KALINGA UNIVERSITY

SCHEME OF EXAMINATION

&

DETAILED SYLLABUS

For

M.Sc Chemistry
(CBCS Mode)

(w.e.f. 2021-22)

Department of Chemistry
Kalinga University
New Raipur, Chhattisgarh

CBCS-based syllabus for M.Sc. Chemistry (2 years)

Programme

I. General Information's & Introduction of Programme:-

(1) It is two years Master Degree Programme .

(2) There shall be four semester to complete programme, i.e. 1st, 2nd, 3rd and 4th semester.

(3) Each semester shall consist of 15 weeks of academic work equivalent to 90 actual teaching days.

(4) This programme will have three types of courses, i.e. Compulsory Core course, Generic open elective and Discipline specific Elective course.

Compulsory Core course- The core courses are those courses whose knowledge is deemed essential for the students registered for a particular Master's degree programme.

Generic Open Elective course & Discipline specific elective courses- The elective course can be chosen from a pool of papers in I.II,III and IV th semester.

II. Nature and Extent of the MSc.Chemistry Programme offered by Faculty of Science Kalinga University, Naya Raipur:-

The learning outcome - based approach for M.Sc. Prog. is to design curriculum framework to suit the requirements of the various industries. The course structure has been designed to allow flexibility in program and course content development while at the same time maintaining a basic uniformity in structure in comparison with other universities across the country. The core courses in Chemistry, Mathematics and Physics are designed to build strong foundation in theory and principles useful for practical applications. The core courses in Industrial Chemistry is designed to familiarize the students with the industrial processes involved in the commercial production of the products. The program also offers wide range of discipline specific electives, skill enhancement and compulsory Ability Enhancement and Environmental Science courses to prepare students to improve their skills required in academic, research and in industrial projects.

III. Aims of Post Graduate Programme in MSc.:-

Acquire knowledge, abilities and insight in well-defined area of research within Chemistry. Examine specific phenomena theoretically and/or experimentally, contribute to the generation of new scientific insights or to the innovation of new applications of research in Chemistry. Bachelor course in Industrial Chemistry offers the synergism of basic concepts of Chemistry with Industrial applications. The main objective of this degree course is to produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies or research and development in the various industrial areas. This degree course of Industrial Chemistry

prepares the students for immediate entry to the workplace with sound theoretical,experimental knowledge in the area of fuels and energy, environment, health, foods, -cosmetics, polymers and related multidisciplinary fields. Overall, the course offers basic foundation in chemistry, physics and maths which enables the students to understand the concepts in chemical processing, engineering and industrial development.

IV. The MSc. program is designed with Post Graduate Attributes aims to empower the students with:-

1. Disciplinary Knowledge: -

The curriculum planning of course envisages the students demonstrating inclusive knowledge of the areas related to polymer chemistry, fuel & industrial chemistry, inorganic chemistry, physical chemistry, organic chemistry &spectroscopy etc. The students will be made capable of using modern ways and means of dealing with issues arising in the dynamic chemical world and will also help them tackle the resistances.

2. Critical Thinking: -

The submit graduates of this programme will be skilled to expand abilties and attitudes needed for essential wondering and adopting a complete trouble-fixing method. They shall be exposed to the pedagogy that helps to understand actual life situations through case-research. It aims at building the simple potential to think severely, evaluate and resolve complex troubles creatively. The content is organized in this kind of manner that the scholars might be capable of assume from diverse perspectives and recommend solutions in keeping with their own sensibilities.

3. Communication Skills: -

The teaching mastering pedagogies used inside the programme make the students successful to supply and communicate information effectively with a mark.

4. Cooperation/Team Work: -

The curriculum additionally inculcates in the younger minds the traits of teamwork, cooperation and harmony which can be seen as a imaginative and prescient of the current business international though complete of competition. The guides included within the programme educate the scholars to domesticate such traits retaining the larger societal aim in mind.

5. Research Related Skill: -

The curriculum making plans of MSC programme no longer simplest infuses into the students the skill set and competence required to keep the countrywide requirements but additionally makes them able to comprehending global frameworks retaining in view studies components in consideration. The guides lead them to apprehend the need of the current business international and cause them to successful to have a look at diverse aspects from international perspective.

The guides goal at instituting entrepreneurial capabilities within the students with the aid of instilling in them abilities had to come to be an entrepreneur. those could cause develop an mindset of existence-long learning.

6. Moral and Ethical Awareness: -

The route additionally includes schooling the scholars to check unethical behaviour, falsification and manipulation of facts so as to keep away from debacles which can be visible growing persistently over the time frame. guides like enterprise Ethics & company Social responsibility could also assist in making responsible residents and facilitate man or woman building.

7. Lifelong Learning: -

This direction broadens the horizons of the students with the aid of making them recognize the intricacies of the business global and typical the economics of the country in addition to the world. This mastering makes them inquisitive to raise worries and act as a result. The curriculum is designed in this kind of way that the scholars are pushed to develop an mindset of life-long mastering.

8. Information/Digital literacy:

This programme enables the students to be technologically up to date In all of the courses, anywhere applicable and possible, additives associated with technological adjustments were included which makes them digitally literate.

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9. Multicultural Competence: -

The courses like worldwide programme deliver a global angle to the scholars such that they will be capable of integrate country wide values and ideals with global culture and competence.

10. Reflective Thinking: -

This programme enables the scholar to analyse the situation objectively and supply powerful arguments and judgments on the basis of the analysis being executed. This programme teaches the students how to move sequentially on the way to solve a hassle effectively**.**

. **V. Eligibility for Admission: -**

Candidates seeking admission to the first year of the Master degree shall be required to have passed the Bachelor degree of science.

VI. Assessment/Evaluation of the course: -

Candidates will be Continuously Evaluated/Assessed on the basis of their performance both Internally and Externally. The Weightage of Internal Marks would be 30% and for Term-end is 70%. The External Marks will be imparted on the basis of End-term Examination and Internal Marks will be imparted on the basis of Class attendance and Participation/Tests/ Assignments/Presentations/ Project etc. Candidates should mandatorily pass separately in both Internal & External Exam.

VII. Programme Structure:-

This Programme is designed as per the following structure:

1. Compulsory Core Courses.

2. Generic Open Elective.

4. Discipline Specific Elective.

5.Dissertation

VIII. Miscellaneous:-

1. Attendance: The student must meet the requirement of 75% attendance per semester per course for grant of the term. The institute may condone the shortage in attendance in exceptional circumstances, up to a maximum of 15%. The institute shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

2. Medium of Instruction: The medium of Instruction & Evaluation shall be English.

IX. Detailed Course List for each category of courses is provided in Annexure I.

X. Detailed syllabus of each course is provided in Annexure II.

Annexure I

M.Sc. (Chemistry)

CBCS Based Course Curriculum

Semester I						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Compulsory Core Course	**MCHM101**	**Inorganic Chemistry-I**	4	70	30	100
	MCHM102	**Organic Chemistry-I**	4	70	30	100
	MCHM103	**Physical Chemistry–I**	4	70	30	100
	MCHM104	**Spectroscopy-1**	4	70	30	100
GE-1		**Choose Any One MCHM105A/ MCHM 105B**	**4**	70	30	100
	MCHM105A	**Research Methodology**				
	MCHM105B	**Science Journalism**				
	MCHM101-P	**Inorganic Chemistry-I**	1	30	20	50
	MCHM102-P	**Organic Chemistry-I**	1	30	20	50
	MCHM103-P	**Physical Chemistry-I**	1	30	20	50
	MCHM104-P	**Spectroscopy-I**	1	30	20	50
		TOTAL	**24**	**470**	**230**	**700**

Semester II						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Compulsory Core Course	**MCHM201**	**Inorganic Chemistry-II**	4	70	30	100
	MCHM202	**Organic Chemistry-II**	4	70	30	100
	MCHM203	**Physical Chemistry–II**	4	70	30	100
	MCHM204	**Spectroscopy–II**	4	70	30	100
GE-2		**Choose Any One MCHM205A/ MCHM205B**	4	70	30	100
	MCHM205A	**Entrepreneurship**				
	MCHM205B	**Intellectual Property Right**				
	MCHM201-P	**Inorganic Chemistry-II**	1	30	20	50
	MCHM202-P	**Organic Chemistry-II**	1	30	20	50
	MCHM203-P	**Physical Chemistry-II**	1	30	20	50
	MCHM204-P	**Spectroscopy-II**	1	30	20	50
		TOTAL	**24**	**470**	**230**	**700**

Semester III						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Compulsory Core Course	**MCHM301**	**Nature Product**	4	70	30	100
	MCHM302	**Analytical Chemistry**	4	70	30	100
DSE -I		**Choose Any One MCHM303A/ MCHM 303B**	4	70	30	100
	MCHM303A	**Polymer Chemistry**				
	MCHM303B	**Biochemistry**				
DSE -II		**Choose Any One MCHM304A/ MCHM 304B**	4	70	30	100
	MCHM304A	**Medicinal Chemistry**				
	MCHM304B	**Organotransition and Bioinorganic**	4	70	30	100
Practical	**MCHM301P**	**Nature Product**	1	30	20	50
Practical	**MCHM302P**	**Analytical Chemistry**	1	30	20	50
	Practical	**Choose Any One MCHM303A/ MCHM 303B**	1	30	20	50
Practical	**MCHM303P(A)**	**Polymer Chemistry**				
Practical	**MCHM303P(B)**	**Biochemistry**				
	Practical	**Choose Any One MCHM304A/ MCHM 304B**	1	30	20	50
Practical	**MCHM304P(A)**	**Medicinal Chemistry**				
Practical	**MCHM304P(B)**	**Organotransition and Bioinorganic**				
		Total	**24**	**470**	**230**	**700**

Semester IV						
	Paper Code	**Subjects**	**Credits**	**End Term**	**Internal Marks**	**Total Marks**
Compulsory Core Course	**MCHM401**	**Environmental Chemistry**	4	70	30	100
DSE-III		**Choose Any One MCHM02A/ MCHM 402B/ MCHM 402C**	4	70	30	100
	MCHM402A	**Green and Nano Chemistry**				
	MCHM402B	**Photo Chemistry**				
	MCHM402C	**Industrial & Fuel Chemistry**				
Practical	**MCHM401P**	**Lab Course (Environmental Chemistry)**	1	30	20	50
		Choose Any One MCHM02A/ MCHM 402B/ MCHM 402C	1	30	20	50
	MCHM402A (P)	**Green and Nano Chemistry**				
	MCHM402B (P)	**Photo Chemistry**				
	MCHM402C (P)	**Industrial & Fuel Chemistry**				
		Project Work/Dissertation	10	200	100	300
		Total	**20**	**400**	**200**	**600**
		Grand Total	**92**			

***Project Dissertation 75**
***Presentation 50**
***Viva Voce 50**
***Scientific Paper 25**

Program Outcome

PO 1- Introduce the basic concepts, fundamental principles, and the theories related to various scientific phenomena and their relevancies in the day-to-day life.

PO 2- Realize how developments in the interdisciplinary fields help in the development of other science subjects and vice-versa and provides better solutions for the sustainable development.

PO 3- Acquire the skills in handling scientific instruments, planning and performing experiments and drawing logical inferences from the scientific experiments.

PO 4- Develop flair by participating in various social and cultural scientific activities voluntarily, in order to spread knowledge, creating awareness about the recent innovations in science and technology etc.

PO 5- Develop various communication skills such as reading, listening, speaking, etc., which we will help in expressing scientific ideas and views clearly and effectively.

PO 6- Realize that pursuit of knowledge is a lifelong activity and in combination with untiring efforts and positive attitude and other necessary qualities leads towards a successful life.

Program Specific Outcome

PSO 1- Provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

PSO 2- Achieve the skills required to succeed in the chemical industry and professional school. Get exposures of a breadth of experimental techniques using modern instrumentation.

PSO 3- Understand the importance of the Periodic Table of the Elements, how it came to be, and its role in organizing chemical information.

PSO4-Understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics, biology and other disciplines to a wide variety of chemical problems.

PSO5- Learn the laboratory skills needed to design safely and interpret chemical research.

PSO6- Acquire a foundation of chemistry of sufficient breadth and depth to enable them to understand and critically interpret the primary chemical literature.

PSO7- Develop the ability to communicate scientific information and research results in written and oral formats.

MCHM101

External Marks: 70

Internal Marks: 30

INORGANIC CHEMISTRY- I

Unit-I

Stereochemistry and Bonding in Main Group Compounds :VSEPR, Walsh diagram (triatomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. Spectroscopic ground states, The correlation of spectroscopic terms into mulliken symbols.

Unit-II

Metal-Ligand Equilibrium in Solution & Magnetic Properties of Transition Metal Complexes Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by potentiometry, spectrophotometry, Bjerrum method , Job's and Mole ratio methods.

Unit-III

Reaction Mechanism of Transition Metal Complexes &:Energyprofile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism,anion reactions, reactions without metal ligand bond cleavage. Substitution reactions in square complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.

Unit-IV

Metal-Ligand bonding Limitation of crystal field theory, molecular orbital theory for bonding in octahedral, tetrahedral and square planar complexes, bonding and molecular orbital theory.

Unit-V

HSAB Theory &, Optical Rotatory Dispersion and Circular Dichroism: Classification of acids and bases as hard and soft; HSAB principle, theoretical basis of hardness and softness; Lewis-acid base reactivity approximation ,donor and acceptor . applications of HSAB concept. Linearly and circularly polarized lights; optical rotatory power and circular birefringence, elasticity and circular dichroism ,ORD.

Reference Book:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
5. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
6. Magnetiochemistry, R.1. Carlin, Springer Verlag.
7. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty,Pergamon.
8. Advanced Inorganic Chemistry, F.A. Cotton and W ilkinson, John Wiley.
9. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
10. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
11. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
12. Magnetiochemistry, R.1. Carlin, Springer Verlag.
13. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A.Mc Cleverty,Pergamon.

Magnetiochemistry, R.1.Carlin, Springer Verlag.

MCHM102 **External Marks: 70**

Internal Marks: 30

ORGANIC CHEMISTRY

Unit I- Fundamental of Organic Chemistry

IUPAC nomenclature of organic molecules including regio- and stereoisomers. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Temporary and Permanent Effect in Organic reactions. Classical and nonclassical carbocations, phenomium ions, norborynl systems.

Aromaticity- Aromatic, Anti-aromatic, Homoaromatic, Non-aromatic and Aromatic Heterocyclic Compounds- general description and reactions.

Unit II- Stereochemistry I

Chirality: Isomers, Configuration and there specifications, D-L and R-S System, Interconversion between Fischer, Sawhorse and Newman Projection, Symmetry Elements Operation Point Group and Stereochemical Properties.

Prochirality and Asymmetric, Conformation of Acyclic and Cyclic System; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.

Unit III- Stereochemistry II

Stereochemistry and Mechanism of Some Reaction: Stereochemistry of Substitution Reaction, Stereochemistry of Elimination Reaction, Stereochemistry of Addition Reaction to carbon-carbon bond (double and multiple bonds).

Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; Conformational analysis of cycloalkanes, decalines, effect of conformation on reactivity, conformation of sugars.

Unit IV- Fundamental of Organic Reaction

Fundamentals Concept of Organic reactions: Factors in Chemical reactions, Hydrogen bonding, Acidity and basicity.

Organic reaction mechanisms involving addition, elimination, substitution and rearrangement reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways. Pericyclic reaction mechanisms and there applications in organic synthesis. Determination of reaction pathways. electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

Unit V- Organic Name Reaction

Acetoacetic Ester Synthesis, Aldol Reaction, Baeyer-Villiger Rearrangement, Beckmann Rearrangement, Cannizzaro Reaction, Claisen Condensation, Diel-Alder Reaction, Friedel-Crafts Acylation/Alkylation, Gabriel Synthesis, Gattermann-Koch Reaction, Haloform Reaction, Hofmann Reaction, Kolbe-Schmitt Reaction, Mannich Reaction, Pinacol Rearrangement, Reimer-Tiemann Reaction, Schmidt Reaction, Wittig Reaction, Wolf-Kishner Reduction.

Reference Book:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes,
4. Longman.Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &* Professional.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
9. Pericyclic Reactions, S.M. Mukherji, Macmillan,
10. IndiaStereochemistry of Organic Compounds, D.Nasipuri, New Age International.
11. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.

MCHM103 **External Marks: 70**

Internal Marks: 30

PHYSICAL CHEMISTRY I

UNIT-I

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

Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate).Applications of variation method and perturbation theory to the Helium atom.

Differential Calculus: Functions: continuity and differentiability. Rules for differentiation. Application of differential calculus including maxima and basic rules for integration, integration by parts. Partial fraction and substitution, reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, curve sketching.

Unit II

Applications of Quantum Mechanics-
MO theory of hydrogen molecule ion. Secular equation and its solution. Electron density distribution and stability of H2+ ion. MO and VB theories of H2. Resonance. MO theory of homonuclear diatomic molecules. Bond order and stability. MO theory of simple heterogeneous diatomic molecules like HF, LiH, CO and NO.

Directed Valences andIonic Bonding: The hybridization, Bonding and hybridization involving d-orbitals. Ionic bonding and potential energy field. Lattice energy. Born theory and Born-Haber cycle. Elctronegativity: Pauling, Mullikan . Electronegativity and percentage of ionic character. Secondary bond forces: The van der Waals' forces, ion-dipole, ion-induced dipole, dipole-dipole, dipole-induced dipole and London dispersion forces. The hydrogen bond.

UNIT- III

Molecular Orbital Theory: Huckel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene etc.Introduction to extended Huckel theory.

Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum operator using ladder operators addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

UNIT- IV

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

Unit-V

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

application to helium.

Reference Book:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistyry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R.McWeen y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. MOraoi, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.

MCHM104

External Marks: 70

Internal Marks: 30

SPECTROSCOPY- I

Unit I- Introduction to Spectroscopy

Principle of spectroscopy: Electromagnetic Spectrum, Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, dispersion, polarization and scattering. Uncertainty relation & natural line width and natural broading, transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral lines. Born-Oppenheimer approximation, rotational, vibration & electronic energy levels

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

Unit II- Infrared Spectroscopy

Infrared-Spectroscopy:Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, Factors affecting Vibrational frequencies; couple vibration, Fermi resonance, Hydrogen bonding, Inductive and Mesomeric effects. Fingerprint Region, Vibration-rotation spectroscopy. P.Q.R. branches, Breakdown of Oppenheimer approximation; vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibrations, normal co-ordinate analysis. Application of IR spectroscopy.

Unit III

Atomic Spectroscopy: Energies of atomic orbitals, vector representation of momenta and vector coupling spectra of hydrogen atom and alkali metal atoms.

Molecular Spectroscopy: Energy levels, molecular orbital, vibronic transitions, vibrational progressions and geometry of the excited states, Frank - Condon principle, electronic spectra of polyatomic molecules. Emission spectra, radiative and non-radiative decay, internal conversion, and spectra of transition metal complexes, charge- transfers spectra, Electronic spectra and application.

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

Unit IV- Raman Spectroscopy

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

Unit V-

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

Electron Diffraction: Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

Neutron Diffraction Scattering of neutrons by solids measurement techniques,Elucidation of structure of magnetically ordered unit cells.

Reference Book:

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

MCHM105A

SUBJECT: RESEARCH METHODOLOGY

Objectives:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner

Unit I

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process

Unit II

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance , Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Unit III

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches. Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Unit IV

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit V

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline. Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

Learning Outcomes:

1. Students will understand a general definition of research design.
2. Students will know why educational research is undertaken, and the audiences that profit from research studies.
3. Students will be able to identify the overall process of designing a research study from its inception to its report.
4. Students will be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research

Assessment Tools:

Written examinations, Case study discussions, Viva examinations.

Books Recommended:-

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari

MCHM105B

SUBJECT: SCIENCE JOURNILISM

Objectives

- Students will learn the mechanics of science writing, including research, sourcing, and generating story ideas; interviewing, note-taking, and organization; fact-checking, editing, writing for story, structure, and formatting.

- Students will practice writing for multiple public, academic, and professional audiences and contexts using writing strategies, conventions, genres, technologies, and formats to communicate effectively.

UNIT 1 Science communication at the end of the Enlightenment and the importance of notions of the public in the origin of modern science - development of new audiences for science in the Nineteenth century and the emergence of new science communication media (e.g. mechanics' institutes, science journalism, public museums and zoos) - advent of the figure of the scientist as public expert and the debate about 'Two Cultures' – difference between science journalism and science communication

UNIT 2 Introduction of Western science in India through missionaries, travelers, army and civilian army of the East India Company– science in the 18th and 19th century –emergence of Indian pioneer scientists – science teaching-– developments during post-Independence period – emerging areas of science and technology – convergence in study of science

UNIT 3 Institutions of science in India - the role of the Asiatic Society – Bose Institute – Indian Institute of Science - Council of Scientific and Industrial Research (CSIR) – Indian Space Research Organization (ISRO) – Indian Science Congress organizations for popularization of science – NCSTC and Vigyan Prasar – noted science societies at state level – Science and Technology Academies – awards for science communication and popularization.

UNIT 4 The boom in new media during the twentieth century and their impact on science journalism - role of a science page editor – popular science magazines in the west – science magazines in India – the ideal science reporter - scope of science journalism on radio & television in developing countries – science serials on radio and television – Bharat ki Chaap on Doordarshan – Science serials on All India Radio - tech news - understanding present market trends.

UNIT 5 Science as an essential element in political, corporate and community news – major issues in science journalism – environmental pollution – genetically modified crops – research for disease prevention and eradication – nuclear power – disaster mitigation – scientific knowledge for effective governance – the North-South divide in science research and scientific development.

Learning Outcomes

- They will appreciate the digital landscape within which science journalism exists today by learning: blogging in science journalism (honing your craft, developing a voice); how to get work

(pitching and staying relevant); the value of social networks for science journalism (sharing stories, finding stories, joining discussions and finding sources); digital strategies employed by major news organizations (data visualization, multimedia, community building).

- Students will analyze and learn about the structure of several types of data including numbers, texts and documents. Students will learn the skills to examine, evaluate, and critique those data, extract patterns, summarize features, create visualizations, and provide insights, while learning to be sensitive to ethical concerns associated

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

Reference Book:

1. Mass Communication: A Critical analysis, Keval J Kumar
2. Professional Journalism, M V Kamat
3. Theory and Practice of Journalism, B N Ahuja
4. Professional Journalist, John Hohenberg
5. Understanding Media, Marshall McLuhan 6. Journalism in India,Nadig Krishnamurthy, Mysore University Press
6. Barbara Gastel, Presenting Science to the Public.
7. Blum, Deborah, Knudson, Mary & Marantz Henig, Robin. A Field Guide for Science Writers: The Official Guide of the National Association of Science Writers. (2005)
8. D. Perlman, Science and the Mass Media.
9. Elise Hancock, Ideas into Words: Mastering the Craft of Science Writing. Baltimore and London: Johns Hopkins, 2003.
10. N Corcoran (Ed.). Communicating health: strategies for health promotion. Sage. (2013).
11. O.P. Jaggi, A Concise History of Science including Science in India.
12. R. Sundara, Popular Science in Mass Media.
13. Renata Schiavo, Health Communication: From Theory to Practice. John Wiley & Sons. 2013
14. Sharon, M. Friedman, Sharon, Woody, Carlol, L. Rogers (Ed) : Scientists and Journalists, Reporting Science as News.
15. Warren Burkett, News Reporting : Science Medicine and High Technology

MCHM101P **Inorganic Chemistry-I-Lab**

I. Qualitative and quantities analysis

1. Qualitative analysis of mixture containing 08 radicals including two less common metals from among the following by semi micro method

Basic radicals: Ag^{+}, Pb^{2+}, Bi^{3+}, Cu^{2+},Cd^{2+}, As^{3+}, Sb^{3+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Hg^{2+}.

Acid radicals: Carbonate, sulphide,sulphite, sulphate, nitrite, nitrate, acetate, chloride, fluoride, bromide, iodide, borate, oxalate, phosphate, , silicate, thiosulphate, ferrocyanide, ferricyanide, chromate, arsenate and permanganate

2. Separation and determination of two metal ions involving volumetric and gravimetric methods.
3. Separation of cations and anions by Paper Chromatography.

II. Preparations

Preparation of selected inorganic compounds

1. $TiO(C_9 H_8 NO)_2 H_2O$
2. $cis\text{-}K[Cr(C_2O_4)_2(H_2O)_2]$
3. $Na[Cr(NH_3)_2(SCN)_4][Fe(C_2O_4)_3]$
4. Prussian Blue, Turnbull's Blue
5. $[Ni(NH_3)_6]Cl_2$
6. $Ni(DMG)_2$
7. $[Cu(NH_3)_4]SO_4 H_2O$
8. $[Co(NH3)_6][Co(NO_2)_6]$
9. $cis\text{-}[Co(trien)(NO_2)_2]Cl.H_2O$
10. $Hg[Co(SCN)_4]$

Reference Book-

1. Vogel's Textbook of Quantitative Analysis Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
4. 2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
5. 3. Chemistry of the Elements,N.N. Greenwood and A. Earnshow, Pergamon.
6. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier

MCHM102P

Organic Chemistry-I -Lab

1.Qualitative Analysis: Separation, purification and identification of compounds of Binary mixture using TLC and columns chromatography, chemical tests.

2. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.

3. Estimation of amines/phenols using bromate bromide solution/or acetylation method.

Organic Synthesis:

4.Acetylation : Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.

5. Oxidation :Adipic acid by chromic acid oxidation of cyclothexaneol

6.Grignard reaction : Synthesis of triphenylmethanol from benzoic acid The Products may be Characterized by Spectral Techniques.

7. Aldol condensation Dibenzal acetone from benzaldehyde.

8.Sandmeyerreactuion : p- Chlorotoluene from p-toluidine.

9. Acetoacetic ester Condensation : Synthesis of ethyl-nbutylacetoacetate .

10.Cannizzaro reaction : 4-Chlorobenzaldehyde as substrate.

Preparation of Heterocyclic compounds:-1.Phenylhydrazine acetophenone phenylhydrazone 2-phenylindole Quinoline from Skraup synthesis

2.Benzaldehyde benzoinbenzyl 2,3diphenylquinoxalineMixed principles

3.Aniline 2,4,6-tribromoaniline 2,4,6-tribromo-1-chlorobenzene

4.Phenol mixture of 2- and 4- nitrophenols separate 2- and 4- nitrophenols

5. Chlorobenzene 1-chloro-2,4-dinitrobenzene 2,4-dinitrophenylhydrazine

Quantitative Analysis

1.Determination of methoxy group.

2.Determination of vitamin C in drug formulations and in fruits.

Reference Books:

- Practical Organic chemistry by A. I. Vogel.
- Practical Organic chemistry by Mann and Saunders.
- Practical Organic chemistry by Garg and Salija.
- The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.

- Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.
- Practical Physical chemistry by Alexander Findlay.
- Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, Mc Graw Hill
- Interscience.
  Findlay's Practical Physical chemistry, revised B. P. Levitt, Longman. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J.
- Mendham, ELBS.
- Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
- Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.
- Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
- Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
- Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

MCHM103P **Physical Chemistry-I-Lab**

ADSORPTION/SURFACE CHEMISTRY

1. To Study Surface Tension - Concentration relationship for solutions (Gibbs equation).

2. To Verify the Freundlich and Langmuir Adsorption isotherms using acetic acid/Oxalic acid and activated charcoal.

3. Determination of CMC of surfactants.

PHASE EQUILIBRIA

1. To Construct the Phase diagram for three component system (e.g., chloroform-acetic acid-water).

CHEMICAL KINETICS

1. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions.

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

3. Determination of the rate constant for the decomposition of hydrogen peroxide by Fe+++ and Cu++ ions.

4. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).

5.Study of kinetics of exchange between ethyl iodide & the iodide ion.

SOLUTIONS/MOLECULAR WEIGHTS

1. Determination of molecular weight of non-volatile substances by Landsber

2. Determination of Molar masses of Naphthelene/acetanilid 3. Molecular weight of polymers by viscosity measurements.

CONDUCTOMETRY

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

2. Determination of solubility and solubility product of sparingly soluble salts (e.g., PbSO4, BaSO4) conductometrically.

3. Determination of pKa of Acetic acid and verification of Ostwald dilution law.

POTENTIOMETRY/pH METRY

1. Determination of the strength of strong and weak acids in a given mixture using a potentiometer/pH meter.

2. Determination of the dissociation constatnt of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.

3. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method.

4. Determination of Redox potential of Fe^{++}/Fe^{+++} system.

POLARIMETRY

1. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

2. Enzyme kinetics –inversion of sucrose.

3. Determine the specific and molecular rotation of optically active substances.

To study the auto catalytic reaction between $KMnO_4$ and Oxalic acid.

Reaction between $K_2S_2O_8$ and Iodine.

Reference Book:

1. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
4. Handbook of Organic Analysis –Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogel's Textbook of Practical Organic Chemistry,
6. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
7. Findley's Practical Physical Chemistry, B.P. Levi
8. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

9. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.

10. Findley's Practical Physical chemistry, B.P. Levitt, Longman.

11. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

MCHM201

INORGANIC CHEMISTRY- II

Unit-I

Electronic Spectral Studies of Transition Metal Complexes

Term symbols for d-ions. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1-d9 states),Janh- teller effect and electronic spectra of complexes. Selection rule for electronic spectroscopy.Intensity of various type electronic transitions. Calculations of 10Dq, B and β parameters, charge transfer spectra.

Unit-II

Magnetic Properties of Transition Metal Complexes: Types of magnetic behavior, Diamagnetism, paramagnetism, Ferromagnetism and antiferromagnetism. Magnetic moment, L-S coupling, determination of ground state term symbol. Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.

Unit-III

Metal π-Complexes

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

Unit-IV

Organometallic Compounds: -Classification, Electro rule, Metal carbonyls, Zintl Ions, Binary carbonyl complexes, Metal Nitrosyls.

a. Metal Clusters
Higher boranes, carboranes, metalloboranes and metallo-carboranes compound with metal multiple bonds.

b. Rings: Borazines, phosphazines.

Unit-V
ISOPOLY ACID AND HETEROPOLYACID

Isopoly and heteropoly acids of Mo and W.

Preparation, properties and structure. Classification, Preparation, properties and structures of borides, carbides, nitrides and silicides. Silicates- classification and Structure, Silicones- preparation, properties and application.

Spectral Methods: Characterization of Inorganic molecules by different spectral methods.

Reference Book:

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.

MCHM202

ORGANIC CHEMISTRY-II

Unit I

Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.

Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.

Unit II

Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.

Spectral Methods: Structure determination of organic compounds by various Spectroscopic Methods; IR, UV-Vis, ^{1}H &^{13}C NMR and Mass spectroscopic techniques.

Heterocyclic Compounds: Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S). Pyrrole, Pyridine, Furan, Thiophene, Indole, Quinoline, azirodines, oxiranes, thiranes, azetidines, oxetanes and thietanes. Knorr Pyrrole Synthesis, Fisher-Indole Synthesis, Paal-Knorr Furan/Pyrrol Synthesis.

Unit III- Advanced Name Reaction with mechanism I

Acyloin Condensation, Adamantane Rearrangement (SchleyerAdamantization), Alder (Ene) Reaction, Algar-Flynn-Oyamada Reaction, Alkene/Alkyne Metathesis, Amadori Reaction/Rearrangement, Appel Reaction, Arbuzov (Michaelis-Arbuzov) Reaction, Arndt-Eistert Synthesis, Aza-Cope Rearrangement, Baldwin's Rules, Barton Reaction, Baylis-Hillman Reaction, Benzilic acid Rearrangement, Benzoin Condensation, Bergman Cycloaromatization Reaction, Bignelli Reaction, Birch Reduction, Brook Rearrangement, Chichibabin Amination Reaction,

Unit IV- Advanced Name Reaction with mechanism II

Chugaev Elimination Reaction, Claisen Rearrangement Reaction, Johnson-Claisen Rearrangement, Clemmensen Reduction, Curtius Rearrangement, Dakin Oxidation, DarzenGlycidic Ester Condensation, Demjanov Rearrangement, Dess-Martin Oxidation, Diazonium coupling, Dieckmann Condensation, Dienone-Phenol Rearrangement, Enyne Metathesis. Favorskii Rearrangement, Fries Rearrangement,Hantzsch Dihydropyridine Synthesis, Heck Reaction, Hell-Volhard-Zelinsky Reaction, Hofmann Elimination, Hofmann-Loffler-Freytag Reaction, Hofmann Rearrangement, Horner-Wadsworth-Emmons Olefination.

Unit V- Advanced Name Reaction with mechanism III

Jones Oxidation, Knoevenagel Condensation, Lossen Rearrangement, Luche Reduction, Meerwein-Ponndorf-Verley Reduction, Mistunobu Reaction, Neber Rearrangement, Nef Reaction, Oppenauer Oxidation, Paterno-Buchi Reaction, Peterson Olefination, Prevost Reaction, Prins Reaction, Pummerer

Rearrangement, Reformatsky Reaction, Smiles Rearrangement, Sommelet-Hauser Rearrangement, Strecker Reaction, Swern Oxidation, Takai Reaction, Tebbe Olefination, Tsuji-Trost Reaction, Vilsmeirreactiion, Wacker Oxidation, Wagner-Meerwein Rearrangement, Wolf Rearrangement.

Reference Book:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes,
4. Longman,Structure and Mechanism in Organic Chemistry, C.K. Ingold, Comell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
6. Modern Organic Reactions, H.O. House,
7. Benjamin.Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic &* Professionsl.
8. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh,
9. Macmillan.Pericyclic Reactions, S.M. Mukherji, Macmillan,
10. India Stereochemistry of Organic Compounds, D.Nasipuri,
11. New Age International.Stereochemisty of Organic Compounds, P.S. Kalsi, New Age International.

MCHM203

PHYSICAL CHEMISTRY-II

Unit-1

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogenbromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features fo fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis ad the nuclear magnetic resonance method, dynamics of unimolecularreactiosn (Lindemann Hinshelwood and Rice-Ramsperger-Kassel- Marcus (RRKM) theories for unimolecular reactions).

Unit-II

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

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

Unit-III

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

Unit-IV

Non Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager’s reciprocity relations, electro kinetic phenomena, diffusion, electric conduction.

Unit V

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

potential and its significance.

Reference Book:

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistyry, A.K. Chandra, Tata Mc Graw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R.McWeen y, ELBS.
5. Chemical Kinetics. K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, Mc Millan.
7. Micelles, Theoretical and Applied Aspects, V. MOraoi, Plenum.
8. Modern Electrochemistry Vol. 1 and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.

MCHM204

SPECTROSCOPY-II

Unit I- Mossbauer Spectroscopy

Mossbauer Spectroscopy: Theory, Line width, Collision broadening, Doppler broadening, Heisenberg's Uncertainty Principal, Principal of MB Spectroscopy, Criteria for MB Spectroscopy, Mossbauer spectrum, Doppler effect, Hyperfine interaction, Isomer shift, Quadrupole interaction, Magnetic interaction, Application of MB spectroscopy.

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Multiple structures in ESR spectroscopy; Fine and Hyperfine structures. Isotropic and anisotropic hyperfine coupling constants, spin Hamiltonian, spin densities and Mc Connell relationship, EPR peak broadening and peak merging and electron spin exchange rate, measurement techniques, applications.

Unit -II

Nuclear Quadrupole Resonance Spectroscopy: Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splitting. Applications.

Atomic Absorption Spectroscopy and Atomic Emission Spectroscopy::
Introduction, Principle, Classification, Measurement, Instrumentation, Origin of Spectra, Measurement, Instrumentation, Applications and Advantages & disadvantages.

UnitIII- Nuclear Magnetic Resonance Spectroscopy:

Nuclear Magnetic Resonance Spectroscopy:Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant "j" Classification (AXB, AMX, ABC, A2B2 etc.). spin decoupling; ^{1}H NMR; Theory, process of absorption of energies. Use of TMS. Basic ideas about instrumentation, Effect of Quadrupolar Nuclei on ^{1}H NMR. NMR studies of nuclei other than proton-^{13}C; Theory, Factors affecting ^{13}C chemical shift,^{19}F and ^{31}P. FT NMR, advantages of FT NMR, NMR spectrum of Paramagnetic Molecules; Contact shift, Pseudo-contact shift, Lanthanide shift Reagents. Fluxional behaviour of Molecules; Ferrocenophane and Cyclooctatetraene Iron Tricarbonyl.

Unit IV

Carbon- 13 NMR Spectroscopy: - General consideration, chemical shift (aliphatic, olefinic, alkynes, aromatic, heteroaromatic and carbonyl carbon), coupling constant.Two and three dimensional NMR spectroscopy-HSQC, COSY, TOCSY, HMBC, NOSY, NOES, DEPT, APT and Inadequate techniques. Calculation of peaks of NMR in small molecules.

Mass Spectroscopy: Theory, ionization method/fragmentation cleavage pattern,Confirmation of Recognized Molecular ion Peak: instrumentation base peak, meta stable peak, mclafferty rearrangement, ring rule, nitrogen rule and application α and β allylic and benzylic cleavage.
Calculation of fragmentation by using Mass Spectroscopy in small molecules.

Unit V

Symmetry and Group theory in Chemistry: Symmetry elements and symmetry operation, definition of group, subgroup. Conjugacy relation and classes.Point symmetry group.Schonfilies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh group to be worked out explicity). Character of a representation.The great orthogonality theorem (without proof) and its importance.Character tables and their use; spectroscopy. Derivation of character table for C2v and C3v point group Symmetry aspects of molecular vibrations of H_2O molecule.

Reference Book:

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

MCHM205A

Entrepreneurship

Course Objective: The goals of this programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. They will be introduced to key traits and the DNA of an entrepreneur, and be given an opportunity to assess their own strengths and identify gaps that need to be addressed to become a successful entrepreneur. The programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, communication, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.

Course Learning Outcomes: After completion of these courses students will be able to understand-

C At the end of the course, the students will:

- Develop awareness about entrepreneurship and successful entrepreneurs.
- Develop an entrepreneurial mind-set by learning key skills such as design, personal selling, and communication.
- Understand the DNA of an entrepreneur and assess their strengths and weaknesses from an entrepreneurial perspective.

Unit I **Contact Hours: 12**

Entrepreneurship: Concept of Entrepreneur, Entrepreneurship and Manager, Difference between Entrepreneur and Entrepreneur, Entrepreneurship, Attributes and Characteristics of successful entrepreneurs. Functions of an Entrepreneurs Function of an Entrepreneur, Classification of Entrepreneurs, Role of Entrepreneur in Indian Economy, Developing Entrepreneurial culture, Factors influencing Entrepreneurship Growth – Economic, Non-Economic Factors, For profit or Not for profit entrepreneurs, Constraints for the Growth of Entrepreneurial Culture, Entrepreneurship as a career, Entrepreneurship as a style of management, Emerging Models of Corporate Entrepreneurship, India's start up revolution-Trends, Imperatives, benefits: the players involved in the ecosystem, Business Incubators-Rural Entrepreneurship, social entrepreneurship, women entrepreneurs, Cases of Tata, Birlas, Kirloskar and new generation entrepreneurs in India.Case study on related topics.

Unit II **Contact Hours: 12**

Theories of entrepreneurship: Innovation Theory by Schumpeter & Imitating, Theory of High Achievement by McClelland, X-Efficiency Theory by Leibenstein, Theory of Profit by Knight, Theory of Social change by Everett Hagen.Case study on related topics.

Unit III **Contact Hours: 12**

Entrepreneurship development: Entrepreneurial Competencies, Developing competencies, concept of entrepreneurship development, Entrepreneur Training and developing, Role of Entrepreneur development Programs (EDP), Role of DIC, EDII, NIESBUD, NEDB, EDP – Objectives – contents – methods – execution, Mudra Yojna: Shishu, Kishore and Tarun Scheme. Role of Mentors. Innovation and Entrepreneurship, Design Thinking Process, Role of consultancy organizations in promoting Entrepreneurs, Problems and difficulties of Entrepreneurs – Marketing Finance, Human Resource, Production; Research – external problems, Mobility of Entrepreneurs,Entrepreneurial change, occupational mobility – factors in mobility.Case study on related topics.

Unit IV **Contact Hours: 12**

Role of Central government and State Government in promoting Entrepreneurship:Introduction to various incentives, subsidies and grants, Export Oriented Units, Fiscal and Tax concessions available, Women Entrepreneurs – Role, Problems and Prospects, Reasons for low women Entrepreneurs, Assistance Programme for Small Scale Units – Institutional Framework – Role of SSI Sector in the Economy – SSI Units – Failure, Causes and Preventive Measures – Turnaround Strategies. Future of Entrepreneurship Development and Government, Start Up India, Make in India.Case study on related topics.

Unit V **Contact Hours: 12**

Enterprise Promotion: Creating Entrepreneurial Venture, Entrepreneurship Development Cycle, Business Planning Process The business plan as an entrepreneurial tool, Elements of Business Plan, Objectives, Market Analysis, Development of product/ idea –Resources, Capabilities, and strategies, identifying attributes of strategic resources, Opportunity Analysis, innovator or imitator, SWOT analysis, Internal and External Environment Analysis, Industry Analysis, Embryonic Companies and Spin off's, Porter's five forces model, Identifying the right Business Model Canvas, Seven Domains of John Mullins, Opportunities in Emerging/Transition/Decline

industries, Opportunities at the bottom of the pyramid, Opportunities in social sector, Opportunities arising out of digitization, Marketing, Finance, Organization & Management, Ownership – Franchising, networking and alliances, Buying an existing business, Critical risk contingencies of the proposal, Scheduling and milestones.Case study on related topics.

Text Books:

1. Vasant Desai (2011), Dynamics of Entrepreneurship Development, Himalaya Publishing House.
2. David H. Holt, (1991) Entrepreneurship: New Venture Creation, Prentice Hall.
3. K. Nagarajan, (2017) Project Management, New Age International Pvt Ltd.

Reference book:

1. The Culture of Entrepreneurship, Brigitte Berger.
2. Entrepreneurship: Strategies and Resources, Marc J, Dollinger.

MCHM205B

INTELLECTUAL PROPERTY RIGHTS

Objectives

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries and Research.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
6. To aware about current trends in IPR and Govt. steps in fostering IPR and case studies .

Unit-1 **Overview and Introduction of Intellectual Property**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994, Phonograms or Geneva Convention, History of IPR.

Unit-2 **Patents and Drafting**

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board, Patent Filing and Drafting

Case studies, Patent Agents role in India.

Copyrights in IPR

Unit-3

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights, Filing and Drafting the Copyrights.

Unit-4 **Trademarks and Trading licences**

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board, Trading licence importance of exports and imports in trading.

Unit-5 **IP transactions; Enforcement of IP, Commercialization**

Implications of Intellectual Property Rights in promoting innovations and their commercialization; technology transfer, Due diligence in patent transactions. Working of patents in India Compulsory licence and its implications; Enforcement of Patents against infringer.

Industrial Designs Registrations: Classification, Protection and Enforcement of Industrial Designs in Indian. Registration and protection of design in India and abroad.

Geographical Indications:Concept of Geographical Indications and GI registration in India; Global scenario of GI. Protection of Traditional Knowledge and development of balanced benefit sharing models; management of GI to enhance the economic returns from GIs. Enforcement

of GI. GI registrations process in India Case studies.

Case Studies and Discussions related to IPR

Learning Outcomes

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works during their research career, information in patent documents provide useful insight on novelty of their idea from state-of-the art search.

2. This course provide further way for developing their idea or innovations.

3. To Pave the way for the students to catch up Intellectual Property(IP) as an career option a. R&D IP Counsel b. Government Jobs – Patent Examiner c. Private Jobs d. Patent agent and Trademark agent e. Entrepreneur

Assessment Tools: Written examinations, Case study discussions, Viva examinations.

REFERENCE BOOKS

Text book

1. Rimmer, M. (2008). *Intellectual property and biotechnology: biological inventions*. Edward Elgar Publishing.
2. Singh, H. B., Jha, A., &Keswani, C. (Eds.). (2016). *Intellectual property issues in biotechnology*. CABI.
3. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4. Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

E-resources:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

2. 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

Reference Journal: 1. Journal of Intellectual Property Rights (JIPR): NISCAIR http://nopr.niscair.res.in/handle/123456789/45 (Case Studies)

Useful Websites:

1. Cell for IPR Promotion and Management (http://cipam.gov.in/)
2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

MCHM201P

Inorganic Chemistry-II Practical

Course Objectives

1. To introduce students to the practical applications of theoretically verified knowledge.
2. To impart knowledge by demonstration.
3. To perform and learn the various laboratory procedures.

List of experiments:

- Preparation of potassium trioxalatoferrate III and estimation of iron.
- Estimation of ferrous ion using 1,10-phenanthroline by colorimetric method.
- Estimation of copper as cuprammonium sulphate by colorimetric method.
- Estimation of Zinc using EDTA.
- Estimation of magnesium using EDTA.
- Estimation of sulphate as Barium Sulphate.
- Gravimetric estimation of nickel.
- Estimation of ferric ion in the given sample of haemetite.
- Preparation of [Cu(NH3)4]SO4 H2O
- Preparation of [Co (NH3)6] [Co (NO2)6]
- Preparation of cis-[Co(trien) (NO2)2] Cl.H2O
- Preparation of Hg [Co (SCN)4]

Course Outcomes

- Learn practical based approach towards practical inorganic Chemistry.
- Performing experiments in accordance with the standard procedures.

Reference Book-

1. Vogel's Textbook of Quantitative Analysis Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.
3. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
4. 2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
5. 3. Chemistry of the Elements,N.N. Greenwood and A. Earnshow, Pergamon.
6. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier

MCHM202P

Organic Chemistry-II Practical

1. Preparation of 4-Chlorotoluene from p-toluidine (Sandmeyer reaction)
2. Preparation of Benzopinacol (Photochemical reaction),
3. Preparation of 7-Hydroxy-4-methyl coumarin (Pechmann Reaction)
4. Preparation of Benzanilide (Beckmann rearrangement)
5. Preparation of 2- and 4-nitrophenols (nitration and separation by steam distillation)
6. Preparation of Stilbene from benzyl chloride (Wittig reaction)
7. Preparation of Ethyl cinnamate from benzaldehyde (Wittig reaction)
8. Preparation of Benzotriazole 16. 1-Phenyl-3-methyl pyrazol-5-one
9. Preparation of Glucose pentaacetate
10. Preparation of 2,4-diethoxycarbonyl-3,4-dimethyl pyrrole from ethyl acetoacetate
11. Preparation of Quinoline from aniline Skraup synthesis).
12. Grignard reaction: Synthesis of triphenylmethanol from benzoic acid The Products may be Characterized by Spectral Techniques.
13. Preparation of Benzimidazole from benzyl.
14. Aniline 2,4,6-tribromoaniline 2,4,6-tribromo-1-chlorobenzene
15. Phenol mixture of 2- and 4- nitrophenols separate 2- and 4- nitrophenols
16. Chlorobenzene 1-chloro-2,4-dinitrobenzene 2,4-dinitrophenylhydrazin

References:

1. Practical organic chemistry by Mann & Saunders

2. Text book of practical organic chemistry –by Vogel

3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin

MSc III Sem- Natural Product Practical

A. **Bio-Inorganic Chemistry**:

(I) Extraction of chlorophyll from green leaves of student's of choice. Separation of chlorophylls and their electronics spectral study.

(II) Complexation study of Cu (II) ion with biologically important amino acids.

B. Isolation of Natural products:

1. Isolation of Caffeine from tea leaves (Soxhlet extraction)

2. Isolation of Piperine from pepper (Soxhlet extraction)

3. Isolation of Eucalyptus oil from leaves (Steam distillation)

4. Isolation of Lycopene from tomatoes

5. Isolation of Trimyristin from nutmeg

6. Isolation of Cinnamaldehyde from cinnamom

7. Isolation of Eugenol from clove

8. Isolation of casein from milk: perform colour reaction of protein.

9. Isolation of nicotine dipicrate from tobacco.

10. Isolation of cinchonine from cinchona bark.

11. Isolation of piperine from black pepper.

12. Isolation of lycopene from tomatoes.

13. Isolation of β-carotene from carrots.

14. Isolation of limonene from citrus rinds

MCHM203P

Physical Chemistry-II Practical

Course Objectives:- Students are encouraged to understand the interconnection between the experimental foundation and the underlying theoretical principles and appreciate the limitations inherent in both theoretical treatments and experimental measurements. Students will gain familiarity with a variety of measurement techniques.

1. To Construct the Phase diagram for three component system (e.g., chloroform-acetic acid-water)
2. To Construct the Phase diagram for any three component system
3. Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions
4. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
5. Determination of the rate constant for the decomposition of hydrogen peroxide by Fe+++ and Cu++ ions
6. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion).
7. Study of kinetics of exchange between ethyl iodide & the iodide ion.
8. Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.
9. Enzyme kinetics –inversion of sucrose using a polarimeter
10. Determine the specific and molecular rotation of optically active substances
11. Determination of molecular weight of non-volatile substances
12. Determination of Molar masses of Naphthelene by Rast Camphor Method
13. Molecular weight of polymers by viscosity measurements

Course outcome: The students will acquire knowledge of

1. Verify the molecular weight of non-volatile substances
2. Dissociation constant of monobasic acid
3. Enzyme kinetics –inversion of sucrose using a polarimeter
4. Operation and application of spectrophotometer, and titration method

Reference Book:

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findley's Practical Physical Chemistry, B.P. Levi 3.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill. 4.

4. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
5. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
6. E-Content present in e-pathsala.

MCHM204P

Spectroscopy-II Practical

Course Objectives: This course provides students with advanced training in analytical techniques. This will include a detailed theoretical background, practical training and a critical understanding of the laboratory-based techniques they will apply during their research projects.

List of Experiments:

1. Spectrophotometric analysis of a mixture, Determination of caffeine and benzoic acid in a soft drink.
2. Determination of chromium and manganese in a mixture.
3. By using UV spectroscopy determine the concentration of manganese in steel solution.
4. Estimation of copper and nickel in a mixture by gravimetry.
5. To learn the principle of H1 NMR & to interpret the NMR Spectra.
6. To learn the principle of C13 NMR & to interpret the NMR Spectroscopy result.
7. To learn the principle, construction & working of GC-MS.
8. To learn the principle, construction & working of GC-MS/MS.
9. Performance characteristics of an Atomic Absorption Spectroscopy.
10. To learn the principle, construction & working of AES.

Course Outcomes:

- Explain the theoretical aspects of key analytical techniques and instruments used in.
- Strategically plan analytical campaigns to apply to different types of samples and research objectives, including selection of the most appropriate technique/instrumentation for the students' research project.
- Undertake the correct sample preparation and characterization prior to analysis by the chosen techniques or instruments.

Reference Books :

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.
4. Spectrophotometric Reactions: By Irena Nemcova

MCHM301

NATURAL PRODUCT

OBJECTIVES OF COURSE LEARNING

To familiarize students with natural goods and their classifications.

Give students a general understanding of amino acids, steroids, carbohydrates, and heterocycles.

The students will have a better understanding of antibiotics (synthesis, bio-activity)

Students will be familiar with enzyme architectures and interactions of various sorts.

COURSE OUTCOME:

1. Sort the natural goods into categories based on their structures.
2. Understand the many types of amino acids, their structures, and their importance.
3. Alkaloids' biofunctions and structures should be understood.
4. Recognize the biochemical actions and structures of terepenoids.
5. Understand the bio-functions and structures of steroids.

Unit I- Carbohydrates

Introduction of sugars, Determination of configuration- Hudsons Rules-Structure of sugars structures of triose, tetrose, pentose, hexose, transformation of sugars, stereochemistry and reactions of Glucose, conformation and anomeric effects in hexoses. Preparation of alditols, glycosides, deoxy-sugars. Synthesis of vitamin C from glucose. Monosaccharides and derivatives of sugars, Lactose, Maltose, polysaccharides (Cellulose and starch) glycosaminoglycans, proteoglycans, protein glycosylation and its significance. Sugar derivatives; Mucopolysaccharides; Glycosaminoglycans; Proteoglycans.

Unit II-

a) Lipids – Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides, Soaps; Micelles; Quality of different edible oils, icosanoids; ω3 and ω6 fatty acids.

b) Proteins: different types of Protein, Peptide synthesis: chemical and Merrifield synthesis. Primary (peptide conformation, N- and C- terminal, peptide cleavage), Secondary (α-helix, sheet, random coil), Tertiary and Quaternary structures of proteins. Glycoproteins, lipoproteins and glycolpeptidolipids: Structure and biological activity, isolation, purification, degradation, structure determination. Chemical Structure of amino acid and their properties.

UNIT III

a) **Vitamins**: Synthesis, properties and deficiency disease of Vitamin A, B complex, C, D and E.

b) **Alkaloids:** Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants.Structure, stereochemistry and synthesis of the following: Ephedrine, (±) Conine, Nicotine, Atropine, Quinine and Morphine: Alkaloids derived from ornithine, lysine, tyrosine and tryptophan. Biosynthesis of alkaloids. The shikimate pathway – cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids

Unit IV

a) **Terpenoids and Carotenoids:** Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry and synthesis of the following representative molecules: Citral, Geraniol, Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid, Taxol and Carotene. Biosynthesis of terpenoids. The Mevalonate and Methylerythritol Phosphate Pathways: Terpenoids

b) **Steroids:** Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry Synthesis and structure elucidation of cholesterol, conversion of cholesterol to progesterone-androsterone and testosterone-cortisone- Vitamin D - Isolation, structure determination and synthesis of Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone. Biosynthesis of steroids. The Mevalonate and Methylerythritol Phosphate Pathways: steroids

UNIT V

a) Prostaglandins and Thromboxanes: Introduction, nomenclature of prostaglandins and thromboxanes; approaches to prostaglandin synthesis; cyclohexane precurors (Woodward synthesis of PGF2a), bicycloheptane precursors (Corey's synthesis of prostaglandins E and F).

b) **Plant Pigments:** Occurrence, classification, nomenclature and general methods of structure determination. Isolation and synthesis of Chlorophyll, xanthophyll, Apigenin, Luteolin, Myrcetin,

Quercetin-3-glucoside, Vitexin, Daidzein, Butein, Aureusin, Cyanidin-3, 5-diglucoside, Acetate pathway and Shikimic acid pathway.

c) **Flavonoids:** Classification, isolation, stereochemistry, biological activity, biosynthesis. UV quantification for Flavonoids. Coumarins and lignans: Classification, isolation, stereochemistry, biological activity, biosynthesis. UV quantification for coumarins. Polyketides. The shikimate pathway –lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids.

REFERENCE BOOKS.

1. I. L. Finar, Organic Chemistry Vol. I & Vol. II- Pearson Education, 6thedn.
2. F. A. Carey and R. J. Sundberg, (Eds) 3rd Edition, Part B. Plenum/Rosetta, 1990.
3. I. Fleming, Selected Organic Synthesis, John Wiley and sons, 1982.
4. Atta-ur-Rahman, Studies in Natural Products Chemistry, Vol.1 and 2, Elsevier, 1988.
5. R. Krishnaswamy, Chemistry of Natural Products; A Unified Approach, Universities Press.
6. R. J. Simmonds: Chemistry of Biomolecules: An Introduction,

MCHM302

Analytical Chemistry

Unit-I

Statistical tests and Error Analysis:

Accuracy, precision, methods for expressing accuracy and precision, Errors, classification of errors and minimization of errors, significant figures and computation of mean deviation, Standard deviation, Coefficient of variation, Relative standard deviations, regression, variance and coefficient of variance. The least squares method for deriving calibration graph. Correlation coefficient. Limit of detection. Significance test : t-test and Chi-test , Rejection of a result.

Unit-II

Spectrochemical and Thermal methods:

Spectrophotometry: Quantities principle of absorption, instrumentation, single beam, double beam, determination of pKa value of an Indicator and other applications.

Atomic spectroscopy: Principles of emission, atomic emission spectroscopy (AAS) and flame Photometry, types of interferences.

Thermal methods of analysis: principle and instrumentation of TGA and DTA. Complementary nature of TGA and DTA. Differential Scanning Calorimeter (DSC). Application of thermal methods in analytical chemistry.

Unit-III

Electroanalytical Methods:

Titrimetric analysis its classification – Acid base titration, Complexometric titration, Precipitation titration and Redox titration, Indicators theory of pH indicator,

Gravimetric analysis- theory and its application for estimation of transition metals. Theory of electrogravimetric analysis, electrode reactions, amperometry, over potential, cyclic voltammetry, Linear-Scan voltammetry, pulse Volta metric methods, stripping methods.

Coulometry: Basic principle

Unit-IV

Separation Techniques:

Chromatography. Theory of Chromatography. Classification of chromatography separation Retention time. Column resolution.

Gas Chromatography. Instrumentation. Columns. Detection: flame ionisation detector, thermal conductivity detector and mass spectrometric detector.

High-Performance Liquid Chromatography. Instrumentation. Pumping systems. Sample injection system.

Columns. Detection: UV-Vis detector, photodiode array detector, fluorescence detector and mass spectrometric detection.

Adsorption and partition chromatography. Ion exchange chromatography, cation and anion exchangers, Column and Detectors and their applications.

Unit-V

Sample Preparation and Extraction Techniques:

Sample Preparation for Chromatography. Solid-phase extraction, solid-phase microextraction. Extraction with molecular imprinted polymers.

Solvent Extraction. The distribution coefficient. Factors favouring solvent extraction. **Extraction reagents**. Synergetic effects. Ion-pair extraction. Extraction and stripping. Solvent extraction with crown ethers, and factors influencing it.

Principle of analytical separation, liquid-liquid extraction: distribution coefficient, distribution ratio, solvent extraction of metal, analytical separation, Microextraction and its types.

Reference Book

1. Gary D. Christian, Analytical chemistry, John-Wiley
2. H.A Willard, L.L. Merrit and J.A.Dean , Instrumental methods of analysis, van Norstand , New York,1986
3. D.A. Skoog & D.M. West principles of instrumental Analysis: Holt Rinahart Winston, New York, 1988
4. K A Robinsons Chemical Analysis, Harper Collins Publisher, New York.
5. A.J. Bard and L.R. Faulkner, Electrochemical methods: Fundamentals and Applications, John Wiley & Sons: New York**.**
6. S.M. Khopkar, Basic concepts of analytical chemistry, Wiley Eastern, New Delhi.
7. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.

MCHM303A

POLYMER CHEMISTRY

UNIT –I

Basics of polymers: Introduction to Polymers: An introduction to the history. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, free radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in homogenous and heterogeneous systems.

Polymerisation techniques such as - bulk, solution, suspension and emulsion polymerisation , Cationic and anionic polymerisation mechanism of ionic polymerisation, effect of gegen ions, temperature and solvent on polymerization, Copolymerisation, reactivity ratios, composition of copolymers, block and graft copolymers, Complex catalyst polymerisation,

UNIT-II

Polymer Characterization: Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distributions.The practical significance of molecular weight.Measurement of molecular weights. End-group, viscosity, light scattering. Osmotic and ultracentrifugation methods.Analysis and testing of polymers.Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study.Microscopy.Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

UNIT-III

Structure and Properties: Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point Tm-melting points of homogenous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. ATRP and Ring opening metathisis polymerization and their kinetics. The glass transition temperature Tg, Relationship between Tm and Tg, effect of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

UNIT-IV

Polymer Processing: Compounding.Processing techniques: Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, die casting, rotational casting, film casting, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer, thermoforming, foaming, reinforcing and fibre spinning.

Polymer testing: Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric

constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

Polymer Technology: Plastics, elastomers, fibers. Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization, vulcanization kinetics.

UNIT-V

Organic Polymer Chemistry I: Systematic study of polymers with emphasis centered on those synthesized by step-growth polymerization and their kinetics such as -polyesters, polycarbonates, polyamides , polyimides, epoxy, phenolic resins, amino plastics, polyurethanes etc

Organic Polymer Chemistry II: systematic study of polymers with emphasis centered on those synthesized by addition polymerization and their kinetics such as- ethers, acetals, lactones, lactams.

Importance of Polymers: commercial polymers and its application.

Reference Book

1. Textbook of Polymer Sciences, F. W. BillmeyerJr, Wiley.
2. Polymer Sciences, V. R. Gwariker, N. V. Vishwanathan and J. Sreedhar, Willey- Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite.
4. Contemperary Polymer Chemistry, H. R. Alcock and F. W. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J. M. G. Cowie, Blackie Academic and Professional.
6. Charles E. Carraher, Polymer chemistry, 6th edn, Marcel Dckker, Brijbasi Art Pvt.Ltd, 2003.
7. F.W.Billmeyer, Jr., A Text Book of Polymer Science, John Wiley and Sons, New York, 1971.
8. V.R.Gowariker, N.V. Viswanathan and Jayadev Sreedhar, Polymer Science, New Age

MCHM303B

BIOCHEMISTRY

OBJECTIVES OF COURSE LEARNING

1. Students will be introduced to the science of biochemistry and its applications.
2. To give pupils a general understanding of amino acids, glycolysis, the Krebs cycle, and bioenergetics.
3. Students will gain an understanding of biological reactions.
4. The students will be familiar with enzyme architectures and interactions of various types.

COURSE OUTCOME:

1. Sort biochemistry into groups based on biochemical reactions and bioenergetics.
2. Learn about the different types of amino acids and how important they are.
3. Bio-functions of biological cells, metal ions, and metalloenzymes should all be understood.

Unit I- Chemical Biology

a) Chemical biology: definition, history. Carbohydrate basic concept. Peptide and Protein: amino acids, peptides, primary, secondary, tertiary, and quaternary structure of proteins, protein folding. Protein Synthesis: biosynthesis, chemical synthesis, solid phase peptide synthesis, strategy of combinatorial synthesis, combinatorial solid phase synthesis of antibiotics.

b) Lipids: Synthesis of lipids. Role of lipids in drug delivery and gene delivery. Lipid probes. Biophysical properties of lipid-protein, lipid-peptide interactions. fatty acids, bilayer, lipidation of proteins and peptides, farnesylation of the Ras protein. Insertion of lipidated peptides into model membrane: biological membranes, transport across membranes, model membrane, biophysical properties of lipidated peptides in model membranes, basic concepts of fluorescence and fluorescence markers, synthesis of vesicles containing fluorescence quencher and lipidated peptides.

c) Metabolism and Energetics: Glycolysis, citric acid cycle, oxidative phosphorylation and transport through membranes

Unit II- Nucleic acids

a) Nucleic acids: Definition, structure and properties, structure of nucleosides and nucleotides-RNA and DNA, Watsons and Crick model base pairing, double helices, DNA replication, genetic

information storage, transmission and gene expression, chemical synthesis of oligonucleotides, hybridization with synthetic oligonucleotides, characterization and purification techniques, nucleic acids as molecular probes.

b) DNA-drug interaction. DNAdamages, mutations and repair. Modified nucleic acids: Peptide nucleic acids (PNAs),LNAs, synthesis of PNAs, doubly labelled PNAs as probes for the detection of point mutations.

UNIT III

a) **Biological Cell and its constituents:** Biological cell, structure and function of proteins,enzymes, DNA and RNA in living systems, Helix coil transition.

a) **Biopolymer Interactions:** Forces involved in biopolymer interaction, Biopolymers Polypeptide and protein structures, introduction to protein folding problem. Molecular recognition: Molecular organization, Chiral recognition and role of sugar in biological recognition

Unit IV

a) **Metal ions in biological systems:** Essential and trace metals. Na^+/K^+Pump: Role of metalions in biological processes.

b) **Bioenergetics and ATP Cycle:** DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, model systems. Biological nitrogen fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenase model systems.

c) **Electron Transport and Storage of Dioxygen:** Heme proteins and oxygen uptake, structure and function of Hemoglobin, Myoglobin, Hemocyanins and Hemerythrin, model synthetic complexes of Iron, cobalt and copper. electron transport process, cytochromes and Iron-sulphur proteins, synthetic models.

UNIT V

a) **Enzymes:** Introduction and historical perspective, chemical and biological catalysis. Remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischers lock and key and Kosohfand induced fit hypothesis, concept and identification of active site by the use of inhibitors, reversible and irreversible inhibition.Mechanism of Enzyme Action

b) **Co-enzyme Chemistry:** Cofactors as derived from vitamins, coenzymes, prosthetic groups,

apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD, NADP, FMN, FAD, lipoic acid, vitamin B12.Mechanisms of reactions catalysed by the above cofactors.

c) Metalloenzymes: Hydrolytic and redox enzymes: Carbonic anhydrase and superoxide 13 dismutase

Reference Books:

1. Chemical Biology: A practical course, edited by H. Waldmann and P. Janning. Wiley – VCH Verlag GmbH & Co. 2004

2. Foundations of Chemical biology, by C.M. Dobson, J.A. Gerrard and A.J. Pratt. Oxford Univ. Press. 2002

3. Biochemistry by J. M. Berg, J. L. Tymoczko and L. Stryer. W. H. Freeman and Company, New York References:

4. Chemical Biology: from small molecules to systems biology and drug design, Vol.-1, edited by S. L. Schreiber, T. Kapoor and G. Wess. Wiley – VCH Verlag GmbH & Co. 2007

5. Chemical Biology: Application and Techniques, edited by Banafshe Larijani, Colin A. Rosser and RudigerWoscholski, John Wiley & Sons Ltd. England, 2006

6. Principles of Biochemistry by Lehninger, Nelson and Cox, CBS Publishers, 1993.

MCHM304A

Medicinal Chemistry

OBJECTIVES OF COURSE LEARNING

1. To provide students with an overview of medicinal chemistry.

2. To give students an understanding of drug categories and the structure-activity relationship.

3. The Students will have a better understanding of antibiotics (synthesis, bio-activity)

4. Students will be familiar with enzyme structure and interactions of various sorts.

COURSE OUTCOME:

1. Understand medicinal chemistry's history and principles.
2. Determine the drug's classification and the link between structure and activity.
3. Understand the bio-mechanics of antibiotics as well as the routes by which they are synthesized.
4. Understand the structure of enzymes, their function, and the various sorts of interactions that occur in biomolecules.

Unit I.

a) **Drug Design:** Introduction to drugs, Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure-activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, bio-isosterism, spatial considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Concepts of drug receptors.

b) **Pharmacokinetics:** Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of uses of pharmacokinetics in drug development process.

c) **Pharmacodynamics:** Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, xenobiotics, biotransformation. Significance of drug metabolism in medicinal chemistry.

Unit II.

a) **Chiral Drugs:** Introduction of chiral drugs, Eutomer, Distomer and eudesmic ratio, b) Distomers- a) with no side effects b) with undesirable side effects Synthesis and pharmacological activity of S-Ibuprofen, S-Metaprolol, Ininvirsulfate, Dextropropoxyphen, (+) Ephedrine, Griseofulvin, R-Indacrinnone, hydrochloride, S-S-captopril. Introduction b) The concept of chiral templates and

chirons wherein the carbon skeleton is the chiral precursor. c) Utilisation of the basic concepts for retrosynthetic strategy and synthesis of the following – (S) Propanediol, (R) and (S) – Epichlorohydrin, L (+)-Alanine, 9 (-) Multistratin, (-) Pentenomycin, (-) Shikimic acid. Semi-synthesis of Medicinally important natural product such as epothilone, podophyllotoxins

b) **Local Anti-infective Drugs:** Introduction and general mode of actionSynthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, econozole, Griseofulvin, chloroquin and primaquin.

Unit III.

a) **Antibiotics:**Cell wall biosynthesis, inhibitors, δ-lactam rings, antibiotics inhibiting protein synthesis, Synthesis of penicillin-G, penicillin-V, ampicillin, amoxycillin, chloramphenicol, cephalosporin, tetracycline and streptomycin.

b) **Drug targets:** Antimicrobial drugs: Antibactaerials: Discovery and development of Penicillins, Cephalosporins, Sulphones and sulphonamides, Tetracyclins, Macrolides, Polypeptides, Chloromycetin Antifungals: Fungal Diseases and Anti-fungal agents Antivirals: Viral diseases and Anti-viral drugs Anti-protozoals: Anti-malarials, Anti-amoebic.

d) **AntineoplasticAgents:** Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors.

UNIT IV.

a) Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy.Hormone and natural products.

b) **Cardiovascular Drugs:** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function. Central intervention of cardiovascular output.Direct acting arteriolar dilators.Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol,oxyprenolol.

c) **Psychoactive Drugs-** The Chemotherapy of Mind**:** Introduction, neurotransmitters, CNS depressants, general anesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry of mental diseases. Antipsychotic drugs- the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs.Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximde, trimethadione, barbiturates, thiopental sodium, glutethimide.

Unit V.

a) Drugs based on a substituted benzene ring: Chloramphenicol, salmeterol, tolazamide, diclophenac, tiapamil, intriptyline. Drugs based on five-membered heterocycles: Tolmetin, spiralpril, oxaprozine, sulconazole, nizatidine, imolamine, isobuzole. Drugs based on six-membered heterocycles: Warfarin, quinine, norfloxacin and ciprofloxacin, methylclothiazide, citrine, terfenadine. Drugs based on seven-membered heterocyclic rings fused to benzene: Chlordiazepoxide, diazepam, diltiazem. Drugs based on heterocycles fused to two benzene rings: Quinacrine, tacrine, Drugs based on five-membered heterocycles fused to six-membered rings: Acyclovir, methotrexate.

b) β-Lactam antibiotics: Penicillin, cephalosporin. New Chemical Entities as Clinical agents Synthetic: Ritonavir, erbumine Natural: Hamamelitannin, pinophilin A & B.

References:

1. Medicinal Chemistry an Introduction-Gareth Thomas
2. 2nd Ed. Wiley 2. An introduction to medicinal chemistry-Graham L. Patrick 5th Ed. Oxford
3. Introduction to Medicinal Chemistry-Alex Gringauz (Wiley)
4. Foye's Medicinal Chemistry
5. Medicinal Chemistry-A. Burger
6. Medicinal Chemistry-Ashutosh Karr

MCHM304B

Organo-transition and Bioinorganic

UNIT- I

Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability and decomposition pathways, organo copper in organic synthesis.

Compounds of Transition Metal-Carbon Multiple Bonds: Alkylidenes, alkylidynes, low valentcarbenes and carbynes-synthesis, nature of bond structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis.

UNIT II

Transition Metal €-Complexes: Transition metal „ -complexes with unsaturated organic molecules, alkenes, alkynes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparations, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligiands and to organic synthesis.Metallocenes: Ferrocene, Bent Sandwich and Half- Sandwich compounds.

UNIT III

Transition Metals Compound with Bond to Hydrogen: - Transition metal compounds with bonds to hydrogen.Fluxional. Fluxionality and dynamic equillibria in compounds such as n2 - olefin, n3 –allyl and dienyl complexes.
Reaction in Organometallic Chemistry and Metal Carbenes: Oxidative Addition, Reductive Elimination, Migratory Insertion, β-Hydride Elimination and Abstraction reaction.

UNIT IV

Homogeneous catalysis: Stochiometric reactions for catalysis homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions, activation of C-H bond.

Metalloproteins, Hemerythin, Hemocyanin, Electron transfer, Cytochrome, Iron-Sulphur Protein, Rubredoxins, Ferredoxins, Blue copper Protein.

Metal Storage Transport and Biomineralization: Ferritin, transferring, and siderophores

Calcium in Biology: Calcium in living cells, transport and regulation, molecular aspects of intramolecular processes, extra cellular binding proteins.

Sodium, Potassium and Magnesium in Biology: Sodium,Potassium and Magnesium in living cells, transport and regulation, molecular aspects of intramolecular processes, role in different biological functions

UNIT V

Metalloenzymes: Zinc enzymes €carboxypeptidase and carbonic anhydrase, Iron enzymes €catalase, proxidase and cytochrome P-450. Copper enzymes- superoxide dismutase.Molybdenumoxatransferase enzymes €xanthine oxidase. Coenzyme vitamin B_{12}

Metal• Nucleic Acid Interactions: Metal ions and metal complex interactions. Metal complexes €nucleic acid.

Inorganic Medicinal Compounds: Cisplatin and related complexes, Auranofin and its application, Vanadium complexes. Other Metals in medicine. Deficiency symptoms, importance and their interaction with other nutrients of metals: Zinc, Copper, Cobalt, Iron, etc.

Reference Book:

1. Principles and Applications of Organotransition Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley
3. Metallo-organic Chemistry, A.J. Pearson, Wiley
4. Organometallic Chemistry, R.C. Mehrotra and A.Singh, New Age International
5. Principles of Bioinorganic Chemistry, S.J.Lippard and J.M.Berg. University Science Books
6. Bioinorganic Chemistry, I Bertono, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books
7. Inorganic Biochemistry vol. I and II ed. G.L. Eichhorn, Elsevier.
8. Progress in Inorganic Chemistry, Vol. 18 and 38 ed. J.J. Lippard, Wiley
9. Basic Experiment with radioisotopes by John, N. Andrews & David J. Hornsey, Pitam Publishing New
10. York.
11. Practical radiochemistry by M.F.C. Ladd & W.H. Lee, Cleaver Hune press Ltd.
12. Practical Physical Chemistry by Alexander Findlay.
13. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, Mc Graw Hill
14. Interscience.
15. Findlay's Practial Physical Chemistry, revised B.P. Levitt, Longman.

MCHM301P

Natural Product Practical

C. Bio-Inorganic Chemistry:

(I) Extraction of chlorophyll from green leaves of student's of choice. Separation of chlorophylls and their electronics spectral study.

(II) Complexation study of Cu (II) ion with biologically important amino acids.

D. Isolation of Natural products:

15. Isolation of Caffeine from tea leaves (Soxhlet extraction)

16. Isolation of Piperine from pepper (Soxhlet extraction)

17. Isolation of Eucalyptus oil from leaves (Steam distillation)

18. Isolation of Lycopene from tomatoes

19. Isolation of Trimyristin from nutmeg

20. Isolation of Cinnamaldehyde from cinnamom

21. Isolation of Eugenol from clove

22. Isolation of casein from milk: perform colour reaction of protein.

23. Isolation of nicotine dipicrate from tobacco.

24. Isolation of cinchonine from cinchona bark.

25. Isolation of piperine from black pepper.

26. Isolation of lycopene from tomatoes.

27. Isolation of β-carotene from carrots.

28. Isolation of limonene from citrus rinds

MCHM302P

Analytical chemistry-Lab

Course Objectives

1. To develop an understanding of the range and uses of analytical methods in chemistry.
2. To establish an appreciation of the role of chemistry in quantitative analysis.
3. Develop an understanding of the broad role of the chemist in measurement and problem solving for analytical tasks.
4. To provide an understanding of chemical methods employed for elemental and compound analysis.

List of Experiments:

1. Error Analysis and statistical data analysis.
   Errors, types of errors, minimization of errors, stastistical treatment for error analysis, standard deviation, method of least squares. Calibration of volumetric apparatus, burettes, pipettes, standard flash, weight box etc.
2. Determination of molecular composition of ferric salicilate /iron-phenanthroline/iron-dipyridyl complex by Job's method of continuous variation
3. Determination of stability constant of Fe(III)-salicyclic acid complex
4. Preparation of Potassium Trioxalatoferrate (III) and estimation of Iron.
5. Estimation of Ferrous Iron using 1,10 Phenolthroline by colorimetric method
6. Estimation of Copper as Cuprammonium sulphate by Colorimetric method
7. Estimation of Zinc using EDTA volumetrically
8. Estimation of Magnesium using EDTA volumetrically
9. Gravimetric estimation of Nickel using dioxime reagent
10. Estimation of Ferric ion in the given sample of Haemetite
11. Estimation of sulphate in a given sample as Barium Sulphate.

Course Outcomes

Students will be able to experience in some scientific methods employed in analytical chemistry. They will develop some understanding of the professional and safety responsibilities residing in working on chemical analysis.

Reference Books :

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

MCHM303P(A)

Polymer Chemistry-Lab

List of Experiments:

1. Synthesis of caprolactum and Nylon-6.
2. Preparation of Nylon-6,6 / -6,10 salt using HMDA- adipic acid/Sebasic acid.
3. Preparation of P-F (Resole and Novalac), and U-F resin.
4. Synthesis of styrene : Maleic anhydride copolymer.
5. Synthesis of Adipic acid.
6. Preparation of Bisphenol-A.
7. Preparation of sodium carboxy methyl cellulose/starch.
8. Preparation of chloro methylated/sulfonated polystyrene.
9. Synthesis of Hexamethylene dimine by oxidative hydrolysis of Nylon-6,6.
10. Synthesis of terepthalic acid from p-xylene.

Reference Book

1. 1.Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS
2. Gary D. Christian, Analytical chemistry, John-Wiley

MCHM303P(B)

BIOCHEMISTRY PRACTICAL

A. Organic Preparations –

1. p-nitrophenyl acetate
2. An aromatic alpha- and beta-glucoside starting with glucose
3. Dinitrophenyl hydrazone of ascorbic acid or any other ketone
4. Dinitrophenyl derivative of an amino acid
5. Prepration of Acetate and phosphate buffer system.

B. Qualitative and Quantitative Analysis of –

1. Carbohydrates
2. Amino acids and proteins
3. Free and bound phosphate
4. Vitamin C
5. Determine pKa and pI of amino acids.
6. Determination of Molar extinction coefficient of protein.
7. To determine concentration of an unknown protein by UV-Vis Spectrophotometer.
8. Protein purification by gel filtration, ion-exchange chromatography.
9. Column chromatography – Separation of a mixture of proteins and salt using Sephadex column.
10. Titration of a weak acid using a pH meter, preparation of buffers.
11. Separation of amino acids and sugars by TLC and Paper Chromatography.
12. Paper chromatography – Separation of carbohydrates in a mixture.
13. Thin layer chromatography of fatty acids.
14. Qualitative and quantitative analysis of:
    (i) Saliva (α-amylase)
    (ii) Urine (urea, uric acid, glucose, proteins, Cl-, PO_3^{-3}, Ca^{+2})

C. Fats: Acid number, saponification, and iodine values

1. Fractionation of egg proteins and its quantification
2. Isolation of casein from milk and its quantification.
3. Estimation of total chlorophyll, chlorophyll a and chlorophyll b pigments firm the leaves.
4. Estimation of carotene, ascorbic acid, phenols and tannins in fruits and vegetables.
5. Spectrophotometric estimation of Indole acetic acid in plant tissues.
6. Estimation of starch content.
7. Determination of optimum pH and temperature for enzymatic activity.
8. Verification of Beer-Lambert's law and determination of absorption coefficients.
9. Electrophoresis

Reference Books:

1. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford, 1983.
2. Plant Physiology, 5th Edition, by Lincoln Taiz and Eduardo Zeiger, Amazon press, 2.
3. Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford.
4. Carl-IvarBrändén, John Tooze, Introduction to Protein Structure , Garland Pub., 1999.
5. Jack Kyte , Structure in Protein Chemistry , Garland Science, 2007.
6. Christian, G. D., Analytical Chemistry, John Wiley & Sons (Asia) Pvt. Ltd., 2004.
7. Wilson, K. and Walker, J., Principles and Techniques of Practical Biochemistry and Molecular Biology, 7th Edition, Cambridge Univ. Press, 2010.
8. David Freifelder, Physical Biochemistry, 2nd edition, John Wiley and Sons 2005

MCHM304P(A)

MEDICINAL CHEMISTRY PRACTICAL

OBJECTIVES OF COURSE LEARNING

The course's goal is to predict how analytical methods will be used to characterize unique materials and how the information will be interpreted in light of the material's characteristics. Relate a drug's structure and its chemical and physical qualities to its pharmacological effect.

COURSE OUTCOME:

1. Aids in the correlation between a disease's pharmacology and its mitigation or cure.
2. To gain a better understanding of medication metabolism, side effects, and therapeutic value.
3. To analyse the purity of medicinal compounds.
4. Prepare medicinally important compounds / intermediates.
5. Familiarity with the synthesis of a significant class of medicines with some drug's chemical synthesis.
6. To understand the structural activity connection of various medication classes.
7. Knowledge of the mechanisms of action of many types of pharmaceutical substances.
8. To comprehend drug chemistry in relation to their pharmacological function.
9. To understand the structural activity connection of various medication classes.
10. Understanding of the mechanistic pathways of several classes of pharmaceutical substances.

A: Preparation of drugs and intermediates

1. Sulphanilamide
2. 7-Hydroxy-4-methyl coumarin
3. Chloro-butanol
4. Triphenyl imidazole
5. Tolbutamide
6. Hexamine
7. Chlorpromazine
8. Phenobarbitone
9. Atropine
10. Benztriazole
11. 2,3- diphenyl quinoxaline

12. Benzocaine
13. Phenytoin
14. Phenothiazine
15. Barbiturate

B: Assay of drugs

1. Iso-nicotinic acid hydrazide
2. Chloroquine
3. Metronidazole
4. Dapsone
5. Chlorpheniramine maleate
6. Benzyl penicillin
7. Chlorpromazine
8. Phenobarbitone
9. Ibuprofen
10. Aspirin
11. Furosemide

Reference Books:

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of Practical organic chemistry- A.I.Vogel.

MCHM304P(B)

1. Determination of the partition coefficient for iodine between carbon tetrachloride &

(a) Water,

(b) aqueous potassium iodide.

2. Study of kinetics of exchange between ethyl iodide & the iodide ion.

3. Determination of the solubility product of lead iodide.

4. Determination of the dissociation constant of Barium Nitrate.

5. To study the effect of temperature, concentration of the reactant and catalyst on the rate of a chemical reaction (Hydrolysis/NucleophilicSubstitutuction).

6. Reaction between Sodium Formate and Iodine by

(i) Volumetric Method.

(ii) Conductometric Method.

7. Saponification of ethyl acetate

(i) Volumetric Method.

(ii) Conductometric Method.

8. Reaction between Acetone and Iodine.

9. To study the autocatalylic reaction between KMnO4 and Oxalic acid.

10. Reaction between K2S2O8 and Iodine.

11. Determination of rate constant of the decomposition of benzene diazonium chloride at different

temperature.

12. To study the effect of substate catalyst etc (i) HCl, K2S2O8 (ii) KOH, NaOH.

13. To study the effect of Electrolyte on the rate hydrolysis (KCl, NaCl,)

Reference Books:

1. Basic Experiment with radioisotopes by John, N. Andrews & David J. Hornsey, Pitam Publishing New

York.

2. Practical radiochemistry by M.F.C. Ladd & W.H. Lee, Cleaver Hune press Ltd.

3. Practical Physical Chemistry by Alexander Findlay.

4. Experimental Physical Chemistry, D.P. Shoemaker, C.W. Garland and J.W. Niber, Mc Graw Hill

Interscience.

5. Findlay's Practial Physical Chemistry, revised B.P. Levitt, Longman.

MCHM401

ENVIRONMENTAL CHEMISTRY

OBJECTIVES OF COURSE LEARNING

To introduce the M.Sc. students to the fundamental ideas of Environmental Chemistry, as well as numerous elements of the four primary spheres of the earth: Atmosphere, Biosphere, Hydrosphere, and Lithosphere, green reagents, as well as their interactions and impacts on humans.

COURSE OUTCOME:

1. Learn the fundamentals of environmental chemistry and its many dimensions.
2. Learn about the major sources of pollution.
3. I'll figure out how to control the analysis data.
4. Recognize the health risks that you face on a daily basis.

Unit-I:

a) **Air Pollution**: Atmospheric pollution, classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols, sampling of gaseous pollutants, analysis of SOx, NOx, CO-CO2, hydrocarbons, effects of air pollutants on animals, ozone layer, chlorofluorocarbons, acid rain, green house effect.

b) Soil Pollution A brief idea of chemistry of soil. Trace element analysis in soil-B, Cd, Cu, Fe, Mn, Mo, Zn, Pb, Pesticides and pollution, classification and degradation of pesticides, methods of pesticides analysis.

c) Noise Pollution Sources, measurement, effects and control.

d) **Water Pollution:** Sampling and preservation of water, physical examination of water-colour, alkalinity, TDS, conductivity, temperature, odour, turbidity, hardness, chemical examination of water-determination of carbonates and bicarbonates, sulphate, chloride and flouride, nitrite and nitrate, iron, manganese, silica, cadmium, arsenic, chromium, lead, mercury, biological examination of water-dissolved oxygen, BOD, COD, MPN. Organic pollutant analysis-phenols and detergents.

Unit II:

a) Water treatment Quality of water, standards of raw and treated water, objectives of waste water treatment, A brief idea of sedimentation, coagulation and flocculation, filtration, disinfection of water, activated sludge process, trickling filters, sludge treatment and disposal.

b) Softening of water, corrosion and its control, removal of nitrogen and phosphorus.

Removal of toxic compounds and refractory organics, removal of dissolved inorganic substances,

Reverse osmosis. Advance Water Treatment of Industrial Waste - I Aeration, air stripping of volatile organics (VOC), biological oxidation - removal of organics
(sorption, stripping, biodegradation), nitrification and de-nitrification.

c) Advance Water Treatment of Industrial Waste - I Lagoons and stabilization basins, membrane processes, trickling filtration, adsorption, ion exchange, chemical oxidation, sludge dewatering and disposal.

Unit-III:

a) Waste Water Reuse and Recovery Treatment, disposal, reuse and recovery of trade waste from (1) Textile Manufacture (2) Distilleries (3) Sugar (4) Paper and Pulp mills (4) Tanneries (5) Food Processing industries (6) Fertilizer Industry.

b) An Introduction to Source, Characteristics and Treatment of Industrial Waste Undesirable waste characteristics, sources and characteristics of waste water, industrial waste
survey, waste characteristics - estimation of organic content, water reuse and in-plant waste control, idea of different technologies for the treatment of industrial waste water and the basis for the selection of treatment technology.

c) Treatment of Industrial Wastes Different steps in the treatment of industrial waste (equalization, neutralization, sedimentation, oil separation, flotation, coagulation), sources and removal of heavy metals e.g. As, Ba, Cd, Cu, F, Fe, Rb, Mn, Hg, Ni, Se, Ag & Zn).

d) **Radioactive Pollution:** Radioactive pollution their effect on environment and process of radioactive waste.

Unit IV:

a) Environmental Toxicology (A) Toxicology and Pharmacokinetics: One-Compartment Model, Two-Compartment Model, Applications to Toxicology Testing , Toxic effects and dose response relationship a brief idea of carcinogens and non-carcinogens, Biotransformation, Biomarker, Xenobiotics, Toxicity due to Hydrocarbons and pesticides . (B) Impact of Toxic Chemical on Enzymes: Biochemical effects of arsenic, cadmium, lead,
mercury, carbon monoxide, cyanide

b) Biomass Energy Resources Biomass energy resources, resources of conversion of biomass into useful energy, raw biomass material for conversion to biogas, biogas generator (factors affecting biodegradation or generation of gas) significance of biogas plants in India's energy strategy, biogas plants, fuel properties and utilization of biogas, biomass as source of energy.

c) Other Energy Sources and Pollution Control (A) Chemical Energy Sources: Fuel cells, principle of operation of a fuel cell (also theory), classification and types of fuel cells, advantages and

disadvantages of fuel cells, conversion efficiencyof fuel cells, applications of fuel cells. (B) Pollution Control of Major Pollutants: Pollution from use of energy: combustion products of fossil fuels, methods of controls of major pollutants - SOx [Flue gas desulphurization (FGD) systems], removal of NOx from flue gas (De-NOx system).

Unit V:

a) Mineral Resources and Environmental Hazards (A) Types of mineral deposits, mineral and rock resources, new methods in mineral exploration, marine mineral resources, conservation of mineral resources, impacts of mining activities. (B) Hydrological hazards: Floods and drought Atmospheric hazards: Severe storms, temperature extreme and wildfires Technological hazards: Bhopal Gas Tragedy and Chernobyl Seismic hazards: Earthquake and volcanoes.

b) **Environmental and Industrial law:** The Environmental Protection Act1986, Powers of the Central Government, Parallel Provisions with the water and the Air act, The Public Liability Insurance Act 1991, Important rules & notification under the Environment Protection Act 1986.Constitution of Central and State Pollution Control Boards, Power, Function and responsibility of Central and State Boards (Objectives, Area of jurisdiction, responsibility of an industry, power and function of state and central Government, Cognizance of offence, Penalties and Punishment), Biomedical waste (Handling and Disposal) rules 1998.

c) Recycled plastic manufacture and usage rules 1999, Municipal Solid Waste (Management and Handling) Rules 2000, The Noise Pollution (Regulation and Control) Rules 2000, Environmental Impact Assessment Notification 2006, e-wastes Management and Handling Rules 2011. Environment Protection Rule 2015,2016, 2018, 2020.

Reference books:

1. G.W. Vanloon, S.J. Duffer, Environmental Chemistry - A Global Perspective, Oxford University Press (2000).
2. F.W. Fifield and W.P.J. Hairens, Environmental Analytical Chemistry, 2nd Edition (2000), Black Well Science Ltd.
3. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York (1995).
4. A.K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd.,New Delhi.
5. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York.
6. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi.

7. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.
8. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 3rd ed. Prentice Hall of India Pvt.Ltd.(1998)
9. C.S.Rao, Environmental Pollution Control Engineering, 3rd ed., Wiley Eastern Ltd.New Age International Pvt.Ltd. (1995).
10. Metcalf & Eddy, Waste Water Engineering, Tata McGraw Hill, New Delhi (2003).
11. C.Harold Wright, A Hand book of Soil Analysis, 4th ed., Logas press New Delhi –
12. Thomous S. Spiro and William M. Stiglicini, Chemistry of the Environment, Prentice Hall of India Pvt. Ltd. (2002).
13. Nicholas P. Cherimisinoff, Biotechnology for Waste and wastewater treatment, Prentice Hall of India Pvt. Ltd. (2001).
14. Jarry A. Nathanson, Basic Environmental Technology, 4th ed., Prentice Hall of India Pvt. Ltd. (2003).
15. Raymond W. Miller and Roy L. Donalvee, Soil in Our Environment, 7th ed, Prentice Hall of India Pvt. Ltd. (1997). Nylie C. Brady, The Nature and Properties of Soil, 10th ed., Prentice
16. Hall of India Pvt. Ltd. (1996).
17. Carla W. Montgomery, Environmental Geology, 5th ed., Mc Graw Hill Higher Education (2000).
18. G.D.Rai, Non Conventional Energy Sources, 4th ed., Khanna Publication (1996).
19. S.A. Abbasi, Renewable Energy Sources and Their Environmental Impact, 1st ed. Ashok K. Ghosh, Prentice Hall of India (2001).
20. H.P. Garg and J.Prakash, Solar Energy Fundamentals and Applications, Tata Mc Graw Hill (1992).
21. S.P. Sukhantine, Solar Energy: Principles of Thermal Collection and Storage, 2nd ed., Tata Mc Graw Hill (1992).
22. S.Rao and B. Prulaker, Energy Technology, 1st ed., Khanna Publications (1996).

MCHM402A

GREEN AND NANO CHEMISTRY

OBJECTIVES OF COURSE LEARNING

To get an understanding of the fundamental concepts of green chemistry and nanoscience, physical and chemical processes of nanomaterial preparation, biologically synthesis of nanomaterials, nanocomposites, nanotechnology danger and safety. Also, an understanding of the relation between green and nano chemistry.

COURSE OUTCOME:

1. Students will learn a variety of green chemical strategies based on current demands.
2. To gain a better understanding of the current state and evolution of the environment.
3. To have a better understanding of pollution and the steps that can be taken to prevent it familiarise yourself with green chemistry
4. To gain a better understanding of bio-catalytic reactions.
5. To investigate the fundamental notion of nanomaterials
6. To understand how nanoparticles are classified
7. To familiarize oneself with the physical and chemical approach for production of nanomaterials
8. To gain a better understanding of nanomaterial biosynthesis
9. To gain knowledge on nanocomposite materials
10. To investigate the dangers of nanotechnology with better understanding of nanotechnology's safety.

Unit I:

a) **Basic Concepts of Green Chemistry:** Definition of green chemistry, need of green chemistry and eco-efficiency, Environmental protection laws, challenges and green chemistry education, pollution control and pollution prevention-Principle of green chemistry.

b) **Green Reagent:** Dimethylcarbonate, polymer supported reagent, polymer supported peracids, poly, ericthioanisolyl resin. Poly-N-bromosuccinimide (PNBS), sulfonazide polymer, polystyrene wittig reagent & polymer supported peptide coupling agent.

c) **Green Catalyst:** Acid catalyst, oxidation catalyst, basic catalyst, polymer supported catalyst, polystyrene– aluminium chloride, polymer supported photosensitizers, miscellaneous illustration & solid support reagents.Heterogeneous catalysis: use of zeolites, silica, alumina, clay, polymers,

cyclodextrin and supported catalysts. Bio-catalysis: enzymes, microbes etc Phase-transfer catalysis: micellar/surfactant etc.

d) **Green Analytical Methods:** Future trends in Green Chemistry - Green analytical methods, Redox reagents, Green catalysts; Green nano-synthesis, Green polymer chemistry, Exploring nature, Biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control

Unit II:

a) **Designing Green Synthesis**: Designing Green Synthesis- choice of starting materials, choice of reagents, choice of catalysts-biocatalysts, polymer supported catalysts, choice of solvents.

b) Chemicals and Consumables- Grade, Labelling, Preparation, Manipulation, Containers Storage, Safety, Disposal- Laboratories Accidents and first aid- Safety Legislations in India.

c) **Green Chemical and Physical of Nanoparticles:** Green Chemical and Physical of Nanoparticles – Physical synthesis of nanoparticles – Inert gas condensation - aerosol method - Arc discharge - laser ablation - Gas-phase synthesis – Chemical Synthesis of nanoparticles – precipitation and co-precipitation method, sol-gel method, solvothermal and hydrothermal method, chemical vapour synthesis.

d) **Bio-inspired Green Nanomaterials:**Bio-inspired Green Nanomaterials – microbial synthesis of nanoparticles – Biosynthesis of Nanoparticles by bacteria and Fungi – Biosynthesis of nanoparticles using plant extracts – Advantage of biosynthesis.

Unit III

a) **Introduction Nano Science:**Introduction, definition History scope and perspectives of nanoparticles and nanomaterials, emergence of nanotechnology, Challenges of nanotechnology. Nanotechnology in relation to other branches of science. Basic concepts of Nanoscience and Nanotechnology – Bottom-up approach and Top-down approaches with examples – Synthesis of Nanomaterials – Classification of Nanomaterials – Properties and Application of Nanomaterials.

b) **Structure of solids:** crystalline and non-crystalline. Types of common materials and advanced materials inorganic, organic, biological. Types of nanomaterials depending upon theirproperties.

c) Synthesis and Stabilization of Nanoparticles, Chemical Reduction; Reactions in Micelles, Emulsions, and Dendrimers; Photochemical and Radiation Chemical Reduction; Cryochemical Synthesis:Physical Methods, Particles of Various Shapes and Films.

Unit IV:

a) **Size Effects in Nano-chemistry:** Models of Reactions of Metal Atoms in Matrices; Properties;

Kinetic Peculiarities of Chemical Processes on the surface of Nanoparticles; Thermodynamic Features of Nanoparticles.

b) **Characterization Methods:** X-ray diffraction, Debye-Scherer formula, dislocation density, micro strain, Synchrotron Radiation, Principle and Applications, Raman Spectroscopy and its Applications, Dynamic Light Scattering (DLS). Electron microscopes: scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS, Probe Microscopy, Neutron diffraction, Working Principle, Instrumentation and Applications. Differential scanning calorimeter (DSC), Thermogravimetric/Differential Thermal Analyzer (TG/DTA), UV – Visible Spectrophotometer, FTIR, Principle and Applications MiscellaneousTechniques, Comparison of Spectral Techniques Used for Elemental Analysis.

Unit V:

a) **Risks and safe nanotechnology :**Risks and safe nanotechnology: Nano-objects – exposure routes to nano-objects – effects seen in animal studies – observations from epidemiological studies – hypothesis from animal and epidemiological studies – fire and explosion risk – risk of catalytic reactions – workplace exposures – sampling strategy.

b) **Application of Nano Chemistry:** Nanobiology, Introduction, Bio-inspired nanomaterials, Interaction between Biomolecules and Nanoparticle Surfaces, Different Types of Inorganic Materials used for the Synthesis of Hybrid Nano-bio Assemblies, Applications of Nano in Biology, Nanoprobes for Analytical Applications, Current Status of Nanobiotechnology, Future Perspectives of Nanobiology; Nanosensors, Electrochemical, Nanobiosensors, Smart Dust; Nanomedicines, Nanodrug Administration Diagnostic and Thenrapeutic Applications

c) Environmental issue; toxicity, biosafety and ethical issue in application of Nanoparticle.

Reference Books:

1. Anastas& Warner, Green Chemistry: Theory & Practice,Oxford Univ. Press,New York,1998.
2. Douglas A. Skoog et al "Instrumental Analysis" Cengage Learning, edition 2007.
3. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015)
4. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
5. P.T. Anastes& J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).
6. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).
7. Biomaterials, S. V. Bhat, 2nd edition, Narasa Publishing house, New Delhi, 2005.
8. Nanotechnology Fundamentals and applications, M. Karkare, I. K. international publishing house pvt. Ltd., Bangalore, 2008.
9. Nanomaterials: Synthesis, properties and applications, A. S. Edelstein, T. C. Cammarata, Inst. Of. Physics, UK, 1966.
10. Springer Handbook of Nanotechnology, B. Bhusan, 3rd edition, Springer-Verlag, 2009.
11. Chemistry of Nanomaterials: Synthesis, Properties and Applications, CNR Rao and T. Cheetham, Wiley & Sons, 2005.
12. Nanoparticles: From Theory to Application Edited by Gu¨nter Schmid, @ 2004 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
13. Nanoparticles and Catalysis Edited by Didier Astruc @ 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim
14. Peter Atkins, Tina Overton, Jonathan Rourke, Mark Weller, Fraser Armstrong, Mike Hagerman Shriver and Atkin's Inorganic Chemistry, Fifth Edition, Oxford, 2010.
15. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
16. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
17. Nano:The Essentials: Understanding Nanoscience and Nanotecnology, T.Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

MCHM402B

Photo Chemistry

Unit-I

Basis of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states life times-measurements of the times. Energy dissipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages- primary and secondary processes.

Properties of Excited States: Structure (geometry), dipole moment, Photochemical kinetics-calculation of rates of radiative processes.Bimolecular deactivation- quenching.

Unit-II

Excited State of Metal Complexes: Excited State of Metal Complexes: comparison with organic compounds, electronically excited states of metal complexes, charge-transfer spectra, charge transfer excitations.

Ligand Field Photochemistry: Photo substitution, photo oxidation and photo reduction, lability, and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states.

Unit-III

Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction and strong interaction-exciplex and Excimer formation; excited electron transfer, metal complexes as attractive candidates (2,2$^{'}$-bipyridine and 1,10-phenthroline complexes), illustration of reducing and oxidizing character of Ruthenium^{2+}(bipyridal complexes), Application of redox processes of electronically excited states for catalytic purposes, chemical energy into light (Chemiluminescence).

Metal Complexes Sensitizers: Metal complex sensitizer, water photolysis, and nitrogen fixation and carbon dioxide reduction.

Photonuclear Reactions:-High energy Photon sources, Types of photonuclear reactions, special features of photonuclear reactions.

Unit-IV

Photochemistry of alkene

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

Photochemistry of Carbonyl Compounds: Isomerisations, Additions and Substitutions

Unit-V

Photochemistry of Carbonyl Compounds

Norrish Type I and II process, Intramolecular reactions of carbonyl compounds –saturated ,cyclic and acyclic β,γ- unsaturated and α,β unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions- dimerisations and oxetane formation

Miscellaneous Photochemical Reactions

Photo-Fries of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reaction. Photochemical formation of smog. Photodegration of polumers. Photochemistry of vision.

Photoaddition of aromatic Compounds, Photochemical aromatic substitution.

Reference:

Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.

Inorganic Photochemistry, J. Chem. Educ., vol. 60, no. 10, 1983.

Progress in Inorganic Chemistry, vol. 30, ed. S.J. Lippard, Wiley.

Coordination Chem. Revs., 1981, vol. 39, 121, 131; 1975, 15, 321; 1990, 97, 313.

Photochemistry of Coordination Compounds, V. Balzari and V. Carassiti, Academic Press.

Elements of Inorganic Photochemistry, G. J. Ferraudi, Wiley.

Books Suggested

A Gilbert and J Baggott, Essentials of Molecular Photochemistry, Blackwell Scientific Publication.

J Coxon and B. Holtom, Organic Photochemistry, CambriDGE University Press.

C H Dupuoy and O L Chapman Molecular Reactions and Photochemistry, Prentice Hall

Photo chemistry chemistry , Alka L Gupta.

MCHM402C

INDUSTRIAL AND FUEL CHEMISTRY

Course Objective: To acquire knowledge of different methods of biofuel production, Fuel chemistry application, and their advantages,student should be able to learn Waste water treatment and industrial applications.

UNIT-I

Fuels. Fossil fuels- classification and unique features- Coal, Petroleum, natural gas. Biofuels: Biomass- biodiesel. Nuclear fuels: for various types of nuclear reactors. Hydrogen as fuel in the future, Hydrogen storage materials. Fuel cells – basic principle.

Fuel Chemistry **Review of energy sources** (renewable and non-renewable). Classification of fuels and their calorific value.

(a) Coal: Uses of coal (fuel and non fuel) in various industries, its composition, carbonization of coal.Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro Gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

UNIT II

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum

Gaseous fuels: Natural gas and gobar gas: production, composition and uses., Gobar electric cell. non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels

Modern Fuel: Electrofuel, Solar Fuel, Renewable Fuel, Syngas and IRENA.

UNIT-III : Cosmetics and Perfumes

Introduction to cosmetics and perfumes, preparation and uses of the following: Hair dye, hair spray.
Shampoo. Sun-tan lotions, face powder, lipsticks. talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours.
Essential oils and their importance in cosmetic industries with reference to Eugenol. Geraniol, Sandalwood oil, Eucalyptus, Rose oil,Jasmone, Civetone, Muscone

UNIT IV

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Oils and Fats Classification of oils, fat splitting, distillation of completely miscible and nonmiscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

UNIT-V: Industrial Applications

Sugar industry, Glass, Cement, Dyes, Paints, Special paints, Refractories, Abrasives, Plastics, Perfumes and flavoring industries, Fermentation industries, Explosives, Pulp and paper industries, Rubber industries, Pharmaceutical industries, Food and food products industries, Ceramic industries.

Food additives: A general study of food flavours, colours and preservatives, artificial sweeteners

Food Quality and safety standard in FMCG, health and safety standard in Chemical and fuel industries.

Course outcomes:

By the end of the course, the students will be able to:

1. Have sound knowledge of cosmetics and perfumes.
2. Become well equipped to design, carry out, record and analyze the industrial preparations
3. Understand the ethical, historic, philosophical, and environmental dimensions of problems and issues facing industrial chemists.
4. Become skilled in problem solving, critical thinking and analytical reasoning.
5. Identify and solve chemical problems and explore new innovative areas of research.

Text/References books:-

1. Chemical Process Industries – Norrish Shreve, R. and Joseph A. Brink Jr. McGraw Hill, Industrial Book Company, London.
2. Production and Properties of Industrial Chemicals – Brain A. C. S. Reinhold – New York.
3. Petroleum Products Hand Book. Guthrie V., McGraw Hill, Tokyo.
4. Industrial Chemistry (Including Chemical Engineering) – B. K. Sharma (10th Edition)

5. Outlines of Chemical Technology – For the 21st Century – M. Gopala Rao & MatshallSittig (3rd Edition)

6. Source Book on Atomic Energy by S. Glasstone

7. Vermani, O. P.; Narula, A. K. (2004), Industrial Chemistry, Galgotia Publications Pvt. Ltd., New
8. Delhi.
9. Bhatia, S. C. (2004), Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi.
10. Jain, P. C.; Jain, M. (2013), Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
11. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), Engineering Chemistry, Vikas Publications.
12. Sharma, B. K. (1997), Engineering Chemistry, Goel Publishing House, Meerut

Facilitating the Achievement of Course learning Outcomes

UNIT NO.	Course learning outcome	Teaching and learning Activity	Assessment Task
I	Know about fuels, composition, carbonization of coal, gasification, liquefaction, and coal tar based chemicals and layout for key processes in oil refining.	Video Lecture & presentation.video links related with topics.	Evaluation of students on the basis of Quiz & Assignment.
II	Understand the role of petroleum and petrochemical industry, composition, applications, process-cracking. Increasing demand of non-petroleum fuels, synthetic fuels. Petrochemical.	Video Lecture & presentation,practicals Video links.	Evaluation of students on the basis of class test I.
III	Knowledge of Cosmetics and perfumes its preparation & uses.	Lecture & presentation,Case study	Evaluation of students on the basis of power point presentation given by students.
IV	Know types of oils, fat	Lecture & presentation.research	Evaluation of students on the basis

	splitting, familiarized with rancidity, saponification value, iodine number, Superiority of synthetic detergent and role of Surfactants.	paper related with topics.	of class seminar.
V	Know merits and demerits of synthetic and natural colouring, flavouring and sweetening agents as food additives & industrial applications.	Lecture ,presentation,Expert talks,	Evaluation of students on the basis of class test II.

MCHM401P

ENVIRONMENTAL CHEMISTRY PRACTICAL

OBJECTIVES OF COURSE LEARNING

The course's goal is to teach students about the chemical composition of several environmental matrices (air, water, and soil) as well as the interactions that occur between them.

COURSE OUTCOME:

1. Demonstrate a thorough understanding of the chemical and biological principles that govern key environmental processes in air, water, and soil.
2. Recognize many types of harmful compounds and responses, as well as toxicological data.
3. Analyze chemical processes involved in many environmental challenges using basic chemical ideas (air, water & soil).
4. Describe the methods of water purification and waste treatment, as well as the chemistry involved.
5. Describe the sources and impacts of energy industry pollution, as well as potential mitigating techniques.
6. Describe the energy dilemma and several facets of sustainability.
7. Based on the knowledge learned throughout the course, discuss local and worldwide environmental challenges.

A: Titration:

1. Neutralization titration:

   (a) Determination of Acidity. **(b)** Determination of free carbon dioxide. **(c)** Determination of alkalinity.
2. Complexometric titration:

   (a) Determination of temporary and permanent hardness. **(b)** Determination of total, calcium and magnesium hardness.
3. Precipitation titration:

   (a) Determination of chloride.
4. Redox titration:

   (a) Determination of ferrous iron. **(b)** Determination of copper.
5. Physio-chemical analysis of water:

(a) Determination of total dissolved and suspended solids, **(b)** Determination of residual chlorine, **(c)** Determination of chlorine demand, **(d)** Determination of bicarbonate and carbonate alkalinity, **(e)** Find out the concentration of sulphite.

6. Measurement of organic pollutant in the water:

   (a) Determination of Dissolved Oxygen (DO), **(b)** Determination of Biological Oxygen Demand (BOD), **(c)** Determination of Chemical Oxygen Demand (COD).

B: SPECTRAL METHODS:

1. Spectrophotometric/ Colorimetric determination:

   (a) Determination of nickel. **(b)** Determination of hexavalent chromium.

2. Conductometric determination:

   (a) Determination of strength of acid against standard alkali. **(b)** Find out the strength of mixture of acids in an unknown mixture.

3. pH metric determination:

   (a) Determination of strength of acid against standard alkali. **(b)** Find out the strength of mixture of acids in an unknown mixture.

4. Chromatographic determination: Identification of a sample compound and its separation from a binary mixture by:

   (i) Paper chromatography **(ii)** Thin layer chromatography and **(iii)** Electrophoresis.

5. Spectrophotometric/ Colorimetric determination (a)Determination of nitrite. (b) Determination of phosphate. (c) Determination of sulphide.

C: SEPARATION TECHNIQUES

1. Determination of the distribution coefficient of iodine between CCl_4 and water.
2. Conductometric determination

   (a) Determination of strength of alkali against standard acid, **(b)** Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

3. pH metric determination:

   (a) Determination of strength of alkali against standard acid, **(b)** Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

4. Determination of oil and grease in water sample by gravimetric method.
5. Determination of sulphate by Turbidometric method.
6. Determination of adsorption isotherm of acetic acid from aqueous solution by using activated charcoal.

Reference Books:

1. TF Yen, *Environmental Chemistry: Essentials of Chemistry for Engineering Practice*.
2. TG Sprio, WM Stigliani, *Chemistry of the Environment*, 1996. Small little book gives an overview of selected topics.
3. DG Crosby, *Environmental Toxicology and Chemistry*.
4. John. R. Dyer, Applications of Absorption Spectroscopy of Organic compounds,9th ed.. Prentice Hall of India Pvt. Ltd. (1994).
5. Dudley H.Williams and Ian Fleming, Spectroscopic Methods in Organic Chemistry, 4th ed., Tata Mc-Graw Hill Book Company (1998).
6. R.M. Silverstein, G.ClaytonBassler and Terence C. Morrill, Spectroscopic Identification of Organic compounds, 6th ed, John Wiley & Sons (1998).
7. D.A. Skoog, F.J. Holler and Nieman, Principles of Instrumental Methods, 5th ed.,Thomson Asia Pvt. Ltd., Singapore (2003). 5
8. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd. (1993).
9. G.D. Christian., Analytical Chemistry, 6th ed, John Wiley & Sons (2000)
10. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Longman Singapore (1999)
11. Jagmohan, Organic Spectroscopy-Principles and applications, 2nd ed, Narosa Publishing House, New Delhi 9. C.S. Rao, Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Age International Ltd., (1995).

MCHM402A(P)

GREEN AND NANO CHEMISTRY PRACTICAL

OBJECTIVES OF COURSE LEARNING

To learn how to make zinc oxide from plant extracts, nitrobenzene nitration, aniline acetylation, silver nanoparticles, environmentally friendly pesticides, activated carbon from agricultural wastes, and Schiff base utilising microwave techniques.

COURSE OUTCOME:

1. To have a better understanding of green synthesis techniques.
2. By plant exact, to investigate the production of zinc oxide utilising the solution combustion method.
3. To comprehend the nitrobenzene nitration.
4. To learn about aniline acetylation/propionelation utilising water as an environmentally acceptable solvent.
5. To learn more about silver nanoparticles using a green synthesis method.
6. To learn how to make environmentally friendly pesticides.
7. Agriculture waste is used to make activated carbon.
8. The microwave approach was used to prepare the Schiff base.

PRACTICALS:

1. Synthesis of zinc oxide by solution combustion method using plant exact.
2. Nitration of nitrobenzene
3. Acetylatation/ Propionelation of aniline using water as eco-friendly solvent.
4. To determine silver nanoparticles by green synthesis.
5. Preparation of Eco-friendly pesticides.
6. Synthesis of activated carbon from agriculture waste.
7. Preparation of Schiff base by microwave technique.
8. To determine breakthrough volume of per gram of the resin for the given water sample.
9. To determine the total organic content of the given water sample.
10. Synthesis of TiO2 nano particles by sonochemical method.
11. Synthesis of ZnO nano particles by sonochemical method
12. Synthesis of CdS nano particles by sonochemical method 4. Synthesis of SrTiO3 nano particles by sonochemical method
13. Biogenesis of Iron nano-particles –for development of Microbial Emulsion.
14. Characterization of nanoparticles by XRD, SEM, TEM, TG-DTA
15. Photocatalytic degradation of hazardous compounds by UV irradiation
16. Photocatalytic degradation of hazardous compounds by VIS irradiation
17. Photocatalytic degradation of hazardous compounds by IR irradiation
18. Photocatalytic degradation of hazardous compounds by solar rays.

19. X-ray diffraction – determination of structure, composition and estimation of particle size,
20. Nanomicrobial degradation of various xenobiotics (e.g. pesticides, organochlorines, pyretheroids, PAH).
21. Immobilization bacterial cells for bioremediation of heavy metals using micronano-filtration process.
22. Development of Bionano-sensor
23. Carbon nanotubes and carbon nanoparticles: Preparation of carbon nanotubes by pyrolysis of organic gases/Pyrolytic thermal treatment of graphite followed by annealing.

REFERENCE BOOKS:

1. Green Processes for Nanotechnology: From Inorganic to Bioinspired Nanomaterials, Vladimir A. Basiuk, Elena V. Basiuk Springer (2015).
2. Green Chemistry for Sustanable future in ‘‘Fundamentals of Environmental Chemistry ’’ Stanley F. Manahan (Ed). Lewis Publishers.
3. Nanotechnology: Importance and Application by M.H. Fulekar, IK International, 2010.
4. Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh .CRC press, 2007.
5. Nanosystem characterization tools in the life sciences by Challa Kumar. Wiley-VCH, 2006.
6. Environanotechnology by Mao Hong fan, Chin-pao Huang, Alan E Bland, Z Honglin Wang, Rachid Sliman, Ian Wright. Elsevier, 2010.
7. Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

MCHM402B(P)

Photo Chemistry Lab

Course Objective: To provide training on different analytical techniques for chemical analysis.

1. Preparation of Potassium tri-oxalato ferrate (III) K3[Fe(C2O4)3.3H2O].
2. To estimate the amount of Zinc using EDTA volumetrically.
3. Estimation of copper cupraammonium sulphate by colorimetric methods
4. To estimate amount of using 1,10- phenanathroline by colorimetric methods
5. Preparation of Cis and Trans potassium oxalate diaquachromate(III) K[Cr(C2O4)(H2O)2].2H2O
6. Preparation of ZnO photocatalyst for rapid photocatalytic degradation.

Course Outcome: The students will acquire knowledge of development of experimental skills on conductivity meter, potentiometer, pH meter and voltammeter for different applications.

Reference Books :

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

MCHM402C(P)

INDUSTRIAL & FUEL CHEMISTRY-LAB

Course objective:-

After studying this course, student shall be able to understand the different aspects of industrial processes of fossil fuels, petrochemicals and industrial applications in detail.

List of Experiments:-

1. Test Methods for Petroleum products
2. To prepare biodiesel from vegetable oil
3. To determination of Calorific value of a given fuel.
4. To determine pore point and cloud point of fuel.
5. To determine free fatty acid content in given sample.
6. Extraction of essential oils from flowers and fruits by soxhlet extraction method.
7. Extraction of natural coloring and flavoring agent from flowers and fruits.
8. Determination of iodine value of the oils/ fats.
9. Determination of saponification value of the oils/ fats.
10. Determination of acid value of the oils/ fats.
11. Testing of turmeric powder, milk and mustard oil for adulterants.
12. Estimation of glucose in food samples.

Course Outcomes:-

1. By the end of the course, the students will be able to:
2. Know about fuels, composition, carbonization of coal, gasification, liquefaction, and coal tar based chemicals and layout for key processes in oil refining.
3. Understand the role of petroleum and petrochemical industry, composition, applications.
4. process-cracking. Increasing demand of non-petroleum fuels, synthetic fuels. Petrochemical.
5. Understand different fossil fuel products and processes, types of lubricants their property based on viscosity index, cloud point, pore point and applications of lubricant in Industry.
6. Know types of oils, fat splitting, familiarized with rancidity, saponification value iodine number,
7. Know merits and demerits of synthetic and natural colouring, flavouring and sweetening agents.

Text/References books:-

1. Vermani, O. P.; Narula, A. K. (2004), Industrial Chemistry, Galgotia Publications Pvt. Ltd., New Delhi.
2. Bhatia, S. C. (2004), Chemical Process Industries, Vol. I & II, CBS Publishers, New Delhi.
3. Jain, P. C.; Jain, M. (2013), Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
4. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), Engineering Chemistry, Vikas Publications.
5. Sharma, B. K. (1997), Engineering Chemistry, Goel Publishing House, Meerut