INVERTIS UNIVERSITY BAREILLY

Scheme of Instruction & Syllabi

For

Master of Science

In

Chemistry

Two Years CBCS M.Sc. Course in Chemistry

(Academic Session: 2020-21)

Second Year

Department of Applied Sciences & Humanities

INVERTIS UNIVERSITY

Invertis Village

Bareilly-Lucknow NH-24, Bareilly-243123, India

15-10-20

Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

Dean
Faculty of Science
Invertis University, Bareilly (U.P.)

15/10/20

MSc (Chemistry)

INVERTIS UNIVERSITY BAREILLY

Programme Outcomes (POs)

PO1: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.

PO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

PO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO4: Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

PO5: Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

PO6: Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

PO7: Students will be able to function as a member of an interdisciplinary problem solving team.

PO8: The graduate has specific skills in planning and conducting advanced chemical experiments and applying structural-chemical characterisation techniques.

PO9: Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.

PO10: Are able to use modern library searching and retrieval methods to obtain information about a topic, chemical, chemical technique, or an issue relating to chemistry.

PO11: Students should be able to communicate scientific results in writing and in oral presentation.

PO12: Students should become proficient in their specialized area of chemistry and acquire the basic tools needed to carry out independent chemical research.

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Head

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Programme Educational Objectives (PEO)

PEO-1: The Masters in Chemistry will extend your depth and breadth of knowledge in all branches of chemistry, suitable for a professional chemist capable of conducting research.

PEO-2: To carryout research in the trust areas of chemistry. Will be able to communicate effectively the scientific information and research results in written and oral formats, to both professional scientists and to the public.

PEO-3: To motivate critical thinking and analytical skills to solve complex chemical problems and the Ability to handle problems of practical relevance to society while complying with economical, environmental, ethical, and safety factors.

PEO-4: To practice chemistry by performance of experiments in the laboratory classes. To perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.

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Department of Applied Science

M.Sc. CHEMISTRY (SECOND YEAR)

SEMESTER -III

S.N	Course Code	Subject	L	T	P	MSM	ESM	Total Marks	Credit
						Evaluation Scheme			
1	MCH301	Inorganic Chemistry-III	3	1	-	30	70	100	4
2	MCH302	Organic Chemistry-III	3	1	-	30	70	100	4
3	MCH303	Physical Chemistry-III	3	1	-	30	70	100	4
4	MCH304	Analytical Chemistry-III	3	1	-	30	70	100	4
5	MCH3011*	Advanced Inorganic Chemistry	3	1	-	30	70	100	4
6	MCH3021*	Advanced Organic Chemistry	3	1	-	30	70	100	4
7	MCH3031*	Advanced Physical Chemistry	3	1	-	30	70	100	4
8	MCH3041*	Advanced Analytical Chemistry	3	1	-	30	70	100	4
9	MCH351*	Inorganic Chemistry Practical-III	-	-	3	20	30	50	2
10	MCH352*	Organic Chemistry Practical-III	-	-	3	20	30	50	2
11	MCH353*	Physical Chemistry Practical-III	-	-	3	20	30	50	2
12	MCH354*	Analytical Chemistry Practical-I	-	-	3	20	30	50	2
13	MCH355**	Field Project/Internship	-	-	2	30	70	100	2
		Total	**15**	**5**	**3**	**200**	**450**	**650**	**24**

***Student has to choose only one (theory + lab) in the specialization.**

****Student will carry out Field Project/Internship during first year session break of the program**

15/10/20

Dr. D. Arumugam

15/10/20

Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

Kuldeep
15/10/20
Dr. Kuldeep Chauhan

Dean

SEMESTER IV

(Inorganic group)

S.No.	Course Code	Subject	Evaluation Scheme						Credit
			L	T	P	MSM	ESM	Total Marks	
1	MCH4012	Spectroscopic Methods	3	1	-	30	70	100	4
2	MCH4013	Bioinorganic Chemistry	3	1	-	30	70	100	4
3	MCH4014	Analytical Techniques	3	1	-	30	70	100	4
4	MCH4015	Nuclear and Radiochemistry	3	1	-	30	70	100	4
5	MCH451	Inorganic Chemistry Practical-IV	-	-	3	20	30	50	2
6	MCH452	Inorganic Chemistry Project & Evaluation	-	-	3	30	70	100	2
		Total	**12**	**4**	**6**	**170**	**380**	**550**	**20**

(Organic group)

S.No.	Course Code	Subject	Evaluation Scheme						Credit
			L	T	P	MSM	ESM	Total Marks	
1	MCH4022	Organic Synthesis	3	1	-	30	70	100	4
2	MCH4023	Biomolecules	3	1	-	30	70	100	4
3	MCH4024	Mechanisms of Organic Reactions	3	1	-	30	70	100	4
4	MCH4025	Medicinal Chemistry	3	1	-	30	70	100	4
5	MCH453	Organic Chemistry Practical-IV	-	-	3	20	30	50	2
6	MCH454	Organic Chemistry Project & Evaluation	-	-	3	30	70	100	2
		Total	**12**	**4**	**6**	**170**	**380**	**550**	**20**

15/10/20
Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

Kuldeep
15/10/20
Kuldeep Chauhan

15/10/20
Dr. D. ARUMUGAM

(Physical group)									
S.No.	Course Code	Subject	Evaluation Scheme						Credit
			L	T	P	MSM	ESM	Total Marks	
1	MCH4032	Advanced Electrochemistry	3	1	-	30	70	100	4
2	MCH4033	Photo and Radio Chemistry	3	1	-	30	70	100	4
3	MCH4034	Biophysical Chemistry	3	1	-	30	70	100	4
4	MCH4035	Crystallography	3	1	-	30	70	100	4
5	MCH455	Physical Chemistry Practical-IV	-	-	3	20	30	50	2
6	MCH456	Physical Chemistry Project & Evaluation	-	-	3	30	70	100	2
		Total	**12**	**4**	**6**	**170**	**380**	**550**	**20**

(Analytical group)									
S.No.	Course Code	Subject	Evaluation Scheme						Credit
			L	T	P	MSM	ESM	Total Marks	
1	MCH4042	Separation Techniques	3	1	-	30	70	100	4
2	MCH4043	Polarography	3	1	-	30	70	100	4
3	MCH4044	Spectroscopic Techniques	3	1	-	30	70	100	4
4	MCH4045	Micro Analytical Techniques	3	1	-	30	70	100	4
5	MCH457	AnalyticalChemistry Practical-II	-	-	3	20	30	50	2
6	MCH458	Analytical Chemistry Project & Evaluation	-	-	3	30	70	100	2
		Total	**12**	**3**	**6**	**170**	**380**	**550**	**20**

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Invertis University, Bareilly (U.P.)

Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

Kuldeep 15/10/20
Dr. Kuldeep Chauhan

15/10/20
Dr. D. ARUMUGAM

SEMESTER-III

MCH301: Inorganic Chemistry-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of inorganic reaction mechanisms and catalysis and bio-inorganic chemistry.

Course Objectives:

1. To know about mechanisms of substitution reactions of tetrahedral.
2. To understand the square pyramidal and octahedral complexes.
3. To learn the chemical activation.
4. To learn the nature of bridge ligands
5. To know the. nitrogen fixation.
6. To understand the chelating reagents in medicine.

Detailed Syllabus

Section-A: **Unit-1: Inorganic Reaction Mechanisms** Mechanisms of substitution reactions of tetrahedral, square planar, trigonal bipyramidal, square pyramidal and octahedral complexes. Potential energy diagrams, transition states and intermediates, isotope effects, factors affecting the reactivity of square planar complexes, Trans effect and its application to synthesis of complexes. Molecular rearrangement processes: Electron transfer reactions (outer and inner sphere), HOMO and LUMO of oxidant and reluctant, chemical activation. Precursor complex formation and rearrangement, nature of bridge ligands, fission of successor complexes, Two-electron transfers.
Section-B **Unit-2: Catalysis and Bio-inorganic Chemistry** Transition metal ion catalysts for organic transformations and their application in hydrogenation (using symmetric and chiral organometallic catalysts), isomerization, olefin oxidation, carbonylation and polymerization reactions. Nitrogen fixation. Futuristic aspects of organo transition metal complexes as catalysts and in bio-inorganic chemistry. Role of metal ions in biological chelation therapy, chelating reagents in medicine, recent advences in cancer chemotherapy using chelates.

Text and Reference Books

Reference Books:

1. Katakis, D. & Gordon, G. Mechanism of Inorganic Reactions John Wiley & Sons: N. Y (1987).
2. Langford, H. &.Gray, H. B. Ligand Substitution Processes W. A. Benjamin: N. Y. (1966).
3. Tobe, M. & Wadington, F. C. Ed., Inorganic Reaction Mechanisms Thomas Nelson: London (1973).
4. Hughes, M. N. The Inorganic Chemisty ofBiological Processes, 2nd Ed., Wiley (1981).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the square pyramidal and octahedral complexes.
CO2	Understand the molecular rearrangement processes.
CO3	Explain the HOMO and LUMO of oxidant and reluctant.
CO4	Develop the fission of successor complexes.
CO5	Calculate the role of metal ions in biological chelation therapy.
CO6	Illustrate the symmetric and chiral organometallic catalysts.

MCH302: Organic Chemistry-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of photochemistry & pricyclic reactions and chemistry of life processes.

Course Objectives:

1. To know about Jablonskii diagram, energy pooling.
2. To understand the photosensitization, quantum yield.
3. To learn the: photochemical additions; reactions of 1.3-.1,4- and1,5-dienes.
4. To learn the Norrish type I & II reactions.
5. To know the General Orbital Symmetry rules.
6. To understand the Correlation diagrams for different systems.

Detailed Syllabus

Unit-1: Photochemistry & Pericyclic Reactions **Photophysical processes:** Jablonskii diagram, energy pooling, exciplexes, excimers, photosensitization, quantum yield, solvent effects. Stern volume plots, delayed fluorescence Stern-volmer plot, delayed fluorescence, etc.
Unit-2: Photochemistry of alkenes: cis-trans isomerization, non-vertical energy transfer: photochemical additions; reactions of 1.3-.1,4- and1,5-dienes. Dimerizations.
Unit-3: Photochemistry of carbonyl compounds: Norrish type I & II reactions (cyclic and acyclic); α, β-unsaturated ketones; β, γ-unsaturated ketones; cyclohexenones (conjugated); cyclohexadienones(cross-conjugated & conjugated); Paterno—Buchi reactions:
Unit-4: Photochemistry of aromatic compounds: Isomerizations, skeletal isomerizations, Dewar and prismanes in isornerization. Singlet oxygen reactions: Photo Fries rearrangement of ethers and anilides; Barton reaction, Hoffman-Loefller-Freytag reaction.
Unit-5: Pericyclic reactions: Electrocyclic. cycloaddition. sigmatropic and chelotropic reactions; General Orbital Symmetry rules. Frontier Orbital approach, PMO approach, Correlation diagrams for different systems. General pericyclic selection rule and its applications, 1 ,3-dipolar additions, Ene reaction.
Unit-6: Chemistry of Life Processes **Introduction to metabolic processes:** Catabolism and anabolism, ATP-currency of biological energy, energy rich and energy poor phosphates. **Carbohydrate metabolism:** Glycolysis, fate of pyruvate under anaerobic conditions, citric acid cycle.
Unit-7: Fatly acid metabolism: Even chain and odd chain (saturated and unsaturated) fatty acids, fatty acids anabolism calorific values of food.

Protein metabolism and disorders: degradation of amino acid (C_3, C_4, C_5 family) urea cycle, uric acid and ammonia formation.
Text and Reference Books **Reference Books:** **1.** Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S. (2004). 2. Horspool, W. M. Aspects of Organic Photochemistry Academic Press (1976). 3. March, J. Advanced Organic Chemistry John Wiley & Sons (1992). 4. Marchand, A. P. & Lehr, R. E. Perc'vclic Reactions Academic Press (1977). 5. Strver, L. Biochemisny 411, Ed., W. H. Freeman & Co. (1995).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the degradation of amino acid.
CO2	Understand the even chain and odd chain (saturated and unsaturated) fatty acids.
CO3	Explain the, 1 ,3-dipolar additions, Ene reaction.
CO4	Develop the frontier orbital approach, PMO approach.
CO5	Calculate the cis-trans isomerization, non-vertical energy transfer.
CO6	Illustrate the delayed fluorescence Stern-volmer plot.

MCH303: Physical Chemistry-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of spectroscopic methods and NMR spectroscopy.

Course Objectives:

1. To know about recapitulation of essential quantum mechanics.
2. To understand the determination of bond lengths and/ or atomic masses from microwave.
3. To learn the non-rigid rotator.
4. To learn the classification of polyatomic molecules.
5. To know the normal coordinate analysis of homonuclear and heteronuclear diatomic molecules.
6. To understand the quantum mechanical theory of NMR spectroscopy.

Detailed Syllabus

Unit-1: Molecular Spectroscopy **Spectroscopic methods:** Recapitulation of essential quantum mechanics, Heisenberg Uncertainty principle, electromagnetic radiation, Einstein coefficient, Time dependent perturbation theory, Fermi Golden rule, Beer Lambert law, Line width analysis, Different branch of spectroscopy.
Unit-2: Rotational Spectroscopy Rotational spectroscopy of diatomic molecules based on rigid rotator approximation. Determination of bond lengths and/ or atomic masses from microwave, Non-rigid rotator. Classification of polyatomic molecules.
Unit-3: Vibrational spectroscopy: Normal coordinate analysis of homonuclear and heteronuclear diatomic molecules. Derivation of selection rules for diatomic molecules based on Harmonic oscillator approximation. Anharmonic oscillator.
Unit-4: Raman spectroscopy: Stokes and anti-Stokes lines. Polarizability ellipsoids. Rotational and Vibrational Raman spectroscopy. Selection rules. Polarization of Raman lines.
Unit-5: Electronic spectroscopy: Concept of electronic states, electronic transitions, Franck-Condon Principle, Selection rule, Dissociation energy. Application of absorption and emission spectroscopy.
Unit-6: NMR spectroscopy: Theory of NMR spectroscopy, spins of common nucleus, Quantum mechanical theory of NMR spectroscopy, Larmor precession.

Text and Reference Books

Reference Books:

1. Hollas. J. M. Aluciern Specroscopy 4h Ed. John Wiley & Sons (2004).
2. Barrow. G. M. huroduction to Molecular Spectroscopy McGraw-Hi11 (1962).
3. Brand, J. C. D. & Speakman. J. C. Molecular Structure: The Physical Approach2nd Ed., Edward, Arnold: London (1975).
4. Chang, R. Basic Principles ofSpectroscopy McGraw-Hill. New York, N.Y. (1970).
5. Moore, W. J. Physical Chemistry 4h Ed. Prentice-Hall (1972).
6. Warren, B. E. X-Ray Dffraction Dover Publications (1990).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the stokes and anti-stokes lines. Polarizability ellipsoids. Rotational and Vibrational Raman spectroscopy.
CO2	Understand the Selection rules. Polarization of Raman lines.
CO3	Explain the selection rules for diatomic molecules based on Harmonic oscillator approximation.
CO4	Develop the Theory of NMR spectroscopy, spins of common nucleus.
CO5	Explain the Fermi Golden rule, Beer Lambert law, Line width analysis.
CO6	Illustrate the Rotational spectroscopy of diatomic molecules based on rigid rotator approximation.

MCH304: Analytical Chemistry-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Develop the photometric titrations and chemical sensors skills.

Course Objectives:

1. To know about comparison with other titrimetric procedures.
2. To understand the advantages and limitations, Typical examples.
3. To learn the principles of Cyclic voltammetry (CV).
4. To learn the humidity sensors.
5. To know the, Clark and Enzyme electrodes).
6. To understand the types of chemical sensor based on the chemically sensitive materials.

Detailed Syllabus

Unit-1: Photometric Titrations: Basic principles, comparison with other titrimetric procedures, types of photometric titration curves, Instrumentation (titration cell, detectors, choice of analytical wavelength). Quantitative applications, typical examples of one component and multicomponent analyses.
Unit-2: Spectrophotometric Determination of Stoichiometry of Complexes: Job's method of continuous variation, mole ratio and slope ratio analysis, Advantages and limitations, Typical examples.
Unit-3: Cyclic Voltammetry Principles of Cyclic voltammetry (CV), electrode and electrolyte, analysis of CV results, appropriate solvents, deciphering reaction mechanisms with cyclic voltammetry.
t-4: Chemical Sensors: Principles, types of chemical sensors based on the modes of transductions, Types of chemical sensor based on the chemically sensitive materials (solid electrolyte, gas, semiconductor), Humidity sensors, Biosensors, Electrochemical sensors (Potentiometric sensors, Ion-selective electrodes, Membrane electrodes, Amperometric sensors, Clark and Enzyme electrodes).

Text and Reference Books

Reference Books:

1. D.A. Skoog and D.M. West, *Fundamental of Analytical Chemistry*, International Edition, 7thEdition (1996), Saunders College Publishing, Philadelphia, Holt, London.
2. R.L. Pecsok, L.D. Shields, T. Cairns and L.C. McWilliam, *Modern Methods of Chemical Analysis*, 2^{nd} (1976), John Wiley & Sons, New York.

3. D.A. Skoog, *Principles of Instrumental Analysis*, 5th Edition (1998), Saunders College of Publishing, Philadelphia, London.

4. H.A. Strobel, *Chemical Instrumentation: A Schematic Approach*, 2nd Edition (1973), Addison Wesley, Reading, Mass.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the types of photometric titration curves.
CO2	Understand the quantitative applications, typical examples of one component and multicomponent analyses.
CO3	Explain the potentiometric sensors, Ion-selective electrodes.
CO4	Develop the types of chemical sensor based on the chemically sensitive materials.
CO5	Calculate the mole ratio and slope ratio analysis.
CO6	Illustrate the comparison with other titrimetric procedures.

MCH3011: Advanced Inorganic Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of chemistry of inorganic rings and solution of multielectron problems.

Course Objectives:

1. To know about chemistry of inorganic rings.
2. To understand the, carboranes, metalloboranes.
3. To learn the synthesis of pillared clays.
4. To learn the pillared clays and zeolites from measurement of surface area.
5. To know the introduction to the solution of multielectron problems.
6. To understand the evaluation of energy matrices using Slater's method.

Detailed Syllabus

Course A:
Chemistry of inorganic rings, cages and metal cluster compounds, borazines, phosphazenes, polyhedral boranes, carboranes, metalloboranes and metallocarboranes. Synthesis of pillared clays, and zeolites. Characterization of clays, pillared clays and zeolites from measurement of surface area.

Course B:
Introduction to the solution of multielectron problems, the central field approximation, angular momenta, step up and step down operators and their use in atomic spectra. Lande's interval rule. Evaluation of energy matrices using Slater's method.The weak and strong field cases. Generation of a secular determinant for 3F term (d2) in weak field. Bethe's method of descending symmetry. Non octahedral ields, tetrahedral (including contribution of odd harmonics), trigonal and tetragonal (including Ds & Dt parameters). Spin orbit coupling and its magnitude in comparison to crystal field. Splitting of eg and /t_{2g} orbitals due to spin orbit coupling. for a d^1 and d^9 case. The use of double group D4. and 0. Effect of spin orbit coupling on A, E and T terms in octahedral fields.

Text and Reference Books

Reference Books:

1. Ballhausen C. J. Introduction to Ligand Field Theory McGraw Hill Book Co. N.Y (1962).
2. Marshal. C. E. The Physical Chemistry and Miner°logv of Soil Vol. I Soil Materials John Wiley &Sons. N.Y.(1964).
3. Wells, A. F. Structural Inorganic Chemisery 5" Ed, Oxford University Press, Oxford (1984).
4. Adams, D. M. Inorganic Solids. An Introduction to Concepts in

Solid-State Structural Chemistry John Wiley & Sons, London (1974).
5. Azaroff, L V. Introduction to Solids Tata McGraw Hill Publishing Co. Ltd. Bombay- New Delhi (1960).
6. Breck. D. W. Zeolites Molecular Sieves- Structure, Chemist))) and Use. John Wiley & Sons N.Y. (1974).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the synthesis of pillared clays, and zeolites.
CO2	Understand the cluster compounds, borazines, phosphazenes.
CO3	Explain the spin orbit coupling.
CO4	Develop the eeffect of spin orbit coupling on A, E and T terms in octahedral fields.
CO5	Calculate the Non octahedral fields, tetrahedral (including contribution of odd harmonics).
CO6	Illustrate the generation of a secular determinant for 3F term (d2) in weak field.

MCH3021: Advanced Organic Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of newer synthetic reactions and reagents and heterocyclic chemistry.

Course Objectives:

1. To know about thermodynamic versus Kinetic enolates.
2. To understand the applications in carbon-carbon bond formation and related reactions.
3. To learn the applications of phase transfer catalysis.
4. To learn the benzofused five membered heterocycles with one heteroatom.
5. To know the chemistry of bicyclic compounds containing one or more heteroatoms.
6. To understand the phenoxazines, phenothiazines, chemistry of porphyrins.

Detailed Syllabus

Section-A:

Newer Synthetic Reactions and Reagents

Enolates, Thermodynamic versus Kinetic enolates, enonate equivalents and enamines: Applications in carbon-carbon bond formation and related reactions. Phosphorus, Sulphur and nitrogen ylides: Preparation and applications in organic synthesis its and mechanism. Principles and applications of phase transfer catalysis, crown ethers and polymer supported reagents in organic synthesis. Principles of Green Chemistry and its applications: Biotransformations: Classification of enzymes, advantages and disadvantages, applications in organic synthesis; Principles of ultrasound and microwave assisted organic synthesis.

Section-B

Heterocyclic Chemistry

Introduction to heterocycles: Nomenclature, spectral characteristics, reactivity and aromaticity Synthesis and reactions of three and four membered heterocycles, e.g., aziridine, azirine, azetidine, oxiranes, thiarines, oxetenes and thietanes. Five membered rings with two heteroatoms: pyrazole, imidazole, oxazole, thiazole, isothiazole and benzofused analogs. Benzofused five membered heterocycles with one heteroatom, e.g. indole, benzofuran,

benzothiophene. Chemistry of bicyclic compounds containing one or more heteroatoms. Benzofused six membered rings with one, two and three heteroatoms: benzopyrans, quinolines, isoquinolines, quinoxazalines, acridines, phenoxazines, phenothiazines, chemistry of pophyrins.

Text and Reference Books

Reference Books:

1. Carey, F.A. & Sundberg, R. J. Advanced Organic Chemistry, Parts A & B, Plenum: U.S. (2004).
2. Carruthers, W. Modern Methods of Organic Synthesis Cambridge University Press (I 971).
3. Acheson, R. M. introduction to the Chemistry of Heterocyclic Compounds John Wiley & Sons (1976).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the Thermodynamic versus Kinetic enolates.
CO2	Understand the Preparation and applications in organic synthesis its and mechanism.
CO3	Explain the crown ethers and polymer supported reagents in organic synthesis.
CO4	Develop the chemistry of pophyrins.
CO5	Calculate the Benzofused six membered rings with one, two and three heteroatoms.
CO6	Illustrate the benzopyrans, quinolines, isoquinolines.

MCH3031: Advanced Physical Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of irreversible thermodynamics and transport phenomena.

Course Objectives:

1. To know about meaning and scope of irreversible thermodynamics.
2. To understand the phenomenological laws- Linear laws.
3. To learn the Gibbs equation.
4. To learn the Fick's first and second laws.
5. To know the relation between lux and viscosity.
6. To understand the factors affecting the CMC of surfactants, counterion binding to micelles.

Detailed Syllabus

Unit-1: Irreversible thermodynamics: Meaning and scope of irreversible thermodynamics. Thermodynamic criteria for non-equilibrium states, Phenomenological laws- Linear laws, Gibbs equation, Onsager's reciprocal relation.
Unit-2: Transport phenomena: Diffusion coefficients, Fick's first and second laws, relation between lux and viscosity, relation between diffusion coefficient and mean free path, relation between thermal] conductivity/viscosity and mean free path of a perfect gas, Einstein relation, Nernst-Einstein equation.
Unit-3: Surface phenomena: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelle concentration (CMC), Krafft temperature, Factors affecting the CMC of surfactants, counterion binding to micelles, thermodynamics of micellization, solubilization, microemulsions, reverse micelles, surface films (eletrokinetic phenomena), catalytic activity at surfaces. Fast reactions: luminescence and energy transfer processes, study of kinetics by stopped-flow

technique, relaxation method, flash photolysis and magnetic resonance method. Kinetics of solid state reactions.

Text and Reference Books

Reference Books:

1. Katchalsky, A. & Curren, P. F. Non Equilibrium Thermodynamics in Biophysics Harvard University Press: Cambridge (1965).
2. Zwanzig, R. Nonequilibrium Statistical Mechanics Oxford University Press (2001)
3. Laidler, K. J. Chemical Kinetics 3rd Ed., Benjamin Cummings (1997).
4. Thomas, J. M. & Thomas, M. J. Principles and Practice of Heterogeneous Catalysis John Wiley &Sons (1996).
5. Campbell, I. M. Catalysis at Surfaces Chapman and Hall, New York/London (1988).
6. Chorkendorff, lb & Niemantsverdriet, J. W. Concepts of Modern Catalysis and Kinetics WileyVCH (2003).
7. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 81h Ed., Oxford University Press (2006).
8. Shaw, D. J. Introduction to Colloid and Surface Chemistry 2nd Ed. Butterworths (1970).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the thermodynamic criteria for non-equilibrium states.
CO2	Understand themicellization, hydrophobic interaction, critical micelle concentration (CMC).
CO3	Explain the, Krafft temperature, Factors affecting the CMC of surfactants.
CO4	Develop the, counterion binding to micelles, thermodynamics of micellization.
CO5	Calculate the, solubilization, microemulsions
CO6	Illustrate the, reverse micelles, surface films (eletrokinetic phenomena), catalytic activity at surfaces.

MCH3041: Advanced Analytical Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -

Concept of Microanalysis of real-world samples and Inorganic microanalysis.

Course Objectives:

1. To know about Scope and objectives of microanalytical technique.
2. To understand the Microanalytical technique based on size and amount of the sample.
3. To learn the polymeric materials.
4. To learn the estimation of protein in egg albumin.
5. To know the saponification value of fats/oils.
6. To understand the estimation of blood cholesterol, DNA and RNA.

Detailed Syllabus

Unit-1: General introduction: Scope and objectives of microanalytical technique, Difference between micro and trace analysis, Microanalytical technique based on size and amount of the sample.
Unit-2: Microanalysis of real-world samples: Molecular recognition and targeted analysis using macrocyclic (crown ethers), macrobicyclic (cryptands), Supramolecular compounds (calixarenes) and polymeric materials.
Unit-3: Biochemical microanalysis: Estimation of carbohydrates, amino acids and ascorbic acid in biological systems, Estimation of protein in egg albumin, Estimation of free fatty acid, Iodine value and saponification value of fats/oils, Estimation of blood cholesterol, DNA and RNA.
Unit-4: Inorganic microanalysis: Principle, technique, qualitative and quantitative applications with special reference to Ring-oven technique and Ring colorimetric technique, chemical microscopy.
Unit-5: Organic microanalysis: Determination of alkoxy, acetyl, acyl, hydroxyl, carbonyl, active hydrogen, nitroso, sulfonyl, amides and ester groups, Determination of molecular weight and percentage purity of carboxylic acid, estimation of sugars, estimation of unsaturation.
Unit-6: Microanalysis by kinetic methods: Theoretical basis, Kinetic parameters, Kinetic methods of microanalysis: Tangent, fixed time and addition method.

Text and Reference Books

Reference Books:

1. P.L. Kirk, *Quantitative Ultramicroanalysis*, John Wiley.
2. C.L. Wilson and D.L. Wilson, *Comprehensive Analytical Chemistry"*, Vol. I (A) and I(B), Elsevier.
3. G.D. Christian, *Analytical Chemistry*, John Wiley & Sons, New York (2001).
4. S.M. Khopkar, *Analytical Chemistry of Macrocyclic and Supramolecular Compounds*, Narosa Publishing House, New Delhi (2002).
5. Jag Mohan, *Organic Analytical Chemistry - Theory and Practice*, Narosa Publishing House, New Delhi (2003).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the estimation of free fatty acid, Iodine value.
CO2	Understand the determination of alkoxy.
CO3	Explain the active hydrogen, nitroso.
CO4	Develop the percentage purity of carboxylic acid .
CO5	Calculate the estimation of unsaturation.
CO6	Illustrate the Tangent, fixed time and addition method.

MCH351: Inorganic Chemistry Practical-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the inorganic chemistry practical skills.

Course Objectives:

1. To know about Synthesis of inorganic complexes/compounds.
2. To understand the characterization by various physicochemical methods.
3. To learn the IR, UV, Visible, NMR, magnetic susceptibility.

Detailed Syllabus

Synthesis of inorganic complexes/compounds and their characterization by various physicochemical methods, viz. IR, UV, Visible, NMR, magnetic susceptibility etc. Selection can be made from the following or any other from the existed literature.

(i) Metal acetylacetonates.
(ii) Cis and trans isomers of $[Co(en)_2C_{12}]Cl$.
(iii) Ion-exchange separation of oxidation states of vanadium.
(iv) Preparation of Ferrocene.
(v) Preparation of triphenyl phosphene Ph_3P, and its transition metal complexes.
(vi) Determination of Cr(III) complexes:$[Cr(H_20)_6]NO_3.3H20$; $[Cr(H_2O)_4Cl_2]C1.2H_20$; $[Cr(en)_3]C1_3$; $Cr(acac)_3$.
(vii) Tin(IV) iodide, Tin(IV) chloride, Tin(I1) iodide.
(viii) (N,N)-bis(salicyldehyde)ethylenediamine Salen H2; and its cobalt complex [Co(Salen)].
(ix) Reaction of Cr(1I1) with multidentate ligands, a kinetics experiment.
(x) Vanadyl acetylacetonate.
(xi) Other new novel synthesis reported in literature from time to time.

Text and Reference Books

References:

1. Metal acetylacetonates *Inorg. Synth*.1957, 5, 130.
2. Cis and trans isomers of $[Co(en)_2C_{12}]Cl$ *J. Chem. Soc*.,960, 4369.
3. Ion-exchange separation of oxidation states of vanadium. *J. Chem., Ehic*.,980, 57, 316:978. 55, 55.
4. Preparation of Ferrocene. *J. Chem.Educ*.1966, 43, 73; 1976, 53, 730.
5. Tin(IV) iodide, Tin(IV) chloride, Tin(I1) iodide. *Inorg. Synth*.1953,4 119.
6. (N,N)-bis(salicyldehyde)ethylenediamine Salen H2; and its cobalt

complex [Co(Salen)]. J. Chem_Educ.1977, 54, 443,1973, 50, 670.
7. Reaction of Cr(1I1) with multidentate ligands, a kinetics experiment. *J. Am. Chem*. Soc.1953. 75, 5670.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the Metal acetylacetonates
CO2	Understand the Cis and trans isomers of $[Co(en)_2C_{12}]Cl$.
CO3	Explain the Ion-exchange separation of oxidation states of vanadium.
CO4	Preparation of Ferrocene.
CO5	Preparation of triphenyl phosphene Ph_3P, and its transition metal complexes.
CO6	Illustrate the $Cr(H_20)_6]NO_3.3H20$; $[Cr(H_2O)_4Cl_2]C1.2H_20$; $[Cr(en)_3]C1_3$; $Cr(acac)_3$.

MCH352: Organic Chemistry Practical-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the organic chemistry practical skills.

Course Objectives:

1. To know about semi-micro qualitative analysis of single/poly functional compounds.
2. To learn the separation of mixtures by chemical and chromatographic methods.
3. To learn the isolation of caffeine from tea leaves.

Detailed Syllabus

Qualitative analysis

1Semi-micro qualitative analysis of single/poly functional compounds data).
2. Separation of mixtures by chemical and chromatographic methods.
3. Isolation of natural products
i. Isolation of caffeine from tea leaves
ii. Isolation of piperine from black pepper
iii. Isolation of 13-carotene from carrots
iv. Isolation of lycopenc from tomatoes
v. Isolation of cholesterol from bile stones

Text and Reference Books

Reference Books:

1. Vogel, A. 1. Vogel's Qualitative Inorganic Analysis - 7th ed. (revised by G. Svehla) Longmans (1996) ISBN 058-221866-7
2. Vogel, A. 1. Vogel's Textbook of Quantitative Chemical Analysis - 5th Ed. Longman (1989).
3. Addison Ault Techniques and Experiments for Organic Chemistry 6th Ed. University Science Books (1998).
4. Mann, F. G. & Saunders, B. C. Practical Organic Chemistry 4th Ed. Orient Longmans (1990).
5. Vogel, A. I. Vogel's Textbook of Practical Organic Chemistry 5th Ed.

(revised by A.R. Tatchell et al.) Wiley (1989) ISBN 0582-46236-3

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the Separation of mixtures by chemical and chromato-graphic methods.
CO2	Understand the Isolation of 13-carotene from carrots.
CO3	Explain the Isolation of lycopenc from tomatoes.
CO4	Develop the Isolation of cholesterol from bile stones.
CO5	Calculate the Isolation of natural products.
CO6	Illustrate the Isolation of piperine from black pepper.

MCH353: Physical Chemistry Practical-III

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the physical chemistry practical skills.

Course Objectives:

1. To know about Titrate a moderately strong acid (salicylic/mandelic acid).
2. To understand the double alkali method.
3. To learn the salt-line method.

Detailed Syllabus

1. Titrate a moderately strong acid (salicylic/mandelic acid) by the
   (a) salt-line method
   (b) double alkali method.
2. Titrate a mixture of copper sulphate, acetic acid and sulphuric acid with sodium hydroxide.
3. Titrate a tribasic acid (phosphoric acid) against NaOH and $Ba(OH)_2$ conductometrically.
4. Estimate the concentration of each component of a mixture of $AgNO_3$ and HNO_3 by conductometric titration against NaOH.
5. Determine the degree of hydrolysis of aniline hydrochloride.
6. Determine the critical micelle concentration of a surfactant(sodium lauryl sulphate) by the conductivity method.

7.Ternary phase diagram of water, benzene, and acetic acid.

Text and Reference Books

Reference Books:

1. Daniels, F., Williams, J. W., Bender, P., Alberty, R. A., Conwell, C. D. & Harriman, J. E. Experimental Physical Chemistry, McGraw-Hill (1962).
2. Das & R. C. & Behera, B., Experimental Physical Chemistry, Tata McGraw-Hill Publishing Co. Pvt. Ltd. (1993).
3. Shoemaker, D. P., Garland, C. W. & Nibler, J. W. Experiments in Physical Cheinisay, McGraw-Hill: New York (1996).
4. Day, R. A., Jr. & Underwood, A. L. Quantitative Analysis3rd Ed. Prentice-Hall India Pvt. Ltd.: New Delhi (1977).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the titrate a mixture of copper sulphate.
CO2	Understand the titrate a tribasic acid.
CO3	Explain the estimate the concentration of each component of a mixture of $AgNO_3$ and HNO_3 by conductometric titration against NaOH.
CO4	Develop the degree of hydrolysis of aniline hydrochloride.
CO5	Calculate the Ternary phase diagram of water, benzene, and acetic acid.
CO6	Illustrate the titrate a moderately strong acid.

MCH354: Analytical Chemistry Practical-I

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the analytical chemistry experiments skills.

Course Objectives:

1. To know about ferrous ammonium sulfate potentiometrically with standard ceric sulfate solution.
2. To understand the Conductometric titration of (I) strong acid, monobasic weak acid or polybasic weak acid with strong base.
3. To learn the Determination of Na_2CO_3 content (in %) of washing soda using a pH meter.

Detailed Syllabus

1. Determination of ferrous ammonium sulfate potentiometrically with standard ceric sulfate solution (Direct and back titration).
2. Determination of concentration of halide ion(s) in the given solution potentiometrically.
3. Conductometric titration of (I) strong acid, monobasic weak acid or polybasic weak acid with strong base (ii) zinc with EDTA, and (iii) KCl vs $AgNO_3$
4. To obtain the protolysis curves involving cases of weak acid, mixture of acids and polybasic acid employing a pH meter and determine the amount of the respective acid (in ppm) in the given solution
5. Determination of Na_2CO_3 content (in %) of washing soda using a pH meter
6. Analysis of mixture of carbonate and bicarbonate (percent in ppm range) using a pH meter or suitable indicators
7. To study the current-potential characteristics of Cd^{2+} ions using DC polarography, sampled DC, cyclic voltammetry and pulse polarographic techniques
8. Determination of Cd^{2+} ions concentration in given solution polarographically following (I) calibration (ii) standard addition and (iii) the pilot-ion procedures
9. Determination of Zn^{2+} ions present at the ppm level in the solution employing conventional D.C.and pulse polarographic techniques
10. Determination of trace metal impurities present in a polluted water sample by anodic stripping voltammetric procedure

Text and Reference Books

Reference Books:

1. Shoemaker, D. P., Garland, C. W. & Nibler, J. W. Experiments in Physical Cheinisay, McGraw-Hill: New York (1996).

2. Day, R. A., Jr. & Underwood, A. L. Quantitative Analysis3rd Ed. Prentice-Hall India Pvt. Ltd.: New Delhi (1977).
3. Burns, D. T. & Ratenbury, E. M. Introductory Practical Physical Chemistry Pergamon Press (1966).
4. Harris, D. C. •Quantitative Chemical Analysis 6th Ed. W. H. Free-man & Co. (2002).
5. Willard, H. H.,L. L., Dean, J. A.Settle, F. A.(Eds.) Instrumental AielitudY of Analysis - 7th Ed., Wadsworth Publishing (February1988) ISBN 0534081428.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the protolysis curves involving cases of weak acid, mixture of acids.
CO2	Understand the analysis of mixture of carbonate and bicarbonate.
CO3	Explain the current-potential characteristics of Cd^{2+} ions using DC polarography.
CO4	Develop the standard addition.
CO5	Calculate the Cd^{2+} ions concentration in given solution polarographically.
CO6	Illustrate the pilot-ion procedures.

SEMESTER-IV

INORGANIC CHEMISTRY SPECIALIZTION

MCH4012: Spectroscopic Methods

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of Vibrational spectroscopy and Electronic paramagnetic resonance spectroscopy.

Course Objectives:

1. To know about vibrational motion and energies.
2. To understand the number of vibrational modes.
3. To learn the quadrupole interactions.
4. To learn the resonance Raman spectroscopy.
5. To know the Pascal's constants derivation and its applications.
6. To understand the spin-orbit coupling.

Detailed Syllabus

Course-A: **Unit-1: Vibrational spectroscopy:** Vibrational motion and energies, number of vibrational modes. vibrational spectra and symmetry, selection rules, symmetry of an entire set of normal vibrations, Raman spectra and selection rules, polarized and depolarized Raman lines, resonance Raman spectroscopy
Unit-2: Mossbauer spectroscopy: Doppler shift and recoil energy, isomer shift and its interpretation, quadrupole interactions, effect of magnetic field on Mossbauer spectra, applications to metal complexes, metal carbonyls. Fe-S. cluster.
Unit-3: Magnetism: Types of magnetic behaviour, magnetic susceptibilities, Pascal's constants.derivation and its applications. Spin-orbit coupling and susceptibility of transition metal ions and rare earths; magnetic moments of metal complexes with crystal field terms of A, E and T symmetry.
Unit-4: Mass spectroscopy: Experimental arrangements and presentation of spectra, molecular ions, appearance and ionization potential, fragmentation, ion reactions and their interpretation, molecular weight determination, thermodynamic data. Application of mass spectroscopy to inorganic compounds.
Course B: **Unit-5:** Potential energy level diagram. Symmetry requirements for n to n*

transitions, oscillator strengths, transition moment integrals (electric dipole and magnetic dipole moment operator), selection rules, spin orbit and vibronic coupling contributions, mixing of d and p orbitals in certain symmetries. Polarized absorption spectra. Survey of the electronic spectra of tetragonal complexes. Calculation of Dq and β for Ni(II) Oh complexes, nephelauxetic effect, effect of o and it bonding on the energy of t2g orbitals and DT spectrochemical series, effect of distortion on the d orbital energy level (Td, D2d, D4h).
Unit-6: Nuclear magnetic resonance spectroscopy: Nuclear spin quantum number, I. and its calculation using the nuclear shell model, spin parity rules. Types of nuclei based on value of I, nuclear spin angular momentum quantum number, and its relation to classical magnetic moment. Behaviour of a bar magnet in a magnetic field. Application of chemical shifts.
Unit-7: Electronic paramagnetic resonance spectroscopy: Electronic Zeeman effect, Zeeman Hamiltonian and EPR transition energy. EPR spectrometers, presentation of spectra. The effects of electron Zeeman, nuclear Zeeman and electron nuclear hyperfine terms in the Hamiltonian on the energy of the hydrogen atom. Shift operators and the second order effect. Hyperfine splitting.
Text and Reference Books
Reference Books: 1. Ebsworth, E. A.0. Structural Methods in Inorganic Chemistry Blackwell Scientific Publications (1991). 2. Drago, R. S. Physical Methods in Chemisuy W. B. Saunders Co.: U.K. (1977). 3. Carrington, A. & McLachlan, A. D. Introduction to Magnetic Resonance Chapman & Hall: N.Y. (1983).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the nuclear spin quantum number .
CO2	Understand the effects of electron Zeeman, nuclear Zeeman and electron nuclear hyperfine terms in the Hamiltonian on the energy of the hydrogen atom.
CO3	Explain the shift operators and the second order effect. Hyperfine splitting. .
CO4	Develop the polarized absorption spectra. Survey of the electronic spectra of tetragonal complexes.
CO5	Calculate the quadrupole interactions, effect of magnetic field on Mossbauer spectra.
CO6	Illustrate the symmetry of an entire set of normal vibrations, Raman spectra and selection rules.

MCH4013: Bio-Inorganic Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of survey of organometallic complexes according to ligands. pi bonded organometallic compounds and metal complexes as probes of structure and reactivity with metal substitution.

Course Objectives:

1. To know about structure and bonding.
2. To understand the nitrosyls, tertiary phosphines.
3. To learn the-, biotransformation of non metallic inorganic compounds.
4. To learn the metal-carbon multiple bonds.
5. To know the role of metal ions in replication and transcription process of nucleic acids.
6. To understand the biochemistry of dioxygen, bioinorganic chips and biosensors.

Detailed Syllabus

Course A: General introduction, Structure and bonding, Survey of organometallic complexes according to ligands. pi bonded organometallic compounds including carbonyls, nitrosyls, tertiary phosphines, hydrides, alkene, alkyne, cyclobutadiene, cyclopentadiene, arene compounds and their M.O. diagrams. Metal-carbon multiple bonds. Fluxional omanometallic compounds including z-ally1 complexes and their characterization.
Course B: Fundamentals of inorganic biochemistry, geo-chemical effects on life systems, essential and non-cssential elements in bio-systems. Role of alkali/alkaline earth metals in bio-systems. Role of 3d block elements and-non-metals in bio-systems. Role of metal ions in oxygen carriers and synthetic oxygen carriers. Designing of chelating agents and metal chelates as medicines. Fixation or dinitrogen biologically and abiologically-, biotrans-

formation of non metallic inorganic compounds. Environmental bioinorganic chemistry. Metal ions as probes for locating active sites. Anti-oxidants. Metal ions as antioxidants, metal ion enhancing catalytic activity of enzymes (Biocatalysts). Metal complexes of polynucleotides, nucleosides and nucleic acids (DNA & RNA) Template temperature, stability of DNA. Role of metal ions in replication and transcription process of nucleic acids. Biochemistry of dioxygen, bioinorganic chips and biosensors. Metals in the regulation of biochemical events. Transport and storage of metal ions in vivo. Metal complexes as probes of structure and reactivity with metal substitution.
Text and Reference Books **Reference Books:** 1. Green, M. L. H. Organometallic Compounds Chapman & Hall: U.K. (1968). 2. Coates, U., Green, iv!. L. t-i. & roweu, r. Principles of Organo-meraiiic Chemistry Chapman and Hall: U.K.(1988). 3. Lippard, S. J. & Berg, J. M. Principles of Bioinorganic Chemistry Univ. Science Books (1994).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the geo-chemical effects on life systems, essential and non-cssential elements in bio-systems.
CO2	Understand the role of alkali/alkaline earth metals in bio-systems.
CO3	Explain the designing of chelating agents and metal chelates as medicines.
CO4	Develop the metals in the regulation of biochemical events.
CO5	Calculate the transport and storage of metal ions in vivo.
CO6	Illustrate the z-ally1 complexes and their characterization.

MCH4014: Analytical Techniques

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of analytical techniques.

Course Objectives:

1. To know about polarography (DC, AC and pulse).
2. To understand the coulometry and anode stripping voltammetry.
3. To learn the dispersive and Fourier Transformed Raman.
4. To learn the Raman and surface Enhanced Raman Spectroscopy.
5. To know the GC-IR, TG-1R spectroscopy.
6. To understand the neutron diffraction and electron diffraction.

Detailed Syllabus

Course A: Analytical techniques (Instrumentation and Applications) **Unit-1: (i)Electroanalytical methods:-** Polarography (DC, AC and pulse), cyclic voltammetry, coulometry and anode stripping voltammetry.
Unit-2: (ii)Optical methods:- UV/Visible, X-ray photoelectron spectroscopy (XPS), Auger. Electron Spectroscopy (AL'S), ESCA, Atomic absorption and emission spectroscopy. **(iii) Imaging Techniques:** Electron microscopy (SEM, TEM)
Unit-3: (iv)Infrared Spectroscopy: Dispersive and Fourier Transformed Raman, Resonance Raman and Surface Enhanced Raman Spectroscopy-Dispersive and Fourier Transformed. **(v) Hifanated Techniques:** GC-IR, TG-1R Spectroscopy, GC-Mass Spectroscopy and any other.
Course B **Unit-4: (i) Diffraction Methods:** Single crystal and Powder X-Ray Diffraction and their applications for inorganic compounds, neutron diffraction and electron diffraction.
Unit-5: (ii) Separation Methods: Theory and applications of separation

methods in analytical chemistry: solvent extraction, ion exchangers including liquid ion exchangers and chromatographic methods for identification and estimation of multicomponent systems (such as TLC, GC, HPLC, etc.). **(iii) Thermal Methods:** TG, DTA, DSC and thermometric titrations.
Text and Reference Books **Reference Books:** **1.** Cheetham, A. K. & Day, P., Eds. Solid Stale Chemist)), Techniques Clarendon Press, Oxford (1987) 2. Christian, G. D., Analytical Chemist', 60, Ed., John Wiley & Sons, Inc. (2004). 3. Skoog, D. A., West, D. M., Holler, R. J & Nieman, T. A. Principles of Instrumental Analysis Saunders Golden Sunburst Series (1997). 4. Willard, H. H., Merritt, L. L., Dean, J. A. & Settle, F. A.(Eds.) Instrumental Methods of Analysis -7h Ed., Wadsworth Publishing (1988) ISBN 0534081428 5. Khopkar, S. M. Concepts in Analytical Chemist)), Halsted (1984).

Course Outcomes: After completing this course, students will be able to achieve the followings:

CO1	Describe the cyclic voltammetry.
CO2	Understand the solvent extraction, ion exchangers including liquid ion exchangers.
CO3	Explain the chromatographic methods for identification and estimation of multicomponent systems.
CO4	Develop the TG, DTA, DSC and thermometric titrations.
CO5	Calculate the electron spectroscopy (AL'S), ESCA, Atomic absorption and emission spectroscopy.
CO6	Illustrate the Electron microscopy (SEM, TEM).

MCH4015: Nuclear and Radio Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of inorganic materials.

Course Objectives:

1. To know about band theory (Zone model, Brillouin Zones, Limitations of the Zone model).
2. To understand the magnetic and thermal properties of inorganic materials.
3. To learn the superconductors with special emphasis on the synthesis and structure of high temperature superconductors.
4. To learn the characteristic differences over bulk materials.
5. To know the Dynamic Light Scattering.
6. To understand the interaction of nuclear radiations with matter.

Detailed Syllabus

Course A: Inorganic Materials Introduction to the solid state, metallic bond, Band theory (Zone model, Brillouin Zones, Limitations of the Zone model); Defects in solids, p-type and n-type; Inorganic semiconductors (use in transistors, IC, etc.); Electrical, optical, magnetic and thermal properties of inorganic materials, Superconductors with special emphasis on the synthesis and structure of high temperature superconductors. Solid State Lasers (Ruby, YAG and tunable lasers): Inorganic phosphor materials; synthesis and advantages of optical ibres over conducting fibres.Preparation of nanomaterials and their characteristic differences over bulk materials. Principles of Electron Microscopy, Dynamic Light Scattering.
Course B: Nuclear and Radiochemistry Nuclear structure and nuclear stability. Nuclear Models. Radioactivity and nuclear reactions (including nuclear ission and fusion reactions). Hot atom Chemistry, Nuclear Fission and Fusion Reactors. The interaction of nuclear radiations with matter. Radiation hazards and therapeutics. Tracer techniques and

their applications. Isotope dilution and radio-activation rnethods analysis. Fission product analysis (e.g., the technique of isolating two or three different fission products of uranium (U), thorium (Th) and determining the yields).

Text and Reference Books

Reference Books:

Harvey, B. C. Introduction to Nuclear Chemistry Prentice-Hall (1969).

Keer, H. V. Principles of the Solid State Wiley Eastern Ltd.: New Delhi (1993).

West, A. R. Solid State Chemistry and its Applications John Wiley & Sons (1987).

Hannay, N. Treatise on Solid State Chemistry Plenum (1976).

Tirnp, G., Ed. Nanotechnology Springer-Verlag: N. Y. (1999).

Course Outcomes: After completing this course, students will be able to achieve the followings

CO1	Describe the Solid State Lasers (Ruby, YAG and tunable lasers).
CO2	Understand the inorganic phosphor materials.
CO3	Explain the principles of Electron Microscopy,.
CO4	Develop the limitations of the Zone model); Defects in solids, p-type and n-type.
CO5	Calculate the nuclear structure and nuclear stability.
CO6	Illustrate the isotope dilution and radio-activation methods analysis.

MCH451: Inorganic Chemistry Practical-IV

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the experimental skills.

Course Objectives:

1. To know about analysis of ores.
2. To understand the metal oxalate hydrates.
3. To learn the pH- meter, potentiometer.

Detailed Syllabus

I.(a) Analysis of ores, alloys and inorganic substances by various chemical methods.
(b) Instrumental methods of analysis utilising lame photometer., atomic absorption spectrophotometer, pH- meter, potentiometer, turbidimeter, electrochemical methods, separation of mixtures of metal ions by ion exchange chromatography.
II. Synthesis and thermal analysis of group Il metal oxalate hydrates.

Text and Reference Books

Reference Books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the alloys and inorganic substances by various chemical methods.
CO2	Understand the synthesis and thermal analysis of group Il metal oxalate hydrates.
CO3	Explain the instrumental methods of analysis utilising lame photometer.
CO4	Develop the atomic absorption spectrophotometer.
CO5	potentiometer, turbidimeter, electrochemical methods.
CO6	Illustrate the separation of mixtures of metal ions by ion exchange chromatography.

MCH452: Inorganic Chemistry Project & evaluation

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 70 marks

Prerequisite: Concept of understand inorganic chemistry research problems and solutions.

Course Objectives:

1. To know about research and development in the field of chemical science.
2. To understand the problems and find the solutions.
3. To learn the advanced materials for industries requirements.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the mechanism of chemical reactions for completed research project.
CO2	Understand the problem and solutions.
CO3	Explain the importance of the research project.
CO4	Develop the new model and mechanism for the chemical reaction of research project.
CO5	Explain the importance materials for chemical science.
CO6	Illustrate the experimental procedure of chemical processes.

ORGANIC CHEMISTRY SPECIALIZATION
MCH4022: Organic synthesis

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of philosophy of organic synthesis and supramolecular chemistry and carbocyclic rings.

Course Objectives:
1. To know about chemoselectivity.
2. To understand the tandem reactions.
3. To learn the regioselectivity.
4. To learn the non-covalent synthesis.
5. To know the tropones. Tropolone.
6. To understand the stereoselectivity.

Detailed Syllabus

Unit-1: Advanced Organic Synthesis **Philosophy of organic synthesis:** Disconnection approach, one group and two group disconnections, reversal of polarity, chemoselectivity, one group C-C disconnection, two group C-C disconnections, 1,3-difunctional and 1 ,5-difunctiona compounds. Tandem reactions, Domino reactions and multi-component reactions.
Unit-2: Asymmetric synthesis: Development of methodologies for asymmetric synthesis, regioselectivity, stereoselectivity, diastereoselectivity and stereospecificity.
Unit-3: Supramolecular chemistry and carbocyclic rings **Principles of molecular associations and organizations:** Non-covalent synthesis, Self assembly and self organization, Supramolecular reactivity and catalysis, Molecular devices.
Unit-4: Chemistry of non-benzenoid aromatics: Tropones. tropolones, azulenes. mctallocenes and annulenes. Bridged rings, caged molecules and adamantane.
Text and Reference Books **Reference Books:** 1. Warren, S. Organic Synthesis: The Disconnection Approach John Wiley & Sons (1984). 2. Lehn, J-M, Supramolecular Chemistry: Concepts. & Perspectives. A Personal Account Vch Verlagsgesellschaft Mbh (1995). 3. Viigtle, F. Supramolecular Chemistry: An Introduction John Wiley & Sons (1993).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the methodologies for asymmetric synthesis.
CO2	Understand the reversal of polarity.
CO3	Explain the diastereoselectivity and stereospecificity.
CO4	Develop the supramolecular reactivity and catalysis, molecular devices.
CO5	Calculate the bridged rings.
CO6	Illustrate the caged molecules and adamantane.

MCH4023: Biomolecules

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: -
Concept of protein and alkaloids and polyphenols.

Course Objectives:

1. To know about squalene to lanosterol.
2. To understand the cholesterol, arternisinin.
3. To learn the methyl transferases, amino acid decarboxylases.
4. To learn the peptide alkaloids with examples.
5. To know the solid phase synthesis, combinatorial synthesis of peptide.
6. To understand the oxidative phenol coupling of selected alkaloids.

Detailed Syllabus

Unit-1: Proteins Peptides and proteins: Classification of naturally occurring peptides, depsipeptide and peptide alkaloids with examples, Sequence determination, chemical, enzymatic and mass spectral methods, Modern methods of peptide synthesis with protection and deprotection. Solid phase synthesis, combinatorial synthesis of peptide.
Unit-2: Carbohydrates: Types of naturally occurring sugars, deoxy sugars, amino sugars, branched chain sugars, sugar methyl ethers and acid derivatives of sugars, polysaccharide.
Unit-3: Terpenes and steroids: Classification and biosynthesis of mono- sesqui-. di- and triterpenoids and steroids. Acetyl CoA, Mevalonic acid, acetoacetyl CoA, squalene to lanosterol, Cholesterol to estradiol, diosgenin and its utility in hormone synthesis. General chemistry of the following compounds- Cholesterol, Arternisinin, Gibbereline A3, Azadirachtin.
Unit-4: Alkaloids and Polyphenols: Isolation and structure elucidation of alkaloids, Biosynthesis and biogenesis of alkaloid using thiokinase. Mixed function oxygenases, methyl transferases, amino acid decarboxylases, oxidative phenol coupling of selected alkaloids.

Text and Reference Books

Reference Books:

1. Bodansky, M. Peptide Chemistry: A Practical Textbook Springer-Verlag (1988).

2. Dugas, H. & Penney, C. Bioorganic Chemistry: A Chemical Approach to Enzyme Action Springer-Verlag (1989).
3. Finar, I. L. & Finar, A. L. Organic Chemistry Vol. 2, Addison-Wesley (1998).
4. Finar, I. L. Organic Chemistry Vol.1, Longman (1998).
5. Sinden, R. P. DNA Structure and Function Academic Press (1994).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the acetyl CoA, mevalonic acid, acetoacetyl CoA.
CO2	Understand the Arternisinin, Gibbereline A3, Azadirachtin.
CO3	Explain the biosynthesis and biogenesis of alkaloid using thiokinase.
CO4	Develop the mixed function oxygenases.
CO5	Calculate the branched chain sugars.
CO6	Illustrate the sugar methyl ethers and acid derivatives of sugars, polysaccharide.

MCH4024: Mechanisms of Organic Reactions

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of chemical kinetics to decipher reaction mechanisms and diagnostic tools.

Course Objectives:

1. To know about types of polar reactions.
2. To understand the deriving the rate laws.
3. To learn the linear Free Energy relationships.
4. To learn the trapping of Intermediates.
5. To know the curtin-Hammett control.
6. To understand the deviation from Linear energy relationships.

Detailed Syllabus

Unit-1: Introduction to Reaction Mechanisms
Writing reaction mechanisms: Arrow pushing; Types of polar reactions; Radical reactions; Reaction coordinate diagram; The Hammond Postulates; The Kinetic vs Thermodynamic Control; Curtin-Hammett control.

Unit-2: Chemical Kinetics to Decipher Reaction Mechanisms
An introduction to reaction kinetics; Deriving the rate laws; Distinguishing reaction mechanism using rate laws; Methods to monitor a reaction.

Unit-3: Diagnostic Tools
The Hammett Equation; Linear Free Energy relationships (LFER); Hammett Plots for electronic effects; Scales used in Hammett Plots; Deviation from Linear energy relationships; Solvents effects; Kinetic isotope effect; Primary kinetic isotope effect; Secondary kinetic isotope effect; Isotope labeling; Trapping of Intermediates.

Unit-4: Catalysis
Enzyme catalysis; Electrophilic catalysis; Other types of catalysis.

Text and Reference Books

Reference Books:

1. Modern Physical Organic Chemistry by Dennis A. Dougherty and Eric V. Anslyn.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the reaction mechanisms: arrow pushing.
CO2	Understand the; radical reactions; reaction coordinate diagram.
CO3	Explain the methods to monitor a reaction.
CO4	Develop the primary kinetic isotope effect; Secondary kinetic isotope effect; Isotope labeling; Trapping of Intermediates.
CO5	Describe the electrophilic catalysis; Other types of catalysis.
CO6	Illustrate the enzyme catalysis.

MCH4025: Medicinal Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Medicinal Chemistry and Bioactive Compounds.

Course Objectives:

1. To know about general mechanism of drug action on lipids, carbohydrates.
2. To understand the receptor structure and sites.
3. To learn the anti-analgesics.
4. To learn the chemistry of Vitamins A.
5. To know the soluble and fat.
6. To understand the soluble hormones.

Detailed Syllabus

Unit-1: Medicinal Chemistry Introduction to the history of medicinal chemistry. General mechanism of drug action on lipids, carbohydrates, proteins and nucleic acids, Drug metabolism and inactivation. Receptor structure and sites. Drug discovery, development, design and delivery systems. General introduction to antibiotics, Mechanism of action of lactam antibiotics, nonlactam antibiotics and quinolones. Anti-histamines, anti-inflammatory, anti-analgesics, anticancer anti-malomial, anti AIDS. Drugs resistance, gene therapy and anti-hypertensive drugs.
Unit-2: Bioactive Compounds **Vitamins:** Classification, occurrence, chemistry of Vitamins A, C and E, structure elucidation and synthesis, deficiency syndromes, etc.
Unit-3: Pyrethroids: Introduction; structure elucidation and synthesis of pyrethroids, namely pyrethrins, cinerins and jasmoline; Synthetic pyrethroids: Structure—activity relationships; synthesis of various synthetic pyrethroids.
Unit-4: Hormones: General study of hormones including classification, mechanism of action of anti –vacter fatility agents. Soluble and fat soluble hormones, secondary messengers.

Text and Reference Books

Reference Books:

1. Finar,1.L. & Finar, A. L. Organic Cheinisto- Vol. 2, Addison-Wesley (1998).
2. Finar, I. L. Organic Cheinisuy Vol., Longman (1998).
3. Grine_auz, A. Introduction to Medicinal Chemistry: How Drugs Act and Why? John Wiley & Sons (1997).
4. Patrick, G. L. Introduction to Medicinal Chemistry Oxford University Press (2001).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the nonlactam antibiotics and quinolones.
CO2	Understand the anti-histamines, anti-inflammatory, anti-analgesics.
CO3	Explain the mechanism of action of anti –vacter fatility agents.
CO4	Develop the secondary messengers.
CO5	Synthetic pyrethroids.
CO6	Illustrate the synthesis of various synthetic pyrethroids.

MCH453: Organic Chemistry Practical-IV

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: -
Concept of quantitative analysis and advanced organic synthesis.

Course Objectives:
1. To know about estimation of glucose.
2. To understand the estimation of amino acids.
3. To learn the estimation of nitro group.

Detailed Syllabus

I. Quantitative analysis

i.Estimation of glucose by chemical methods
ii.Estimation of amino acids by chemical methods
iii.Estimation of nitro zroup in organic compounds
iv. Estimation of iodine by Vij's solution
v.Estimation of carbohydrates, amino acids, proteins and caffeine by UV/VIS spectra
vi. Estimation of a given mixture by NMR spectra
II Advanced organic synthesis
(I) Multistage synthesis including photochemical and enzymatic methods (some examples are given below)
Benzophenone→benzopinacol→ benzopinacolone
Benzoin →benzil → benzilic acid

Cyclohexanone →cyclohexanone oxime → caprolactone
(ii) Enzymatic reaction: reduction of ethyl acetoacetate with Baker's yeast; PPL catalysed deacetylation of 2,4-diacetoxyacetophenone.
(iii) Use of ultrasound and microwaves in organic synthesis.
(iv) Application of phase transfer catalysis in organic synthesis.

Text and Reference Books

Reference Books:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the estimation of iodine by Vij's solution.
CO2	Understand the estimation of carbohydrates, amino acids, proteins and caffeine by UV/VIS spectra.
CO3	Explain the estimation of a given mixture by NMR spectra.
CO4	Develop the Multistage synthesis including photochemical and enzymatic methods.
CO5	Calculate the enzymatic reaction: reduction of ethyl acetoacetate.
CO6	Illustrate the use of ultrasound and microwaves in organic synthesis.

MCH454: Organic Chemistry Project & evaluation

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 70 marks

Prerequisite: Concept of understand organic chemistry research problems and solutions.

Course Objectives:

1. To know about research and development in the field of chemical science.
2. To understand the problems and find the solutions.
3. To learn the advanced materials for industries requirements.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the mechanism of chemical reactions for completed research project.
CO2	Understand the problem and solutions.
CO3	Explain the importance of the research project.
CO4	Develop the new model and mechanism for the chemical reaction of research project.
CO5	Explain the importance materials for chemical science.
CO6	Illustrate the experimental procedure of chemical processes.

PHYSICAL CHEMISTRY SPECIALIZATION

MCH4032: Advanced Electrochemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Electrochemical methods and Relaxation Methods.

Course Objectives:

1. To know about exchange current density.
2. To understand the Tafel plot, Multistep electrode reactions.
3. To learn the charge transfer at electrode-solution interfaces.
4. To learn the electrochemical instrumentations.
5. To know the thermodynamics of the double layer.
6. To understand the electrocatalysis.

Detailed Syllabus

Unit-1: Relaxation Methods-Theory and Techniques Electrode kinetics: Overpotentials. Exchange current density, Derivation of ButlerVolmer equation and its implications, Tafel plot, Multistep electrode reactions, Determination of multistep electrode reactions, Mass transfer by diffusion.
Unit-2: Quantum aspects: Charge transfer at electrode-solution interfaces, Quantization of charge transfer, Tunnelling.
Unit-3: Electrochemical methods: Controlled potential and current techniques, Hydrodynamic techniques, Electrochemical instrumentations, Scanning probe techniques.
Unit-4: Adsorption and Electric Double Layer: Thermodynamics of the double layer, Electrocapillary phenomena; Adsorption— Ionicand oreanic molecules_ Adsorption isotherms-Langmuir, Friamkin, temkin• Experimental evaluation of surface excesses and electrical parameters, Structure of electrified interfaces - Gouy-Chapman, Stern.
Unit-5: Bioelectrochemistry Membrane potentials, Nernst-Planck equation, Hodgkin-Huxley equations, Core Conductor model, Electrocardiography
Unit-6: Applied Electrochemistry **Corrosion:** Introduction to corrosion, forms of corrosion, Corrosion monitoring and prevention methods Conversion and storage of electrochemical energy: Fuel cells and batteries. Electrocatalysis: Influence of various parameters, fly.drogen electrode

Text and Reference Books

Reference Books:

1. Bard, A. J. Faulkner, L. R. Electrochemical Methods: Fundamentals and Applications, 2nd Ed., John Wiley & Sons: New York, 2002.
2. Bockris, J.0' M. & Reddy, A. K. N. Modern Electrochemistry 1: Ionics 2nd Ed., Springer (1998).
3. Bockris, J.0' M. & Rcddv. A. K. N. Modern Electrochemistry2B: Electrodics in Chemistry Engineering, Biology and Environmental Science 2nd Ed. Springer (2001).
4. Brett, C. M. A. & Brett, A. M. 0. Electrochemistry Oxford University Press (1993).
5. Koryta, J., Dvorak, J. & Kavan, L. Principles of Electrochemistry John Wiley & Sons: NY (1993).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the charge transfer at electrode-solution interfaces,
CO2	Understand the quantization of charge transfer, Tunnelling.
CO3	Explain the conversion and storage of electrochemical energy: Fuel cells and batteries.
CO4	Develop the influence of various parameters.
CO5	Calculate the conductor model, Electrocardiography.
CO6	Illustrate the Nernst-Planck equation.

MCH4033: Photo & Radio Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Molecular photochemistry and Radiation dosimetry.

Course Objectives:

1. To know about transitions between states.
2. To understand the potential energy surface.
3. To learn the classical model of radiative transitions.
4. To learn the energy transfer.
5. To know the diffusion-controlled quenching.
6. To understand the various mechanisms of their formation and energy transfer processes).

Detailed Syllabus

Unit-1: Molecular photochemistry: An overview: Transitions between states (chemical, classical and quantum dynamics, vibronic states). Potential energy surfaces; transitions between potential energy surfaces, The Franck-Condon Principle and radiative transitions. A classical model of radiative transitions.
Unit-2: Photophysical radiationless transitions: Wave mechanical interpretation of radiationless transitions between state factors that influence the rate of vibrational relaxation. Energy transfer: Theory of radiationless energy transfer, energy transfer by electron exchange: An overlap or collision mechanism. The role of energetics in energy transfer mechanism. Diffusion controlled quenching.
Unit-3: Radiation Chemistry An overview, G-value. The mechanism of interaction of high energy radiation with matter, Photoelectric effect, Compton effect, Pair production, total absorption coefficient, excitation and ionization, Stopping power and linear energy transfer.
Unit-4: Radiation dosimetry: Radiation dose and its measurement, standard free air chamber method, chemical dosimeter (Frick's Dosimeter). Short lived intermediates (ions, excited molecules, free radicals: Various mechanisms of

their formation and energy transfer processes).
Text and Reference Books **Reference Books:** Turro, N. J. Modern Molecular Photochemisty Univ, Science Books (1991). Gilbert, A. & Baggot, .1. Essentials of Molecular Photochemistri' Blackwell Scientiic (1990) Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 81i, Ed., Oxford University Press (2006). McQuarrie, D. A. & Simon, J. D. Physical Chemisty: A Molecular Approach 3rd Ed., Univ. Science Books (2001).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the transitions between states (chemical, classical and quantum dynamics, vibronic states).
CO2	Understand the transitions between potential energy surfaces.
CO3	Explain the theory of radiation less energy transfer, energy transfer by electron exchange.
CO4	Develop the the mechanism of interaction of high energy radiation with matter, Photoelectric effect.
CO5	Calculate the stopping power and linear energy transfer.
CO6	Illustrate the various mechanisms of their formation and energy transfer processes).

MCH4034: Biophysical Chemistry

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of fundamentals of biological macromolecules and optical methods and applications.

Course Objectives:

1. To know about**:** chemical bonds in biological systems.
2. To understand the properties and classification of amino acids.
3. To learn the general principles.
4. To learn the zonal sedimentation.
5. To know the capillary electrophoresis.
6. To understand the fluorescence spectroscopy.

Detailed Syllabus

Unit-1: Fundamentals of biological macromolecules: Chemical bonds in biological systems: Properties of water; Thermodynamic principles in biological systems; Properties and classification of amino acids; Structures of nucleic acids. Protein structure and function. Properties of nucleosides and nucleotides; composition of nucleic acids. Methods for the separation of biomolecules: General principles, including Chromatography: Sedimentation,Moving Boundary Sedimentation, Zonal Sedimentation, Electrophoresis, Isoelectric focusing, Capillary electrophoresis, MALDI/TOF.
Unit-2: Structural determinations: Physical methods. Ultracentrifugation and other hydrodynamic techniques; Light scattering, fundamental concepts, scattering from a number of small particles: Rayleigh scattering, scattering from particles that are not small compared to the wavelength of radiation; Dynamic light scattering; Low angle X-Ray scattering; Neutron scattering; Raman scattering
Unit-3: Optical methods and applications: Optical techniques in biological systems: Absorption spectroscopy, Fluorescence spectroscopy, Linear and Circular Dichroism, Single and multidimensional NMR spectroscopy.

Text and Reference Books
Reference Books: 1. Cantor, C. R. & Schimmel Biophysical Chemistry Vols. 1 -3, W. H. Free- man (1080) 2. Lehninger, A. L_, Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemisry 4e, Ed., W. H. Freeman (2004).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the physical methods. Ultracentrifugation and other hydro- dynamic techniques.
CO2	Understand the light scattering, fundamental concepts, scattering from a number of small particles.
CO3	Explain the Rayleigh scattering.
CO4	Develop the single and multidimensional NMR spectroscopy.
CO5	Calculate the neutron scattering; Raman scattering.
CO6	Illustrate the Linear and Circular Dichroism.

MCH4035: Crystallography

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of crystal structures and basic symmetry.

Course Objectives:

1. To know about description of a crystal structure in terms of atom positions.
2. To understand the relation of the crystal symmetry.
3. To learn the interaction of radiation with condensed matter.
4. To learn the Bragg condition.
5. To know the structure factor and its relation to intensity.
6. To understand the Fourier synthesis.

Detailed Syllabus

Unit-1: Crystal structures and basic symmetry Overview: Description of a crystal structure in terms of atom positions, unit cells, and crystal symmetry; Relation of the crystal symmetry to the symmetry observed in a diffraction experiment for primitive, orthorhombic,.tetragonal.Scattering and Diffraction Theory
Unit-2: X-Ray Diffraction: Interaction of radiation with condensed matter and how this can be used in generalized crystallography. 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, Fourier synthesis.
Unit-3: Crystal defects and non-stoichiometry: Perfect and imperfect crystals, intrinsic and extrinsic defects- point defects, line and plane defects, vacancies- Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colour centres, non-stoichiometry and defects.
Unit-4: Protein Crystallography Basics of modern protein crystallography using Web-based material; different levels of structure exhibited by proteins; instrumentation, steps, and methods used in protein crystallography with appropriate case studies; concept of non-crystallographic symmetry to protein crystallography, Ramachandran diagram.
Unit-5: Electronic properties and band theory: Metals, insulators and semiconductors, electronic structure of solids- band theoy, band struc-

ture of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Magnetic properties- Classification of materials: Quantum theory of paramagnetics cooperative phenomena - magnetic domains. Hysteresis.
Unit-6: Electron diffraction: Scattering intensity versus scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.
Unit-7: Neutron dffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cells.

Text and Reference Books

Reference Books:

1. Moore, E. & Smart, L. Solid State Chemistry: An Introduction 2nd Ed. Chapman & Hall (1996).
2. Rhodes, G. Crystallography Made Crystal Clear: A Guide for Users of illacromolecular Models 3rd Ed. Elsevier (2006).
3. Massa, W. Crystal Structure Determination 2nd Ed. Springer (2004).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the perfect and imperfect crystals, intrinsic and extrinsic defects- point defects.
CO2	Understand the different levels of structure exhibited by proteins.
CO3	Explain the concept of non-crystallographic symmetry to protein crystallography, Ramachandran diagram.
CO4	Develop the intrinsic and extrinsic semiconductors.
CO5	Calculate the Wierl equation, measurement technique.
CO6	Illustrate the low energy electron diffraction and structure of surfaces.

MCH455: Physical Chemistry Practical-IV

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the practical skills.

Course Objectives:

1. To know about determination of surface tension by differential capillary method.
2. To understand the determination of g-value by ESR method.
3. To learn the spectrophotometric study on H-bonded complexation.

Detailed Syllabus

Determination of surface tension by differential capillary method.
Determination of molecular weight of a macromolecule by viscometry.
Determination of molecular weight by Victor Meyer's method.
Cryoscopy and determination of degree of dissociation.
Determination of g-value by ESR method.
Analysis of a UV spectrum and calculation of oscillator strength and transition moment.
Spectrophotometric study on H-bonded complexation.
Determination of ionization constant of a weak indicator acid.

Text and Reference Books

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011)

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the analysis of a UV spectrum and calculation of oscillator strength and transition moment.
CO2	Understand the determination of ionization constant of a weak indicator acid.
CO3	Explain the determination of molecular weight of a macromolecule by viscometry.
CO4	Develop the determination of molecular weight by Victor Meyer's method.
CO5	Calculate the determination of g-value by ESR method.
CO6	Illustrate the spectrophotometric study on H-bonded complexation.

MCH456: Physical Chemistry Project & evaluation

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 70 marks

Prerequisite: Concept of understand physical chemistry research problems and solutions.

Course Objectives:

1. To know about research and development in the field of chemical science.
2. To understand the problems and find the solutions.
3. To learn the advanced materials for industries requirements.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the mechanism of chemical reactions for completed research project.
CO2	Understand the problem and solutions.
CO3	Explain the importance of the research project.
CO4	Develop the new model and mechanism for the chemical reaction of research project.
CO5	Explain the importance materials for chemical science.
CO6	Illustrate the experimental procedure of chemical processes.

ANALYTICAL CHEMISTRY SPECIALIZATION

MCH4042: Separation Techniques

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of separation techniques based on phase equilibria and separation techniques based on rate processes.

Course Objectives:

1. To know about principles of analytical separation: Plate theory, rate theory.
2. To understand the craig concept of counter current distribution.
3. To learn the chromatography: Gas chromatography.
4. To learn the size exclusion chromatography.
5. To know the field separation methods: Electrophoresis.
6. To understand the Electrophoresis, Ultracentrifugation.

Detailed Syllabus

Unit-1: Separation Techniques Based on Phase Equilibria: Principles of analytical separation: Plate theory, rate theory, Craig concept of counter current distribution, process optimization, Retention analysis; Resolution (Fundamental equation). Distillation: Fractional distillation, Molecular distillation. Chromatography: Gas chromatography, Liquid chromatography (including high performance chromatography), Ion-exchange chromatography, Ion chromatography, Size exclusion chromatography, Planar chromatography (PC, TLC, HPTLC), Reverse phase chromatography & Bonded phase chromatography (BPC), Super critical fluid chromatography (SFC). Solvent Extraction: Liquid-Liquid and super critical fluid extraction, Quantitative treatment of various solvent, extraction equilibria. Sublimation: Normal and vacuum sublimation. Crystallisation: Zone refining and Fractional.
Unit-2: Separation Techniques Based on Rate Processes: (a) Barrier-separation methods: Membrane separation- Ultrafiltration, dialysis, electrodialysis, electro-osmosis, reverse osmosis. (b) Field separation methods: Electrophoresis, Ultracentrifugation.

Text and Reference Books

Reference Books:

1. G.H. and H. Freiser, *Solvent Extraction in Analytical Chemistry*, 1st Edition (1958), John Wiley, New York.
2. B.L. Karger, L.R. Snyder and C. Howarth, *An Introduction to Separation Science*, 2nd Edition (1973), John Wiley, New York.
3. E.W. Berg, *Chemical Methods of Separation*, 1st Edition (1963), McGraw Hill, New York.
4. D.G. Peters, J.M. Hayes and C.M. Hieftj, Chemical *Separation and Measurements*, 2nd Edition (1974), Saunders Holt, London.
5. J.D. Seader and E.J. Henley, *Separation Process Principles*, 1st Edition (1998), John Wiley & Sons. Inc., New York. Edition(1998),JohnWiley&Sons.Inc., New York.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the reverse phase chromatography.
CO2	Understand the Barrier-separation methods: Membrane separation- Ultrafiltration, dialysis.
CO3	Explain the electrodialysis, electro-osmosis, reverse osmosis.
CO4	Develop the Super critical fluid chromatography (SFC). Solvent Extraction: Liquid-Liquid and super critical fluid extraction.
CO5	Explain the quantitative treatment of various solvent.
CO6	Illustrate the electrodialysis, electro-osmosis, reverse osmosis.

MCH4043: Polarography

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Polarography and modern polarography.

Course Objectives:

1. To know about electrode Processes.
2. To understand the diffusion current.
3. To learn the kinetic adsorption and capacitive currents.
4. To learn the necessity and development of new voltammetric techniques.
5. To know the differential and derivative voltammetry.
6. To understand the electro-spot testing.

Detailed Syllabus

Unit-1: General Introduction: Overviews of Electrode Processes, Electrocapillary curve and electrocapillary maximum potential, Exchange current, Polarization and over-voltage, Reference electrodes. Mercury electrodes (DME, SME, HMDE), Rotating platinum electrode. Three-electrode system.
t-2: Polarography: Origin of polarography, Interpretation of a polarographic curve. Instrumentation. Limiting current, residual and charging current, diffusion current, migration current. Supporting electrolytes. Effect of supporting electrolyte on the limiting current. Diffusion coefficient and its evaluation. Ilkovic equation, its derivation and applications. Estimation of n-value(s). Theory and equations of different current- potential curves. Criteria of polarographic reversibility. Quasi-reversible and irreversible processes. Half- wave potentials and their significance. Interpretation of catalytic, kinetic, adsorption and capacitive currents. Polarographic maxima and maximum suppresors. Methods of quantitative analysis: absolute, comparative, the PILOT ION and kinetic methods.
Unit-3: Modern Polarography: Necessity and development of new voltammetric techniques and their comparison with classical polarography. Fundamentals of sampled DC polarography (Tast), oscilliography, differential and derivative voltammetry, cyclic, pulse, alternating current and square wave polarography.
Unit-4: Related Techniques: Amperometric titration, Chronoamperometry, Chronopotenti-

ometry. Controlled- potential and constant current coulometry. Stripping analysis, Electrogravimetry, Electrography and Electro-spot testing.
Text and Reference Books **Reference Books:** 1.L. Meites, *Polarographic Techniques*, 2nd Edition (1965), John Wiley, New York. 2.J. Heyrovsky and K. Kuta, *Principles of Polarography*, 1st Edition (1966), Academic Press, New York. 3.D.A. Skoog, F.J. Holler and T.A. Nieman, *Principles of Instrumental Analysis*, 5th Edition (1998), Saunders College Publishing, Harcourt Brace & Company, U.S.A. 4.A.J. Bard and L.R. Faulkner, *Electrochemical Methods: Fundamentals and Applications*, 2nd Edition (2000), Wiley, New York.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the effect of supporting electrolyte on the limiting current.
CO2	Understand the theory and equations of different current- potential curves. Criteria of polarographic reversibility.
CO3	Explain the quasi-reversible and irreversible processes. Half- wave potentials and their significance.
CO4	Develop the comparative, the PILOT ION and kinetic methods.
CO5	Explain the Fundamentals of sampled DC polarography (Tast), oscilliography,.
CO6	Illustrate the Amperometric titration, Chronoamperometry, Chronopotentiometry.

MCH4044: Spectroscopic Techniques

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Nuclear Magnetic Resonance Spectroscopy and Applications in analysis of special materials.

Course Objectives:

1. To know about infrared instruments.
2. To understand the Raman spectroscopy, Instrumentation.
3. To learn the theory of nuclear magnetic resonance.
4. To learn the two dimensional Fourier- transform NMR.
5. To know the atomic force microscopy (AFM).
6. To understand the food additives, petrochemicals.

Detailed Syllabus

Unit-1: Infrared Spectroscopy: Infrared instruments, typical applications of infrared spectroscopy (qualitative and quantitative).
Unit-2: Raman Spectroscopy: Raman spectroscopy, Instrumentation, Analytical applications of Raman spectroscopy
Unit-3: Nuclear Magnetic Resonance Spectroscopy: Theory of nuclear magnetic resonance, Environmental effects on NMR spectrometers, Applications of proton ^{1}HNMR, ^{13}C NMR, Two dimensional Fourier- transform NMR, Magnetic resonance imaging (MRI), Quantitative applications of NMR: Drug Analysis, Molecular Weight determination.
Unit-4: Electron Spin Resonance Spectroscopy: Theory, Instrumentation and Important analytical applications.
Unit-5: Electron Spectroscopy: Theory, Instrumentation and applications of Electron spectroscopy (ESCA and Auger), Scanning electron microscopy (SEM), Scanning tunnelling microscopy (STM) and Atomic force microscopy (AFM).
Unit-7: Applications in analysis of special materials: Analysis of dairy products**,** food additives, petrochemicals (including liquid and gaseous fuels), drugs and pharmaceuticals and fertilizers.

Text and Reference Books

Reference Books:

1. D.A. Skoog, F.J. Holler and T.A. Nieman, *Principles of Instrumental Analysis*, 5th Edition (1998), Harcourt Brace & Company, Florida.
2. R.L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, Modern *Methods of Chemical Analysis*, 2nd Edition (1976), John Wiley, New York.
3. J.M. Hollas, *Modern Spectroscopy*, 3rd Edition (1996), John Wiley, New York.
4. H.A. Strobel, *Chemical Instrumentation – A Systematic Approach*, 2nd Edition (1973), Addison Wesley, Mass.
5. D.C. Garratt, *the Quantitative Analysis of Drugs*, 2nd Edition (1992), Chapman and Hall Ltd., London.
6. W. Horwitz (Editor), *Official Methods of Analysis*, 11th Edition (1970), Association of Official Analytical Chemists, Washington DC.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the typical applications of infrared spectroscopy (qualitative and quantitative).
CO2	Understand the drugs and pharmaceuticals and fertilizers.
CO3	Explain the Scanning electron microscopy (SEM).
CO4	Develop the instrumentation and applications of Electron spectroscopy (ESCA and Auger).
CO5	Calculate the molecular Weight determination.
CO6	Illustrate the magnetic resonance imaging (MRI), Quantitative applications of NMR.

MCH4045: Micro Analytical Techniques

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Concept of Biochemical Microanalysis**.**

Course Objectives:

1. To know about scope and objectives of microanalytical technique.
2. To understand the microanalysis of real-world Samples.
3. To learn the Biochemical Microanalysis.
4. To learn the inorganic microanalysis.
5. To know the inorganic microanalysis.
6. To understand the Microanalysis by Kinetic Methods.

Detailed Syllabus

Unit-1: General Introduction: Scope and objectives of microanalytical technique, Difference between micro and trace analysis, Microanalytical technique based on size and amount of the sample.
Unit-2: Microanalysis of real-world Samples: Molecular recognition and targeted analysis using macrocyclic (crown ethers), macrobicyclic (cryptands), Supramolecular compounds (calixarenes) and polymeric materials.
Unit-3: Biochemical Microanalysis: Estimation of carbohydrates, amino acids and ascorbic acid in biological systems, Estimation of protein in egg albumin, Estimation of free fatty acid, Iodine value and saponification value of fats/oils, Estimation of blood cholesterol, DNA and RNA.
Unit-4: Inorganic microanalysis: Principle, Technique, qualitative and quantitative applications with special reference to Ring-oven technique and Ring colorimetric technique, Chemical microscopy.
Unit-5: Organic Microanalysis: Determination of alkoxy, acetyl, acyl, hydroxyl, carbonyl, active hydrogen, nitroso, sulfonyl, amides and ester groups, Determination of molecular weight and percentage purity of carboxylic acid, Estimation of sugars, Estimation of unsaturation.
Unit-6: Microanalysis by Kinetic Methods: Theoretical basis, Kinetic parameters, Kinetic methods of microanalysis: Tangent, fixed time and addition method.

Text and Reference Books

Reference Books:

1. P.L. Kirk, Quantitative Ultramicroanalysis, John, Wiley.
2. C.L. Wilson and D.L. Wilson, Comprehensive Analytical Chemistry", Vol. I (A) and I(B), Elsevier.
3. G.D. Christian, Analytical Chemistry, John Wiley & Sons, New York (2001).
4. S.M. Khopkar, Analytical Chemistry of Macrocyclic and Supramolecular Compounds, Narosa Publishing House, New Delhi (2002).
5. Jag Mohan, Organic Analytical Chemistry - Theory and Practice, Narosa Publishing House, New Delhi (2003).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the difference between micro and trace analysis.
CO2	Understand the supramolecular compounds (calixarenes) and polymeric materials.
CO3	Explain the estimation of free fatty acid, Iodine value and saponification value of fats/oils.
CO4	Develop the ring colorimetric technique, Chemical microscopy.
CO5	Calculate the quantitative applications with special reference to Ring-oven technique.
CO6	Illustrate the percentage purity of carboxylic acid, Estimation of sugars.

MCH457: Analytical Chemistry Practical-II

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -8 Marks
	Teachers Assessment – 4 Marks Attendance – 8 Marks
Credits: 2	End Semester Exam – 30 marks

Prerequisite: Develop the experimental skills.

Course Objectives:

1. To know about determination of accuracy, precision, mean deviation.
2. To understand the composition of two sets of results in terms of significance.
3. To learn the solvent extraction: determination of Fe (III) by chloride extraction in ether.

Detailed Syllabus

Statistical Treatment of Results

2. Determination of accuracy, precision, mean deviation, standard deviation, coefficient of variation, normal error curve and least square fitting of certain set of experimental data in an analysis.
3. Composition of two sets of results in terms of significance (Precision and accuracy) by (I) student's t-test, (ii) F-test.
4. Solvent Extraction: Determination of Fe (III) by chloride extraction in ether.
5. Complexometric and Redox Titrations
6. Metal-EDTA titrations using Eriochrome Black T, Xylenol orange and PAN indicators (only back titration or substitution titration methods).
7. Estimation of the purity of oxalic acid employing standard Ce (IV) solution.
8. Spectrophotometric Analysis
9. Spectrophotometric determination (in ppm) of Fe (II) or Fe(III) using 1,10 Phenanthroline (or thiocyanate) as colorimetric reagent.
10. Colorimetric determination of chromium (VI) (in ppm) using 1,5 diphenyl carbazide as a reagent for colour development.
11. Quantitative analysis of APC tablet by NMR or IR spectroscopy
12. Water Analysis: Analysis of water samples for the following parameters
    (I) BOD, (ii) COD, (iii) Dissolved oxygen, (iv) total phosphorous, (v) sulfur as SO_2, (vi) total hardness and chloride, (vii) total dissolved solids.
13. To prepare a buffer solution of known ionic strength and to find its maximum buffer capacity.

Text and Reference Books

Reference Books:

1. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
2. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the colorimetric determination of chromium (VI) (in ppm) using 1,5 diphenyl carbazide as a reagent for colour development.
CO2	Understand the Estimation of the purity of oxalic acid employing standard Ce (IV) solution.
CO3	Explain the composition of two sets of results in terms of significance (Precision and accuracy) by (I) student's t-test, (ii) F-test.
CO4	Develop the water analysis: analysis of water samples for the following parameters.
CO5	Explain the (i) BOD, (ii) COD, (iii) Dissolved oxygen, (iv) total phosphorous, (v) sulfur as SO_2, (vi) total hardness and chloride, (vii) total dissolved solids.
CO6	Illustrate the prepare a buffer solution of known ionic strength and to find its maximum buffer capacity.

MCH458: Analytical Chemistry Project & evaluation

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/Week	Class Test -12 Marks
	Teachers Assessment - 6Marks Attendance – 12 Marks
Credits: 2	End Semester Exam – 70 marks

Prerequisite: Concept of understand analytical chemistry research problems and solutions.

Course Objectives:

1. To know about research and development in the field of chemical science.
2. To understand the problems and find the solutions.
3. To learn the advanced materials for industries requirements.

Course Outcomes:

After completing this course, students will be able to achieve the followings:

CO1	Describe the mechanism of chemical reactions for completed research project.
CO2	Understand the problem and solutions.
CO3	Explain the importance of the research project.
CO4	Develop the new model and mechanism for the chemical reaction of research project.
CO5	Explain the importance materials for chemical science.
CO6	Illustrate the experimental procedure of chemical processes.