, Halogenations, Oxidation, Reduction, Polymerization.

List of Experiments:

1. Separation, purification, and identification of compounds of ternary mixture (three solid, one liquid, one solid) using TLC and column chromatography.
2. Spectroscopic analysis of known aliphatic and aromatic compound like methane and benzene.
3. Spectroscopic analysis of acetone, aldehyde, carboxylic acid.
4. Spectroscopic analysis of synthesized compounds like nitrobenzene, aspirin etc.
5. Separation and identification of monovalent, divalent, trivalent cations through paper chromatography.
6. Synthesis of nitrobenzene compound.
7. To prepare the sample of acetanilide from aniline.
8. To prepare the sample of dichlorobenzene.
9. Some basic knowledge about scientific software like chem draw, origin8.0 , Schrodinger and pymol.

Prerequisites: B. Sc.

Co-requisites: Nil

Case Studies: Not applicable

Project: Optional.

Course outcomes:

The student will acquire knowledge of:
1. Separation, purification and identification of compounds of ternary mixture
2. TLC and columns chromatography.
3. IR spectra to be used for functional group identification.
4. Preparation of organic compounds.
5. Skill of synthesis of some organic compounds.

Text books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.

Web Source:

1. https://application.wiley-vch.de
2. www.researchgate.net

Open Learning Source:
1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week				
		L	T	P	Hrs	Credit
CH5CO03P	Physical Chemistry- I	4	0	4	4	6

Course Objectives:

The main objectives of this Lab Course are:

1. Students will be able to understand and apply different types for analysis of statistical data and error.
2. Students will gain knowledge to validate Freundlich and Langmuir's adsorption isotherm by experimental study of adsorption of oxalic acid from it's aqueous solution by activated charcoal.
3. Students will gain practical knowledge to construct phase diagram of two and three component system and to determine related constant by these phase diagrams.
4. Students will gain skill to determine rate constant of different chemical reactions.
5. Students will learn about deviation from ideal behavior of solutions and their applications to determine physical parameters.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Error Analysis and Statistical Data Analysis

(a) Errors, types of errors, minimization of errors, distribution curves precision, accuracy and combination; statistical treatment for error analysis, student's test, null hypothesis, rejection criteria. F & Q test; linear regression analysis, curve fitting. Calibration of volumetric apparatus, burette, piette and standard flask.

Adsorption Experiment

i. To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's adsorption isotherm.

Phase Equilibria

i. Determination of congruent composition and temperature of a binary system (e.g. diphenylamine- benzophenone system).
ii. Determination of glass transition temperature of a given salt (e.g., CaC_{12}) conductometrically.
iii. To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).

Chemical Kinetics

i. Determination of the effect of (a) Change of temperature (b) Charge of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reaction.

ii. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

iii. Determination of the velocity constant for the oxidation of iodide ions by hydrogen peroxides. Study the kinetics as an iodine clock reaction.

Solution

i. Determination of molecular weight of non-volatile electrolyte by cryoscopic method and to
determine the activity coefficient of an electrolyte.

ii. Determination of the degree of dissociation of weak electrolyte and to study the deviation from
ideal behavior that occurs with a strong electrolyte.

List of experiments:

Experiment No.	**Title of the Experiment**
Experiment 1	To determine different types of error by using given experimental data.
Experiment 2	To investigate the adsorption of oxalic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's adsorption isotherm.
Experiment 3	Determination of congruent composition and temperature of a binary system (e.g. diphenylamine- benzophenone system).
Experiment 4	Determination of glass transition temperature of a given salt (e.g., CaC_{12}) conductometrically.
Experiment 5	To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
Experiment 6	Determination of the effect of (a) Change of temperature (b) Charge of concentration of reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reaction.
Experiment 7	Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.

Experiment 8	Determination of the velocity constant for the oxidation of iodide ions by hydrogen peroxides. Study the kinetics as an iodine clock reaction.
Experiment 9	Determination of molecular weight of non-volatile electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
Experiment 10	Determination of the degree of dissociation of weak electrolyte and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

Case Studies: Not applicable

Project: Optional.

Text Books:

1. Experimental Physical Chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, McGraw Hill Intercedence.
2. Experiments in Physical Chemistry – J.B. Yadav, Goel Publishing House.
3. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill.

References:

1. Chemistry Experiments for Instrumental Methods: D.T. Sawyer, W.R. Heinemanand J.M. Beebe.
2. Journal of Chemical Education, ACS: some selected readings and experiments offered from this journal.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

MEDI-CAPS UNIVERSITY

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Medi-Caps University, Indore

Syllabus

SEMESTER – II						
S.N.	Course Code	Courses	L	T	P	Credit
1	CH5CO05	Inorganic Chemistry-II	4	0	4	6
2	CH5CO06	Organic Chemistry-II	4	0	4	6
3	CH5CO07	Physical Chemistry-II	4	0	4	6
4	CH5CO08	Group Theory & Spectroscopy-II	3	0	0	3
5	CH5SE01	Computer for Chemist	3	0	2	4
		Total	**18**	**0**	**14**	**25**
		Total Contact Hours	**32**			

SEMESTER – II SYLLABUS

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5CO05	**INORGANIC CHEMISTRY-II**	**4**	0	**4**	**8**	**6**

Course Objectives:

1. To understand about Electronic Spectral Studies.
2. To know about magnetic moments.
3. To understand about bonding structure.
4. To study about compounds with metal metal multiple bonds.
5. To gain the knowledge of Optical Rotatory Dispersion and Circular Dichroism.

Prerequisites: B.Sc. pass

Co-requisites: Nil

Curriculum:

Unit-I Electronic Spectral Studies of Transition Metal Complexes:

Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1 to d^9 states), Selection rule for electronic spectroscopy. Intensity of various type electronic transitions. Calculations of lODq, B and P parameters, charge transfer spectra.

Unit-II Magnetic Properties of Transition Metal Complexes

Anomalous magnetic moments, Quenching of Orbital contribution. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.

Unit-III Metal -Complexes

Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl, dinitrogen and dioxgen complexes; tertiary phosphine as ligand.

Unit-IV Metal Clusters

Higher boranes, carboranes, metalloboranes and metallo-carboranes compounds with metal metal multiple bonds.

Unit-V Optical Rotatory Dispersion and Circular Dichroism

Linearly and circularly polarized lights; optical rotatory power and circular birefringence, elipticity and circular dichroism; ORD and Cotton effect, Faraday and Kerr effects; Assignment of electronic transitions; applications of ORD and CD for the determination of (i) absolute configuration of complexes and (ii) isomerism due to non-planarity of chelate rings.

Case Studies: Optional

Project: Optional.

Course Outcomes:
After completion of this course:
A. The students will be able to know about Orgel and Tanabe-Sugano diagrams.
B. The students will gain the knowledge of Magnetic Properties of Metal Complexes.
C. The students will understand about bonding and structural of Metal Complexes.

D. The students will study about Metal Clusters.
E. The students will gain importance of Optical Rotatory Dispersion and Circular Dichroism.

List of experiments:

1. Separation and determination of two metal ions Cu-Ni, involving volumetric and gravimetric methods.
2. Separation and determination of two metal ions Ni-Zn/ Cu-Fe involving volumetric and gravimetric methods.
3. Quantitative analysis with rare elements.

4. Volumetric analysis $KMnO_4$, $K_2Cr_2O_7$
5. Chromatographic separation of cations and anions by paper chromatography/TLC.
6. Preparation of selected inorganic compounds and their studies by different spectroscopic and other techniques- $K_3[Fe(C_2O_4)_3]$
7. Preparation of selected inorganic compounds and their studies by different spectroscopic and other techniques- Prussian blue/Turnbull's blue
8. Preparation of selected inorganic compounds and their studies by different spectroscopic and other techniques- $Na[Cr(NH_3)_2(SCN)_4]$

Text Books:

1. Advanced Inorganic Chemistry, F. A. Cotton and Wilkinson, John Wiley.

2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.

3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.

Reference Books:

1. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.

2. Magnetiochemistry, R.l. Carlin, Springer Verlag.

3. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty,Pergamon.

Web Source:

https://www.wiley-vch.de/de/

https://www.researchgate.net/

Open Learning Source:

https://swayam.gov.in/
https://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO06	ORGANIC CHEMISTRY-II	4	0	4	8	6

Course Objectives:

The student will be able

1. To impart knowledge of mechanisms of addition, elimination and some named reactions in organic chemistry.
2. To learn about factors affecting reactivity of different reactions.
3. To learn about the addition reactions between a hetero atom and double bonded carbon compounds.
4. To learn about some specific examples of elimination reactions.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction Aromatic Nucleophilic Substitution.

The SN_{Ar} SN_1, benzyne and SN_1 mechanism, Reactivity effect of substrate structure, leaving group and attacking nucleophile. The Von Richte. Sommelet-Hauser, and Smiles rearrangements.

Unit-II Free Radical Reactions

types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboyxlic acids, autooxidation, coupling of

alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Unit III Addition Reactions

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bounds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation.

Unit-IV Addition to Carbon-Hetero Multiple bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Witting reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

Elimination Reactions

The E_2, E_1 and E_1 cB mechanisms and their spectrum. Orientation of the double bond. Reactivity-effects of substrate structures, attacking base, the leavign group and the medium. Mechanism and orientation in pyrolytic elimination.

Unit-V Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of periycyclic reactions. Woodward-Hoffmann correlatino diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cycloadditions and cheleotrpic reactions. Sigmatropic rearrangements suprafacial and antarafacial shifts of H, sigmatropic involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claise n, Cope and aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.

Case Studies: Not applicable

Project: Optional.

Course outcomes:

The student will acquire knowledge of:

1. Mechanism of aliphatic nucleophilic Substitution.
2. Conformational analysis of cycloalkanes, reactivity, chirality, interconversion, resolution.

3. Aromaticity, non-aromaticity and antiaromaticity in carbocyclic and heterocyclic compounds.
4. Stereochemistry and its importance.
5. Various types of aliphatic nucleophilic substitution.

List of experiments:

1. Separation, purification and identification of compounds of ternary mixture (three solids, one liquid and one solid) using TLC and column chromatography. (5 different types of mixtures).
2. Organic synthesis based on acylation, nitration, oxidation, reduction, polymerization. (5 different compounds preparation)

Text books:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
3. Modern Organic Reactions, H.O. House, Benjamin.
4. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
6. Pericyelic Reactions, S.M. Mukherji, Macmillan, India
7. Stereochemistry of Organic Compounds, D.Nasipuri, New Age International.
8. Stereochemisty of Organic Compounds, P.S. Kalsi, New Age International.

References:

1. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

List of experiments:

1. Determination of Velocity constant, order of reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
2. Determination of solubility and solubility product of sparingly soluble salts (e.g. $PbSO_4$, $BaSO_4$ conductometrically)
3. Determination of strength of the strength of strong acid and weak acid in a given mixture conductometrically.
4. Determination of activity coefficient of zinc ion in solution of 0.002 M zinc sulphate solution using Debye Huckel's limiting law.
5. Determination of strength of halides in a mixture pH-metry/ Potentiometry.
6. Determination of strength of the strength of strong acid and weak acid in a given mixture pH-metry/ Potentiometry.
7. Acid base titration in a non-aqueous media using a pH meter.
8. Determine of rate constant for hydrolysis/ inversion of sugar using a polarimeter.
9. Enzyme kinetics – inversion of sucrose.

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO07	PHYSICAL CHEMISTRY-II	4	0	4	8	6

Course Objectives:

The student will be able

1. To learn about chemical kinetics and mechanism of reactions.
2. To learn about surface chemistry.
3. To understand about polymers.
4. To learn about non equilibrium thermodynamics.
5. To understand about Electrochemistry of solutions. Debye-Huckel-Onsager treatment.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I Chemical Dynamics

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt

effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dyamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogenbromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features fo fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis ad the nuclear magnetic resonance method, dynamics of unimolecular reactiosn (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories for unimolecular reactions).

Unit-II Surface Chemistry

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

Micelles

Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles.

Unit-Ill Macromolecules

Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures.

Unit-IV Non-EquilibriumThermodynamics

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non-equilibrium. Stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction.

Unit-V Electrochemistry

Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance.

Case Studies: Not applicable

Project: Optional.

Course outcomes:

The student will acquire knowledge of:

A. Mechanism of aliphatic nucleophilic Substitution.
B. Conformational analysis of cycloalkanes, reactivity, chirality, interconversion, resolution.
C. Aromaticity, nonaromaticity and antiaromaticity in carbocyclic and heterocyclic compounds.
D. Stereochemistry and its importance.
E. Various types of aliphatic nucleophilic substitution.

Text books:

1.Physical Chemistry, P.W. Atkins, ELBS.

2. Chemical Kinetics. K.J. Laidler, McGraw-Hill.

3. Micelles, Theoretical and Applied Aspects, V. M Oraoi, Plenum.

4. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.

5. Introduction to Polymer Science, V.R Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

References:

1. Kineties and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO08	GROUP THEORY AND SPECTROSCOPY-II	3	0	0	3	3

Course Objectives:

The student will be able

1. To learn about nuclear magnetic resonance.
2. To learn about NQR.
3. To understand about Electron Spin Resonance Spectroscopy
4. To learn about X ray diffraction.
5. To understand about Electron diffraction.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I: Nuclear Magnetic Resonance Spectroscopy

Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors, influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "j" Classification (AXB, AMX, ABC, A2B2 etc.). spin decoupling; basic ideas about instrument, NMR studies of nuclei other than protein-^{13}C, ^{19}F and ^{31}P. FT NMR, advantages of FT NMR.

Unit II: Nuclear Quadrupole Resonance Spectroscopy

Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting. Applications.

Unit-III: Electron Spin Resonance Spectroscopy

Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications.

Unit-IV: X-ray Diffraction

Bragg condition, Miller indices, Laue Method, Bragg method, Debye Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.

Unit-V: Electron Diffraction

Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces. Neutron Diffraction Scattering of neutrons by solids measurement techniques, Elucidation of structure of magnetically ordered unit cells.

Case Studies: Not applicable

Project: Optional.

Course outcomes: After completion of the course, the student will acquire knowledge of:

1. NMR. Chemical shift, and advantages of FT NMR
2. Nuclear Quadrupole Resonance Spectroscopy.
3. Electron Spin Resonance Spectroscopy
4. 4.X-ray structural analysis of crystals
5. Electron diffraction.

Text books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.

2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish,
4. Ellis Harwood.
5. Physical Methods in Chemistry, R.S. Drago, Saunders College.
6. Chemical Applications of Group Theory, F.A. Cotton.
7. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
8. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.

References:

1. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.

2. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.

3. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, harper & Row.

Web Source:

1. https://application.wiley-vch.de
2. **www.researchgate.net**

Open Learning Source:

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2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5SE01	Computer For Chemists	3	-	2	5	4

Course Objectives:

1. To understand the basic of computer for Chemistry and learn C language and its applications in solving problems in Chemistry.
2. This is a theory cum-laboratory co use with more emphasis on laboratory work.

Prerequisites: 12th

Co-requisites: Nil

Curriculum:

Unit-I: Introduction to computers and Computing

Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programming Algorithms and flow-charts.

Unit-II: Computer Programming in FORTRAN/C/BASIC

(the language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Elements of the computer language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement.

LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement (Student learns the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.)

Unit-III: Programming in Chemistry

Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity and Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles.

Unit-IV: Use of Computer programmes

Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physical chemistry laboratory.

Unit V: Internet

Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

Case Studies: Not applicable

Project: Optional.

Course outcomes:
After completion of the course, the student will be able to:

1. Able to apply knowledge of computing and mathematics appropriate to the discipline
2. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
3. The computer basic will let the student to know the component
4. The cyber investigation helps
5. Research field in cyber security

Text books:

1. Fundamentals of Computer: V. Rajaraman (Prentice Hall)
2. Computers in Chemistry: K.V. Raman (Tata Mc Graw Hill)
3. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

References:

1. Sudhir Pundir, “Computer For Chemist” Pragati Prakashan
2. D. Kadia, “Basic Knowledge of Computer” Shanti Prakashan.
3. Ashok Arora, “Computer Fundamentals and Applications” Vikas Publishing
4. Kanitker Y, “Let us C” , BPB Publications

Web Source:

https://application.wiley-vch.de
www.researchgate.net
https://www.intechopen.com/

Open Learning Source:

1. https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

MEDI-CAPS UNIVERSITY

Knowledge is Power

मेडी-केप्स विश्वविद्यालय, इंदौर

Medi-Caps University, Indore

Syllabus

SEMESTER III						
S.N.	Course Code	Courses	L	T	P	Credit
1	CH5CO09	Applications of Spectroscopy	4	0	4	6
2	CH5CO10	Photochemistry	2	0	4	4
3	CH5CO14	Environmental Chemistry	3	0	4	5
4	CH5EL05	Polymers	3	0	0	3
5	CH5EL06	Industrial Chemistry	3	0	0	3
		Total	**15**	**0**	**12**	**21**
		Total Contact Hours	**27**			

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5CO09T	Applications of Spectroscopy	4	0	0	4	4

Course Objectives:

The student will be able

1. To understand about Mossbauer spectroscopic techniques.
2. To know about electronic spectroscopy.
3. To understand about Vibrational spectroscopy.
4. To study about Nuclear magnetic resonance spectroscopy.
5. To gain the knowledge of advancement of Nuclear magnetic resonance spectroscopy.

Prerequisites: B.Sc. pass

Co-requisites: Nil

Curriculum:

Unit-I Mossbauer spectroscopy:

Basic principles, spectral parameters and spectrum display. Application of technique to the studies of followings: (A) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin (B) Sn^{2+} and Sn^{4+} compounds nature of M-L bond, co-ordination number, structure

(C) detection of oxidation state and in equivalent MB atoms.

Unit-II Electronic spectroscopy:

Electronic spectral studies for d^1-d^9 systems in tetrahedral, octahedral, and square planer complexes.

Unit-III Vibrational spectroscopy

Symmetry and shapes of AB_2, AB_3, AB_4, AB_5 and AB_6, mode of bonding of ambidentate ligands, nitrosyl, ethylenediamine and diketontao complexes, application of resonance Raman spectroscopy.

Unit-IV Nuclear Magnetic Resonance spectroscopy –I

General introduction and definition, chemical shift, shielding and deshielding mechanism, chemical shift values for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto).

Unit-V Nuclear Magnetic Resonance spectroscopy – II

Chemical exchange, effect of deuteration, Complex spin-spin interaction between two, three, four and five nuclei (I order spectra) Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with disordered angle. NMR shift reagents, solvent effects. Nuclear overhauser effect (NOE).

Case Studies: Optional

Project: Optional.

Course Outcomes: After completion of the course,

A. The students will be able to know about Mossbauer spectroscopic techniques.
B. The students will gain the knowledge of electronic spectroscopy.
C. The students will understand about Vibrational spectroscopy.
D. The students will study about Nuclear magnetic resonance spectroscopy.
E. The students will gain knowledge of advancement of Nuclear magnetic resonance spectroscopy.

Text Books:

1. Applications of spectroscopy of Organic compounds, J. R. Dyer Prentice Hall.
2. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.

3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Lotus, Wiley.

4. Mössbauer Spectroscopy, Dominic P.E. Dickson, Frank J. Berry., Cambridge University Press.

Reference Books:

1. Structural methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin, S. Cradcock, ELBS.
2. Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
3. NMR, NQR, EPR and Mössbauer spectroscopy in inorganic chemistry, Richard Vernon, Parish
4. Ellis Horwood Limited.
5. Spectroscopic identification of organic compounds, R.M. Silverstein, G.C. Bassler and T.C. Moril, John Wiley.

Web Source:

1.https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

1.https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php
3. http://epgp.inflibnet.ac.in/

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Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO10T	**Photochemistry**	**2**	0	**0**	**2**	**2**

Course Objectives:

The student will be able

1. To impart knowledge of mechanisms Photochemical Reaction.
2. To learn about factors affecting Determination of Reaction Mechanism.
3. To learn about the Photochemical reactions between alkenes and aromatic compounds.
4. To learn about some specific examples Photochemistry of Carbonyl Compounds.
5. To gain the knowledge of advancement of Miscellaneous Photochemical Reactions.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I Photochemical Reaction

Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Unit-II Determination of Reaction Mechanism

Classification, rate constants and life times of reactive energy state, determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociations, gas-phase photolysis.

Unit III Photochemistry of Alkenes

Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4-and 1,5-dienes.

Photochemistry of Aromatic Compounds:

Isomerisations, additions and substitutions.

Unit-IV Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β, γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerization's and oxetane formation.

Unit-V Miscellaneous Photochemical Reactions

Photo-Fries reactions of annilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen and its reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

Case Studies: Not applicable

Project: Optional.

Course Outcomes:

A. The students will be able to know about Photochemical reaction.

B. The students will gain the knowledge of determination of reaction mechanism

C. The students will understand about photochemistry of alkenes and aromatic compounds.

D. The students will study about Photochemistry of Carbonyl Compounds.

E. The students will gain knowledge of Miscellaneous Photochemical Reactions spectroscopy.

Text books:

1. Molecular Photochemistry, N. J. Turro, W. A. Benjamin.
2. Introductory Photochemistry, A. Cox and T. Camp, McGraw-Hill
3. Photochemistry, R. P. Kundall and A. Gilbert, Thomson Nelson.
4. Organic Photochemistry, J. Coxon and B. Halton, Cambridge University Press.
5. Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.

References:

1. Fundamentals of Photochemistry, K. K. Rohtagi-Mukherji, Wiley- Eastern.
2. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific
    a. Publication.
3. Organic spectroscopy, William Kemp, ELBS, 3rd ed., 1987.
4. Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March. Mc. Graw Hill and Kogakush.

Web Source:

1. https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

1.https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO11T	Environmental Chemistry	3	0	0	3	3

Course Objectives:

The student will be able

1. To understand about structure, chemical and photochemical reactions of atmosphere.
2. To learn about air pollution and its effects.
3. To understand about aquatic pollution and its measurements.
4. To learn about environmental toxicology.
5. To understand Soil and Environmental Disasters with few examples.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I -

Atmosphere

Atmosphere layers, Vertical temperature profile, heat/radiation budget of the earth atmosphere systems. Properties of troposphere, thermodynamic derivation of lapse rate. Temperature Inversion. Calculation of Global means temperature of the atmosphere. Pressure scale heights in atmosphere. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus, oxygen. Residence times.

Atmospheric Chemistry:

Sources of trace atmospheric constituents: nitrogen oxides, sulphur dioxide and other sulphur compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons.

Tropospheric photochemistry

Mechanism Photochemical decomposition of NO_2 and formation of ozone. Formation of oxygen. atoms, hydroxyl, hydroperoxyl and organic radicals and hydrogen peroxide. Reactions of hydroxyl radicals with methane and other organic compounds. Reaction of OH radicals with SO_2 and NO_2. Formation of Nitrate radical and its reactions. Photochemical smog meteorological conditions and chemistry of its formation.

Unit-II

Air Pollution:

Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.

Acid Rain:

Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions. Damaging effects on aquatic life, plants, buildings-and health. Monitoring of SO_2 and NO_2. Acid rain control strategies. Mechanism of Ozone formation, Mechanism of catalytic ozone depletion, Discovery of Antarctic Ozone hole and Role of chemistry and meteorology. Control Strategies.

Green House Effect

Terrestrial and solar radiation Spectra, Major green house gases and their sources and Global warming potentials. Climate change and consequences.

Urban Air Pollution

Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies.

Unit-Ill

Aquatic Chemistry and Water Pollution

Redox chemistry in natural waters. Dissolved oxygen, biological, oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water acid-base chemistry of fresh water and sea water. Aluminium, nitrate and fluoride in water. Petrification. Sources of water pollution. Treatment of waste and sewage Purification of drinking water, techniques of purification and disinfection of water.

Unit-IV

Environmental Toxicology

Toxic heavy metals: Mercury, lead, arsenic and cadmium. Causes of toxicity. Bio accumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects.

Toxic Organic Compound: Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects.

Polychlorinated biphenyls: Properties, use and environmental continuation and effects.

Polynuclear Aromatic Hydrocarbons: Source, structures and as pollutants.

Unit-V Soil and Environmental Disasters:

Soil composition, micro and macreo nutrient, soil pollution by fertilizers, plastic and metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three-mile island, Minamata Disease, Seveso (Italy), London smog.

Case Studies: Not applicable

Project: Optional.

Course Outcomes:

A. The students will be able to know about Atmosphere, its chemistry and photochemistry.

B. The students will gain the knowledge of Air pollution and its effects viz. acid rain, greenhouse effect.

C. The students will understand about aquatic chemistry and water pollution.

D. The students will study about Environmental toxicology with few examples.

F. The students will gain knowledge of advancement of Soil and Environmental disasters.

Text books:

1. Environmental Chemistry, A.K. De, Wiley Eastern.
2. Environmental Chemistry-Analysis, S.M. Khopkar, Wiley Eastern.
3. Environmental Science, P. Jain, D. Jagwani, Shri Parasmani Publication.
4. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.

Reference books:

1- B. Joseph, Environmental Studies, Tata McGraw Hill.

2- Method of Chemical Analysis, F. J. Welcher, Van Nostr and Reinhold Co.

3- APHA, 1977, Methods of air c Health Sampling Association Washington and Analysis US Standard.

4- Fundamentals of Environmental Chemistry, Manahan, Stanley. E. Boca Raton, CRC Press.

Web Source:

1.https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

1.https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5EL06T	Polymers	3	0	0	3	3

Course Objectives:

The student will be able

1. To learn about basics of polymers.
2. To learn characterization of polymers.
3. To understand about analysis and testing of polymers.
4. To learn about inorganic polymers.
5. To understand about structure, properties and applications of polymers.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I Introduction to polymers

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition/radical chain- ionic and copolymerization. Polymerization condition and polymer reactions. Polymerization in homogeneous and heterogeneous systems.

Unit II Polymerization

Polydisperse-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity a molecular weight distribution. The practical significance of molecular weight: Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods.

Unit-III Analysis and testing of polymers

Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact, tear, resistance, Hardness and abrasion resistance.

Unit-IV Inorganic Polymers

A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers. Structure, Properties and Applications of followings:

a) Polymers based on boron-borazines, boranes.

b) Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, silazanes**.**

Unit-V Structure, Properties and Application of Polymers

a) Polymers based on Phosphorous-Phosphagens, Polyphosphates.

b) Polymers based on Sulphur-Tetra sulphur tetranitride and related compounds.

c) Co-ordination and metal chelate polymers.

Case Studies: Not applicable

Project: Optional.

Course Outcomes: After completion of the course:

A. The students will be able to know about Basics of polymers.

B. The students will gain the knowledge of Mechanism of polymerization.

C. The students will understand about Analysis and testing techniques for polymers.

D. The students will study about refining of Properties and applications of Inorganic polymers.

E. The students will gain knowledge of Structure, Properties and Application of Polymers.

Text books:

1. Textbook of Polymer Science, F. W. Billmeyer, Wiley.
2. Polmer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley Eastern.
3. Physics and Chemistry of Polymers, JMG Cowie, Blackie Academic and Professional.

Reference books:

1. Polymer Chemistry introduction, Malcom T. Stevens, Addison-Wesley Educational Publishers Inc.

2. Contemporary Polymer Chemistry, H. R. Alcock and F. W. Lambe, PrenticeHall.

Web Source:

1.https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

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Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5EL02T	Industrial Chemistry	3	0	0	3	3

Course Objectives:

The student will be able

1. To learn about water pollutants and their purification.
2. To learn about gases and heavy chemicals.
3. To understand about coal and petroleum.
4. To learn about petroleum.
5. To understand about fats and oils.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-I Water Treatment

Water pollutants

Water Pollutants, their classes with examples, Biochemical Oxygen demand, thermal pollution, pollution by fertilizers, detergents, pesticides and industrial wastes.

Water Purification:

Classical and modern Methods — Ion exchange, electrodialysis, Reverse osmosis. Softening of Hard water. Chlorination and fluoridation.

Unit II – Gases and Heavy Chemicals

Gases:

Chemistry Large-scale production, storage, hazards and uses of the following industrial gases: Hydrogen, oxygen, nitrogen, carbon dioxide, chlorine, fluorine, sulphur dioxide, phosgene, acetylene, argon, neon and helium.

Heavy Chemicals:

Manufacture, Physical properties, Analysis, Hazards and applications of the following chemicals: HCl, H_2SO_4, HNO, H_3PO_4, polyphosphoric acid, $NaHCO_3$, Na_2CO_3, NaOH, NaCl, $Na_2S_2O_3$, Bleaching Powder, Bromine.

Unit-III Coal

Coal: Origin and economic importance of coal. Coal composition, Coal carbonization, Coal gasification,

Synthetic Gas: Coal Gas, Water Gas, Producer gas, coal tar industry and manufacture of coal tar-based chemicals and their importance. Role as carcinogens, Non-fuel uses of coal, and Chemistry based on MeOH synthesis from CO/CO_2. CH_4 and CH_2O.

Unit-IV Petroleum:

Origin and composition, Refining, Reforming Fractionation; Cracking; knocking and Octane number, Kerosene and Naphtha, Liquified Petroleum gas (L.P.G.), Synthetic Petrol,

Petrochemicals, manufacture of ethylene propylene, xylenes, etc. Economic importance with particular reference to India.

Unit-V Fats & Oils

Fats & Oil Natural Fats, Edible and Industrial Oils of vegetable origin, Common fatty acids and glycerides. Hydrogenation of Unsaturated oils, manufacture of Vanaspati and margarine**.**

Case Studies: Not applicable

Project: Optional.

Course Outcomes: After completion of the course,

A. The students will be able to know about Water and its purification.

B. The students will gain the knowledge of Gases and heavy chemicals.

C. The students will understand about Coal & Petroleum.

D. The students will study about refining of Petroleum and its different products.

E. The students will gain knowledge of Fats & Oils

Text books:

6. P. Jain, A Tet Book of Engineering Chemistry, Shree Parasmani Publications, Indore.
7. S. S. Dara, A Text Book of Engineering Chemistry, S. Chand & Company.
8. Shashi Chawla, Engineering Chemistry, Dhanpat Rai Publications.

Reference books:

1. P. C. Jain, Monka Jain, Engineering Chemistry, Dhanpat Rai Publications.
2. Engineering Chemistry, O. G. Palanna. Tata McGraw.
3. Engineering Chemistry, Baskar, Wiley.

Web Source:

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Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5CO09P	Applications of Spectroscopy	0	0	4	4	2

Course Objectives:

The student will be able

1. To understand basic analytical techniques of colorimeter/ spectrophotometer
2. To understand various applications of Flame photometer for determination of metal ion concentration in give unknown samples.
3. To understand applications of given spectroscopic data/ spectrum to identify unknown compounds.
4. To design experiment to determine dissociation constant/ constant/ another parameter through spectrophotometer.
5. To understand the determination of basic physical properties of substance like partial molar volume, pK_a etc.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

1. **Colorimetric:** Estimation of Cr/Fe/Mn/Ni, Cu etc.
2. **Flame Photometry:**
   i) Determination of sodium.
   ii) Determination of potassium.
   iii) Determination of calcium.
   iv) Sodium and potassium when present together.
3. **Spectroscopy (Data interpretation)**:

   Identification of unknown compounds with the help of given spectroscopic data/ spectrum.
4. **Spectroscopy (Practical study):**

   Determination of dissociation constant of an indicator (e.g. methyl red) by

spectrophotometric method.

5. **Determination of basic physical properties of substance**

Determination of partial molar volume of KCl-H_2O/ NaCl-H_2O system.

Determination of pH of various mixtures of CH_3COONa and CH_3COOH in aqueous solution and hence to determine the pK_a of acid.

- **Some advanced level sophisticated instrument based (FTIR, GC-MS, AAS etc.) experiments may be given to the students.**

List of Experiments:

Experiment No.	Title of the Experiment
1	To determine concentration of Cr/Fe/Mn/Ni, Cu in given unknown sample by colorimetric method.
2	To determine the concentration of potassium or sodium in given sample by flame photometric method.
3	To determine the concentration of calcium in given sample by flame photometric method.
4	To determine the concentration of potassium and sodium (when present together) in given sample by flame photometric method.
5	Identification of unknown compounds with the help of given IR spectroscopic data/ spectrum.
6	Identification of unknown compounds with the help of given NMR spectroscopic data/ spectrum.
7	Identification of unknown compounds with the help of given combined spectroscopic data/ spectrum (viz. IR, NMR etc).
8	Determination of dissociation constant of an indicator (e.g. methyl red) by spectrophotometric method.
9	Determination of partial molar volume of KCl-H_2O/ NaCl-H_2O system.
10	Determination of pH of various mixtures of CH_3COONa and CH_3COOH in aqueous solution and hence to determine the pK_a of acid.

Case Studies: Not applicable

Project: Optional.

Course Outcomes:

After completion of this course the students shall able to:

A. Understand practically basic analytical techniques of colorimeter/ spectrophotometer.

B. Know utility of various applications of Flame photometer for determination of metal ion concentration in give unknown samples.

C. Acquire knowledge of given spectroscopic data/ spectrum to identify unknown compound.

D. Get knowledge of using instrumental techniques to design experiment for determination of dissociation constant/ other parameter through spectrophotometer

E. To understand the determination of basic physical properties of substance like partial molar volume, pKa etc. in basic laboratory.

Books Recommended:

References:

1. Chemistry Experiments for Instrumental Methods: D.T. Sawyer, W.R. Heinemanand J.M. Beebe.
2. Journal of Chemical Education, ACS: some selected readings and experiments offered from this journal.

Text Books:

1. Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, McGraw Hill Interscience.
2. Experiments in Physical Chemistry – J.B. Yadav, Goel Publishing House.
3. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill.

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO10P	Photochemistry	0	0	4	0	2

Course Objectives:

The student will be able

1. To understand basic concepts of Photo-chemical reactions
2. To understand various applications of UV Visible Spectroscopy
3. To understand basic methods of Chromatography
4. To understand the Extraction of Different components
5. To understand refractometry process

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

1. **Study of Photochemical reactions**

   Study of photochemical decomposition of azo compounds.

   To study the photolysis of uranyl oxalate.

   Diels-Alder reaction of anthracene and maleic anhydride.

2. **Extraction of Natural products through plants:**

   Isolation of caffeine from tea.

   Isolation of β–Carotene from carrots.

3. **Organic synthesis:**

   To synthesize benzophenone oxime from benzophenone.

   To perform the basic application of Diels-Alder reaction on anthracene and maleic anhydride.

4. **Refractometry:**

   Determination of the specific and molar refraction of a given liquid by Abbe refractometer.

   Determination of variation of refractive index.

   To verify law of refraction of mixture (glycerol + water)

5. **Chromatography**

Separate different pigments of plant leaves by Thin Layer Chromatography

List of Experiments:

Experiment No.	Title of the Experiment
1	To isolate β–Carotene from carrots.
2	To study of photochemical decomposition of azo compounds under sun light.
3	To study of photochemical decomposition of azo compounds under UV light.
4	To synthesize benzophenone oxime from benzophenone.
5	To perform the basic application of Diels-Alder reaction on anthracene and maleic anhydride.
6	To isolate caffeine from tea.
7	To determine the specific and molar refraction of a given liquid by Abbe Refractometer.
8	To determine the variation of refractive index.
9	To verify law of refraction of mixture (glycerol + water).
10	To separate different pigments of spinach by Thin Layer Chromatography

After completion of this course the students shall able to:

A. Design of Photochemical experiments.
B. Become well conversant with different applications of UV-Visible spectroscopy.
C. Understand designing of Refractometry experiments.
D. Understand and get skill to perform the extraction processes.
E. Separate the different pigments via Chromatography.

Books Recommended:

Text books:

1. Advanced Practical Organic Chemistry – N. K. Vishnoi, Vikas Publishing House Pvt. Ltd.
2. Vogel's Textbook of Practical Organic Chemistry, Pearson.
3. Practical Organic chemistry, Garg and Saluja.

Reference books:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Advanced Practical Organic Chemistry, O.P. Agrawal, Goel Publishing House.

Course Code	Courses	Hours Per week			Total	
		L	T	P	Hrs	Credit
CH5CO11P	**Environmental Chemistry**	**0**	0	**4**	**0**	**2**

Course Objectives:

The student will be able

1. To learn about Water testing like DO, BOD, COD.
2. To understand about aquatic parameters like hardness, alkalinity, residual chlorine and their measurements.
3. To learn about turbidity of water sample and its coagulant dose.
4. To understand Soil and the physical properties of soil with few examples.
5. To learn about chloride content of water sample by Mohr's method.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

1. **Pollutant analysis of water:**

To determine dissolved oxygen content in given water sample.

To determine biological oxygen demand in given water sample.

To determine chemical oxygen demand in given water sample.

2. **Chemical analysis of water by complexometric/ iodometric method:**

   To determine residual chlorine in given water sample.

   To determine the total hardness of water sample by complexometric method.

3. **Chemical analysis of water by acid-base/ precipitation titration method.**

   To determine the mixed and total alkalinity of water sample.

   To determine the mixed and total alkalinity of water sample.

4. **Determination of turbidity and coagulant dose of water:**

   To determine the turbidity of water sample.

   To determine the coagulant dose required to treat the given turbid solution.

5. **Determination of physical properties of soil.**

   To determine the physical properties of soil.

List of experiments:

Experiment No.	Name of Experiments
1	To determine dissolved oxygen content in given water sample.
2	To determine biological oxygen demand in given water sample.
3	To determine chemical oxygen demand in given water sample.
4	To determine residual chlorine in given water sample.
5	To determine the total hardness of water sample by complexometric method.
6	To determine the mixed and total alkalinity of water sample.
7	To determine the turbidity of water sample.
8	To determine chloride content of water sample by Mohr's method.
9	To determine the coagulant dose required to treat the given turbid solution.
10	To determine the physical properties of soil.

Case Studies: Not applicable

Project: Optional.

Course Outcomes:

After completion of this course the students shall able to:

A. The students will be able to know about Water testing like DO, BOD, COD.

B. The students will understand about aquatic parameters like hardness, alkalinity, residual chlorine and their measurements.

C. The students will study about turbidity of water sample and its coagulant dose.

D. The students will study soil and the physical properties of soil with few examples.

E. The students will gain knowledge of chloride content of water sample by Mohr's method**.**

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MEDI-CAPS UNIVERSITY

मेडी-केप्स विश्वविद्यालय, इंदौर

Medi-Caps University, Indore

Syllabus

SEMESTER – IV						
S.N.	Course Code	Courses	L	T	P	Credit
1	CH5CO12	Solid State Chemistry	2	0	0	2
2	CH5CO15	Bio Organic, Bio inorganic, Bio Physical Chemistry	3	0	0	3
3	CH5EL07	Analytical Chemistry	3	0	0	3
4	CH5EL08	Chemistry of Materials	3	0	0	3
5	CH5PC03	Project Work	0	0	12	6
6	CH5CV01	Comprehensive Viva	0	0	4	2
		Total	**11**	**0**	**16**	**19**
		Total Contact Hours	**27**			

IV Semester

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5CO12	Solid State Chemistry	2	-	0	2	2

Course Objective:

1. Ideas about basic concepts, experimental procedure of solid-state reactions, co-precipitation and kinetics of solid-state reactions.
2. Detailed knowledge about various types of crystal defects and non-stoichiometry
3. Comprehensive knowledge about electronic properties and band theory of solids.
4. Learning about the concepts of organic solids; electronically conducting solids, organic charge transfer complexes, organic metals.
5. Learning about liquid crystals – types, its theories, concepts of liquid crystal display.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-1 Solid State Reactions

General principles, experimental procedure, co-precipitation as a precursory to solid statereactions, kinetics of solid-state reactions.

Unit-2 Crystal Defects and Non-Stoichiometry

Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and planedefects, vacancies-Schottky detects and Frenkel defects. Thermodynamics of Schottky andFrenkel defect formation, colour centres, non-stoichiometry and defects.

Unit-3 Electronic Properties and Band Theory

Metals insulators and semiconductors, electronic structure of solids band theory bandstructure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties-Application ofoptical and electron microscopy. Magnetic Properties-Classification of materials: Effectof temperature calculation of magnetic moment, mechanism of ferro and antiferromagnetic ordering super exchange.

Unit-4 Organic Solids

Electrically conducting solids. organic charge transfer complex, organic metals, new superconductors.

Unit-5 Liquid Crystals:

Types of liquid crystals: Nematic, Smectic, Ferroelectric, Antiferroelectric, Various theories of LC, Liquid crystal display, New materials.

Case Studies: Not applicable

Project: Optional.

Course Outcome: After completion of this course the students shall be able to acquire**:**

- **A.** Knowledge about introductory concepts, experimental procedure, co-precipitation and kinetics of solid-state reactions. Basic ideas of crystal defects, electronic properties and band theory of solids, organic solids, liquid crystals.
- **B.** Ideas about different types of crystal defects and non-stoichiometry
- **C.** Detailed knowledge about electronic properties and band theory of solids – semiconductors, superconductors.
- **D.** Knowledge about organic solids - electronically conducting solids, charge transfer complexes, organic metals, new superconductors. Basics of organic superconductors.
- **E.** Ideas about liquid crystals - different types of it, theories of liquid crystals, liquid crystal display. Detailed knowledge of semiconductors. Knowledge about organic solids.

Text Books:

1. Solid state chemistry and its applications, A.R. West. Peenum.
2. Principles of the Solid State, H.V. Keer, Wiley Eastern.

Reference Books:

1. Solid State Chemistry, N.B. Hannay.
2. Solid State Chemistry, D.K. Chakrabarty, New Wiley Eastern

Web Source:

https://www.wiley-vch.de/de/

https://www.researchgate.net/

Open Learning Source:

https://swayam.gov.in/

https://nptel.ac.in/course.php

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5CO15	Bio Organic, Bio inorganic, Bio Physical Chemistry	3	-	0	3	3

Course Outcome:

1. To understand about metal ions in biological system.
2. To know about nitrogen fixation.
3. To understand about enzymes.
4. To study about co-enzyme chemistry.
5. To gain knowledge of biological cell.

Prerequisites: B. Sc.

Co-requisites: Nil

Curriculum:

Unit-1 Metal Ions in Biological Systems

Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K+/Na+ pump.

Bioenergetics and ATP Cycle.

DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophyll's, photosystem I and photosystem II in cleavage of water.

Transport and Storage of Dioxygen

Heam proteins and oxygen uptake structure and function of haemoglobin's, mygolobin,haemocyanms and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Unit-2 Electron Transfer in Biology

Structure and function of metal of proteins in electron transport processes cytochrome'sand ion-sulphure proteins, synthetic models.

Nitrogen fixation

Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation.

Unit-3 Enzymes

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshalnd's inducedfit hypothesis, concept and identification of active site using inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michael's-Menten and Lineweaver Burk plots, reversible and irreversible inhibition.

Mechanism of Enzyme Action

Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase.

Kinds of Reactions Catalysed by Enzymes

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and thecoupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition andelimination reactions, enolic intermediates in Isomerisations reactions, b-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalysed carboxylation and decarboxylation.

Unit-4 Co-Enzyme Chemistry

Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalysed by the above cofactors. **Enzyme Models** Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular a symmetry and prochirality Biometric chemistry, crown ether, cryptates. Cyclodextrins, cyclodextrion-based enzyme models, clixarenes, ionospheres, micelles synthetic enzymes or synzymes.

Biotechnological Applications of Enzymes

large-scale prodcution and purification of enzymes, techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese- making, syrups from cron starch,

enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA Technology.

Unit-5 Biological Cell and its Constituents

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in livingsystems. Helix coils transition.

Bioenergetics

Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysisof ATP, synthesis of ATP from ADP.

Biopolymer Interactions

Forces involved in biopolymer interactions. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibrium and various types of bidning processes in biological systems. Hydrogen ion titration curves.

Cell Membrane and Transport of Ions

Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport. Nerve conduction.

Case Studies: Not applicable

Project: Optional.

Course Outcome: After completion of this course the students shall be able to:

A. Know about transport and storage of dioxygen.
B. Gain the knowledge of Electron transfer in biology.
C. Understand about kinds of reactions catalyzed by enzymes.
D. Study about structure and applications of various important enzymes.
E. Gain importance of biological cell and its constituents.

Text Books:

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, 1. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Inorganic biochemistry vol. I and II ed. G.L. Eichhorn, Elsever.
4. Progress in Inorganic Chemistry, Vol 18 and 38 ed J.J. Lippard, Wiley.
5. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
6. Understanding Enzymes, Trevor Palmer, Prentice Hall.

Reference Books:

1.Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, chemistry.
2.Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
3.Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
4.Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael ID. Trevan, Hohn Wiley.
5.Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
6.Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
7.Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Web Source:

https://www.wiley-vch.de/de/
https://www.researchgate.net/

Open Learning Source:

https://swayam.gov.in/
https://nptel.ac.in/course.php

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5EL07	Analytical Chemistry	3	0	0	3	3

Course Objectives:

The student will be able

1. To know about basic analytical techniques for general laboratory- glassware, apparatus and instruments.
2. To understand about errors and evaluation of analytical data.
3. To understand about the different modern analytical techniques for food analysis.
4. To acquire knowledge of different chemical analytical- skills, techniques and parameters for water.
5. To gain the knowledge of advancement in analytical techniques for Soil, Fuel, Body Fluids and Drugs

Co-requisites: Nil

Curriculum:

Unit-I Introduction

Role of analytical Chemistry. Classification of analytical methods- classical and instrumental. Types of instrumental analysis. Selecting a analytical method. Neatness and cleanliness. Laboratory operations and practices. Analytical balance. Techniques of weighing, errors. Volumetric glassware cleaning and calibration of glassware. Sample preparations- dissolution and decompositions, Gravimetric techniques. Selecting and handling of reagents. Laboratory note book. Safety in the analytical laboratory.

Unit-II Errors and Evaluation

Definition of term in mean and median. Precision-standard deviation, relative standard deviation, Accuracy-absolute error, relative error. Types of error in experimental data-determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effect upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The use of statistics.

Unit-III Food Analysis

Moisture, ash, crude protein, fat, crude fibre, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration-common adulterants in food. Contamination of food stuffs. Microscopic examination of foods for adulterants. Pesticide analysis in food products. Extraction and purifications of sample. HPLC, Gas chromatography for organophosphates. Thin layer chromatography for identification of chlorinated pesticides in food products.

Unit-IV Analysis of Water Pollution

Origin of waste water, types, water pollutants and their effects. Sources of water pollution. Objectives of analysis-parameter for analysis- colour, turbidity, total solids,

conductivity, acidity, alkalinity, hardness, chloride, sulphate, fluoride, silica, phosphates and different forms of nitrogen. Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental techniques for the analysis of heavy metals in aqueous systems. Measurements of DO, BOD and COD. Pesticides as water pollutants and analysis. Water pollution laws and standard.

Unit-V Analysis of Soil, Fuel, Body Fluids and Drugs

(a) Analysis of soil: moisture, pH, total nitrogen, phosphorous, silica, lime, magnesia, manganese, Sulphur and alkali salts.

(b) Fuel analysis: solid, liquid and gas. Ultimate and proximate analysis – heating values, grading of coal. Liquid fuels- flash point, aniline point, octane number and carbon residue. Gaseous fuels-producer gas and water gas -calorific value.

(c) Clinical Chemistry: Composition of blood collection and preservation of samples. Clinical analysis. Serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulins, barbiturates, acid and alkaline phosphates. Immunoassay: Principle of radio immunoassay (RIA) and applications. The blood gas analysis-trace elements in the body.

(d) Drug Analysis: Narcotics and dangerous drugs. Classification of drugs. Screening by gas and thin-layer chromatography and spectrophotometric measurements.

Case Studies: Optional

Project: Optional.

Course Outcomes: After the completion of the course,

A. The students would be able to understand proper analytical techniques for handling general laboratory glassware, apparatus and instruments.
B. The students would be skilled to identify different errors as well as to solve statistical evaluations over chemical analysis data.
C. The students would understand about the different modern analytical techniques for food analysis.

D. The students would acquire knowledge of different chemical analytical- skills, techniques, parameters for water and able to explore it in new areas of research.
E. The students would gain advance knowledge of analytical techniques for Soil, Fuel, Body Fluids and Drugs.

Text Books:

1. Analytical Chemistry, G.D. Christian, J. Wiley.
2. Analytical Chemistry, Principles and Techniques, L.G. Hargis, Prentice Hall.
3. Handbook of Instrumental Techniques for Analytical Chemistry, F. Settle, Prentice Hall.

Reference Books:

1. Basic concept of Analytical Chemistry, S.M. Khopkar, Wiley Eastern.
2. Quantitative Analysis, R.A. Day, Prentice Hall.
3. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastern.

Web Source:

1.https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

1.https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php
3. http://epgp.inflibnet.ac.in/

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5EL08	Chemistry of Materials	3	0	0	3	3

Course Objectives:

The student will be able

1. To recognize and understand the chemical structure of different materials viz. glass, ceramics, composite and nanomaterials.
2. To know about the structures and properties of thin film, LB film and liquid crystals.
3. To differentiate various types of conducting, ferro- electric, superionic conductors. behaviour of polymeric materials and ionic conductors.
4. To acquire knowledge of synthesis and characteristic properties of high Tc materials.
5. To gain the knowledge of advancement related to new materials like materials of solid-state devices, organic solids, fullerenes, molecular devices.

Co-requisites: Nil

Curriculum:

Unit-I Multiphase materials, Glasses, Ceramics, Composites and Nano materials

Ferrous alloys; Fe-C phase transformations in ferrous alloys; stainless steels, non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications. Microscopic composites; dispersion-strengthened and particle-reinforced, fibre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.

Microscopic composites; dispersion-strengthened and particle-reinforced, firbre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation procedures, special properties, applications.

Unit-II Thin Films, Langmuir-Blodgett Films and Liquid Crystals-

Preparation techniques; evaporation/sputtering, chemical processes, MOCVD, sol-gel etc. Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases; smectic-nematic transition and clearing temperature- homeotropic, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

Unit-III Polymeric Materials and Ionic Conductors

Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their application, conducting and ferro- electric polymers.

Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

Unit-IV High T_c Materials

Defect perovskites, high Tc superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave, absorption-pairing and multigap structure in high Tc materials, applications of high Tc materials.

Unit-V Materials of Solid-State Devices, Organic Solids, Fullerenes, Molecular Devices

Rectifiers, transistors, capacitors-IV-V compounds, low-dimensional quantum structures; optical properties.

Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes-doped, fullerenes as superconductors.

Fullerenes-doped, fullerenes as superconductors.

Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches-sensors. Nonlinear optical materials; nonlinear optical effects, second and third order-molecular hyperpolarizability an second order electric susceptibility materials for second and third harmonic generation.

Case Studies: Optional

Project: Optional.

Course Outcomes: After completion of the course.

- **A.** The students will be able to recognize and understand the chemical structure of different materials viz. glass, ceramics, composite and nanomaterials.
- **B.** The students will gain knowledge of structures and properties of thin film, LB film and liquid crystals.
- **C.** The students will differentiate among conducting, ferro- electric, superionic conductors type behaviors of polymeric materials and ionic conductors.
- **D.** The students will acquire knowledge of synthesis and characteristic properties of high Tc materials
- **E.** The students will acquire advance knowledge related to solid-state devices, organic solids, fullerenes, molecular devices and able to explore it in new areas of research.

Text Books:

1. Material Science and Engineering, An Introduction, W.D. Callister, Wiley.
2. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
3. Material Science, J.C. Anderson, K.D. Leaver, J.M. Alexander, ELBS.

Reference Books:

1. Handbook of liquid crystals, Kelkar and Hatz, Chemie Verlag.
2. Principle of solid state, H.V. Keer, Wiley Eastern.
3. Thermotropic Liquid crystals, Ed., G.W. Gray, John Wiley.

Web Source:

1.https://application.wiley-vch.de
2.www.researchgate.net

Open Learning Source:

1.https://swayam.gov.in/courses/public
2. http://nptel.ac.in/course.php
3. http://epgp.inflibnet.ac.in/

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hrs.	Credits
CH5PC03	Project Work	0	0	12	0	6

M.Sc. Chemistry
Course Code- CH5PC02
Course Name- Project Work (P)

Course Objectives:

A: To enable the learners to get knowledge of Literature Survey.

B. To have knowledge of review of literature and selection of Topic related to project.

C: To have practical knowledge of assign project.

D: To obtain the result of Project and its significance.

E: To submit the report and do it's presentation

Modules:

Module 1: Literature Survey.

Module 2: Selection of Topic

Module 3: Experimental Procedure

Module 4: Result and Discussion

Module 5: Submission of Report and Presentation

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Course Outcomes: Students at end of the course will be able to:

CO1: To get knowledge of Literature Survey.

CO2: To do review of literature and selection of Topic related to project.

CO3: To have practical knowledge of assign project.

CO4: To obtain the result of Project and its significance.

CO5: To submit the report and do it's presentation.

Proposed List of Practicals

1. To do Literature Survey.
2. To do review of literature and selection of Topic related to project
3. To do Experiment related to project.
4. Result and Discussion.
5. To submit the report and do its presentation.