School of Sciences

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M.Sc. Chemistry

Prog. Code: 0902CH

(Two year Full Time Post Graduate Course)

Semester Pattern

GENERAL INTRODUCTION OF THE DEPARTMENT

MATS School of Sciences (MSS) was established with a vision to create technocrats in the applied branches of Biological and Chemical Sciences to convey updated scientific knowledge. In the school the performances of the students are constantly monitored by continuous assessment. The School believes in supplementing academic input of students with the help of regular Seminar, Guest Lectures, Industrial/Research Institute visits and encouraging the students to participate in National & International Seminars, Conferences and Workshops.

DEPARTMENT HIGHLIGHTS

- Research focus on frontier of Life Sciences and affordable healthcare
- Highly acclaimed scientists as faculty
- State-of-the-art Lab facilities
- Hand-on training on sophisticated equipments
- Academia – Industry interface
- Multidisciplinary research in affordable healthcare, Agriculture and Food

COURSEDESIGN

The department follows a unique course-design which is contemporary and cutting-edge. It includes modern and advanced papers/ subjects including the papers from Basic Science as given in the curriculum matrix

PEDAGOGY

- Chalk Board, LCD and Projector based teaching
- Research based teaching
- Project based learning
- Separate lab bench for each student

FACILITIES

State-of-the-art facilities include:

Double beam UV- Visible Spectrophotometer, Cooling Centrifuge, Microfuge, Incubators, Microscopes, Laminar flow hoods, Colorimeter, Micro- and regular balance, Electronic Balance Autoclave, Glass distillation apparatus, Computers, Deep freeze, DNA/RNA & Protein Electrophoresis apparatus, Plant Tissue Culture racks with light arrangements, Shakers, BOD incubator & Orbital Shaking Incubator etc

FACULTIES

- Well experienced faculties from Academic Institutes and Industries
- Invited lectures by eminent scientists from different countries

M. Sc. CHEMISTRY: SCOPE AND CONTENT

Chemistry is the Industry & research-oriented science including Inorganic, Organic, Physical, & Analytical Chemistry and Chemical technology. This study includes a large variety of subjects including Inorgaic, Organic, Physical Chemistry, Spectroscopy, Spectroscopy application, Group theory & computer for chemist, Organotrasition Metal chemistry, Biochemistry & Natural Products, Polymer Nuclear & Solid State Chemistry, Medicinal Chemistry, Photochemistry, Environmental & Analytical chemistry and dissertation etc. Chemistry features the use of chemicals in the industrial process. Chemistry can be applied in developing various Drugs & Medicines, Dyes, Paints, Plastics, Waste treatments, improving energy production and increasing productivity.

OBJECTIVES OF THE PROGRAM:

1. To impart basic knowledge and skills of various aspects of Chemistry.
2. To train the students for industrial need and to pursue further education
3. To inculcate entrepreneurship among the students so as to start their own ventures in the field of Chemistry.
4. To develop human resource and entrepreneurs in Chemistry with the ability to independently start their own ventures or small chemical units in the field of Chemistry and Biochemistry.
5. To understand modern Chemistry - practices and approaches with an emphasis in technology application in pharmaceutical, medical, industrial, environmental and agricultural areas.
6. To become familiar with public policy, biosafety, and intellectual property rights issues related to Chemistry applications nationally and global
7. To Gain experience with standard Chemistry tools and approaches.
8. To develop skills in international teamwork and research collaboration.

ELIGIBILITY FOR ADMISSION:

Interested aspirants for M.Sc. Chemistry degree need to fulfill the below mentioned minimum eligibility criteria.

- Completion of UG (10+2+3) level of education.
- Chemistry as one of the subjects at UG level

Instead of Chemistry, one may even have had any subject related to Chemical sciences as one of the main subject of study.

PROGRAM OUTCOME:

1. Post graduates will be able to apply knowledge, concepts to solve issues related to their course.
2. Post graduates will have ability to identify problems related to their subjects.
3. Post graduates will have ability to analyze and derive valid conclusions with fundamental knowledge in their respective subjects.
4. Post graduates upon the needs of environment and society, will be able to fulfill the same in the form of solutions within the safety limit of prevalent rules and guidelines.
5. Post graduates will have ability to design, conduct experiments, analyze and interpret data for investigating problems in their respective fields.
6. Post graduates will have ability to select and apply appropriate tools and techniques.
7. Post graduates will have knowledge for assessing societal, health, safety and legal aspects and the duties as responsible citizen of country.
8. Post graduates will have the knowledge for the need of sustainable development.
9. Post graduates will have the knowledge of ethics and regulatory norms of their respective course.
10. Post graduates will have oral, written communications skill along with team spirit.

PROGRAM SPECIFIC OUTCOMES:

1. Application of knowledge and techniques of basic sciences related to chemical sciences.
2. Scale up of chemical process after designing, optimization and analysis for developing products required for society.
3. Tabulation and interpretation of chemical data using computer software.

CAREER PROSPECTS:

The Chemical Industry is constantly growing and in the past 10 years, human resources in the field have grown drastically. Today, Indian Chemical sector comprises of lot many companies and Chemical suppliers, generating ample amounts of revenues. Indian Chemical industry comprises of Research, New drug discovery, Chemoinformatics, R&D, Pharmaceuticals etc. Chemical industry has rapid growth rate per annum. As there is increasing popularity and explosive growth, there are plenty of opportunities available in Chemistry field. One can be a Research Scientist, Teacher, Marketing manager, Science Writer, Chemoinformatician, Quality Control Officer or Production in-charge in the Food, Chemical and Pharmaceutical industry, Analyst, Environmental / Safety Specialist .

THE MAIN JOB SECTORS ARE AS FOLLOWS:

Chemical companies, Health service organizations, Pharmaceutical companies, Universities and research institutes, Horticultural industries, Conservation organizations, Food and drink manufacturers, Water industry, Agricultural industry, Law Enforcement.

ATTENDANCE:

A candidate shall be deemed to have undergone a regular course of study in the University, if he/she has attended at least 60% of the lectures in each subject will be at least 75% in the aggregate of lectures, tutorials and practical in order to be eligible to appear at the Final Examination.

SCHEME OF EXAMINATION, EVALUATION AND DISTRIBUTION OF MARKS:

1 The overall weightage of a course in the Syllabi and Scheme of Teaching & Examination shall be determined in terms of Marks assigned to the course.

2 The evaluation of students in a course shall have two components unless specifically stated otherwise in the Scheme of Teaching & Examination and Syllabi:

(i) Evaluation through a semester-end examination (University Examination Marks)

(ii) Continuous evaluation by the teacher(s) of the course.

3 Continuous Evaluation (Internal Marks)

i) Theory courses

The division of internal marks will of 50% marks for mid semester examination and 50% of marks for the internal class tests. There shall be three class tests held during each semester. The three class tests shall ordinarily be held after 4 weeks, 8 weeks and 12 weeks of teaching in accordance with the University Academic Calendar.

(ii) Practical/Laboratory courses

The total internal marks in practical /Laboratory courses shall be based on performance in the laboratory, regularity, practical exercises /assignments, quizzes, etc. The assessment shall be given at three nearly equi-spaced intervals.

Evaluation through a semester-end examination

The distribution of weightage for various components of evaluation shall be as given below:

		Bachelor's degree/ Under-graduate diploma	Master's degree/ Post-graduate diploma
A.	THEORY COURSES		
	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%
B.	PRACTICAL/LABORATORY COURSES		
	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%

C.	DISSERTATION/THESIS			
	(i)	Assessment by External Examiner	70%	70%
	(ii)	Assessment by Internal Examiner	30%	30%

PASSING MARKS:

For undergraduate students, obtaining a minimum of 40% marks in aggregate in each course shall be essential for passing the course and earning its assigned credits. A candidate, who secures less than 40% of marks in a course, shall be deemed to have failed in that course.

GRADING SYSTEM:

For UG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)

40% and above but below 45% - "Grade Point 4" and Letter Grade "P" (Pass)

For PG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)

45% and above but below 50% - "Grade Point 4" and Letter Grade "P" (Pass)

PROGRAM DURATION:

The maximum permissible period for completing a program for which the prescribed program duration is **n semesters**, shall be **(n+4)** semesters. All the program requirements shall have to be completed in (n+4) semesters.

ATKT criteria:

1. ATKT Candidate means a candidate who failed in not more than forty percent of the total number of Core and Core bracket papers, excluding the Practical Examination / Project Work / Viva Voce Examination in the Semester Examination and is appearing in the Examination of same semester again which is organized with the next Semester Examination. Forty percent (of the total number of Core and Core bracket papers) will be rounded off to higher side in case it is not a whole number. In case a Students fails or was absent in Practical Examination / Project Work / Viva Voce Examination, he/she may be allowed to have ATKT exam on his/her own expenses.

2. For postgraduate students, obtaining a minimum of 45% marks in aggregate in each course shall be essential for passing the course and earning its assigned credits. A candidate, who secures less than 45% of marks in a course shall be deemed to have failed in that course. For Diploma Courses the obtaining a minimum of 23% marks in aggregate in each course shall be essential for passing course and earning its assigned credits. A candidate, who secures less than 23% of marks in a course shall be deemed to have failed in that course. For PG Diploma courses the minimum pass marks for each paper will be 25% and in aggregate it should be 33%, remaining conditions being the same.

Curriculum Matrix M.Sc. Chemistry (Prog. Code: 0902CH)

Semester I					Marks Distribution		
	Code	**Subject**	**Hours/week**	**Credit (L+T+P)**	**External**	**Internal**	**Total**
Core Course	0902CH1101	Inorganic chemistry I	4	4 (4+0+0)	70	30	100
	0902CH1102	Organic chemistry I	4	4 (4+0+0)	70	30	100
	0902CH1103	Physical chemistry I	4	4 (4+0+0)	70	30	100
	0902CH1104	Spectroscopy I	4	4 (4+0+0)	70	30	100
Laboratory	0902CH1205	Lab Course I	4	2 (0+0+2)	35	15	50
	0902CH1206	Lab Course II	4	2 (0+0+2)	35	15	50
Open Elective	0902OE1307 OR 0902OE1308	Environmental and Analytical Chemistry (0902OE1307) **OR** Management in Practice(0902OE1308)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Semester II							
Core Course	0902CH2101	Inorganic chemistry II	4	4 (4+0+0)	70	30	100
	0902CH2102	Organic chemistry II	4	4 (4+0+0)	70	30	100
	0902CH2103	Physical chemistry II	4	4 (4+0+0)	70	30	100
	0902CH2104	Spectroscopy II	4	4 (4+0+0)	70	30	100
Laboratory	0902CH2205	Lab Course III	4	2 (0+0+2)	35	15	50
	0902CH2206	Lab Course IV	4	2 (0+0+2)	35	15	50
Open Elective	0902OE2307 OR 0902OE2308	Material Chemistry (0902OE2307) **OR** Computer Applicationand Statistics (0902OE2308)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Semester III							
Core Course	0902CH3101	Organotransition MetalChemistry	4	4 (4+0+0)	70	30	100
	0902CH3102	Biochemistry andNatural Products	4	4 (4+0+0)	70	30	100

Core/ Discipline Based Elective	0902CH3103 OR 0902CH3104	Industrial Chemistry (0902CH3103) **OR** Polymer Chemistry (0902CH3104)	4	4 (4+0+0)	70	30	100
	0902CH3105 OR 0902CH3106	Medicinal and Pharmaceutical Chemistry (0902CH3105)**OR** Nanoscience and GreenChemistry (0902CH3106)	4	4 (4+0+0)	70	30	100
Laboratory	0902CH3207	Lab Course V	4	2 (0+0+2)	35	15	50
	0902CH3208	Lab course VI	4	2 (0+0+2)	35	15	50
Open Elective	0902OE3309 OR 0902OE3310	Instrumental Methods of Analysis (0902OE3309)**OR** IPR and Research Methodology (0902OE3310)	4	4 (4+0+0)	70	30	100
		Total	**28**	**24 (20+0+4)**	**420**	**180**	**600**
Semester IV							
Core Course	0902CH4101	Nuclear and Solid StateChemistry	5	4 (3+1+0)	70	30	100
	0902CH4102	Photochemistry	5	4 (3+1+0)	70	30	100
	0902CH4103	Project		8	140	60	200
	0902CH4104	Project Seminar		2	35	15	50
	0902CH4105	Viva-Voce		2	35	15	50
		Total		**20**	**350**	**150**	**500**
	L = Lecture	**T = Tutorial P = Practical**	**Grand Total**	**92**	**1610**	**690**	**2300**
1 credit = 1 hour of teaching/week or 2 hours of Lab/week							
SGPA and CGPA will be calculated by the Examination Cell							
Coding Pattern : 1st digit denote semester; 2nd digit for type of paper [1-Core/Discipline based Elective,2-Lab/Practical, 3-For others such as Open Elective]; 3rd & 4th digit for Paper Number							




M.Sc. Chemistry
Semester I: Theory
Inorganic Chemistry I
Code: 0902CH1101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Inorganic Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To gain experience with standard chemical tools.
5. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Inorganic Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Main Group and Transition Elements

Noble gas compounds: Preparation, properties, and structure and bonding. Halogens in positive oxidation states. Interhalogen compounds: Preparation, Properties, structure and bonding, and uses. Pseudohalogens: Preparation, properties, and structure and bonding. Polyhalide ions. Astatine: Synthesis, stability and properties.

VSEPR, dπ, Pπ bonds Bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules. Walsh diagram.

Module II

Stereoisomerism in Co-ordination Compounds

Geometrical and optical isomerism in 4 and 6 coordination compounds, resolution of recemic mixture. Molecular rearrangement in 4 and 6 coordination compounds. Stereochemistry of complexes having coordination number 3, 5, 7 and 8. Methods used for their characterization. Effect of non bonding electrons on the preferred stereochemistry of Transiton metal comlexes exhibiting the coordination number 3, 5, 7 and 8.

Module III

Sulphur, Nitrogen, Phosphorus and Boron Compounds

Sulphur-Nitrogen compounds: Tetrasulphur tetranitride, disulphur dinitride and polythiazyl. SxNy compounds. S-N cations and an ions. Other S-N compounds. Sulphur-phosphorus compounds: Molecular sulphides such as P4S3, P4S7, P4S9 and P4S10. Phosphours-nitrogen compounds: Phosphazines. Cyclo and linear phosphaziens. Other P-N compounds. Boron-nitrogen compounds: Borzine, substituted borazines and boron nitride.

Metal Clusters

Module IV

Metal-Ligand Equilibria in Solution

Stepwise and overall formation constant and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion & ligand chelate effect and its thermodynamic origin. Determination of binary formation constant by pH metry and spectrophotometry.
Metal – Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π bonding and MO theory.

Module V

Isopoly and Heteropoly Acids

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 applications.
Boron hydrides: Reactions of diborane. Structure and bonding. Polyhedral boranes: Preparation, properties, and structure and bonding. The topological approach to boron hydride structure. Styx numbers. Importance of icosahedral framework of boron atoms in boron chemistry. Closo, nido and arachno structures. Structural study by NMR. Wade's rules. Carboranes. Metallocarboranes. Organoboron compounds and hydroboration.

Suggested Readings:

1. Advanced Inorganic Chemistry. F. A. Cotton and Wilkinson, John.
2. Inorganic Chemistry J. E. Huhey, Harpes & Row.
3. Chemistry of the Elements N. N. Greenwood & A. Earnshow, Pergamon.
4. Compherensive co-ordination chemistry by G. Wilkinson, R.D. Gallares & J. A. Mcclevetty Pergamoil.
5. Co-ordination Chemistry, S,S. Rao and Vani Rao, Kalyani Publishers
6. Advanced Inorganic Chemistry, Keemti Lal and Agrawala, Pragati Prakashan.
7. H.R.Alcock, "Phosphorus-Nitrogen Compounds", Academic Press.
8. J.H.Hollaway, "Noble Gas Chemistry", Methuen, New York.

M.Sc. Chemistry
Semester I: Theory
Organic Chemistry I
Code: 0902CH1102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Organic Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Organic Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Nature of Bonding in Organic Molecules: Delocalized chemical bonding – conjugation, cross conjugation, resonance, and hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non – benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π molecular orbitals, annulenes, anti-aromaticity. Aromaticity, homo-aromaticity, cyclodextrins, catenanes and rotaxanes.

Module II

Structure, Reactivity and Intermediates

Effect of structure on reactivity – resonance and field effects – quantitative treatement, the Hammet equation and linear free energy relationship, substituent and reaction constant Taft equation.

Electronic and steric effects. Influence of structural features on acidity, basicty and reactivity of organic compounds. Structure, formation and properties of carbenes, nitrenes and arynes. Singlet and triplet carbenes, formation and reactions. Carbon free radicals: Structure, formation and stability. Radical reactions, autoxidation and radical chain reactions. Structure, stability and formation of carbocations and carbanious. Arynes: Formation and structure

Module III

Reaction Mechanism:

Types of mechanism, types of reaction, thermodynamics and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin- Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effect

Aliphatic Nucleophilic Substitution: The SN2, SN1, mixed SN1 & SN2 and SET mechanisms The neighboring group mechanism, neighboring group participation by TM and N bonds. Anchimeric assistance.

Aromatic Nucleophilic Substitution: The SNAromatic, SN1, benzyne and SRN1 mechanism, reactivity – effect of substrate structure leaving group and attacking nucleophiles. The Von-Richter. Sommelet–Henser and Smith rearrangements.

Module IV

Aliphatic Electrophilic Substitutions: Bimolecular mechanism SE1 & SE2 . The SE1 mechanism electrophilic substitution accompanied by double bond shifts, effect of substrate, leaving group and the solvent polarity on the reactivity.

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

Module V

Stereochemistry: Conformational analysis of cycloalkanes, decalines, effects of conformation on reactivity. Conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral centre, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diasterotopic atoms, groups and faces. Stereo specific & stereo selective synthesis. Asymmetric synthesis, optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes). Chirality due to spherical shape.

Suggested Readings:

1. Organic Reactions and their mechanism, P. S. Kalsi.
2. Advanced Organic Chemistry- Reactions, Mechanism and Structure, Jerry March.
3. Structure and Mechanism in Organic Chemistry, Peter Skyes.
4. Stereochemistry of Organic Compounds, P. S. Kalsi.
5. REACTION MECHANISM IN ORAGANIC *CHEMISTRY BY S.M.MUKHERJI* AND S.P.SINGH.
6. D.Nasipuri, “Stereochemistry of Organic Compounds”, Wiley Eastern
7. I.L.Finar, “Organic Chemistry” Vol 2, Longman
8. J.March, “Advanced Organic Chemistry”, Wiley

M.Sc. Chemistry
Semester I: Theory
Physical Chemistry I
Code: 0902CH1103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Physical Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To gain experience with standard chemical tools.
5. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Physical Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Differential Calculus: Functions: continuity and differentiability. Rules for differentiation. Application of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels. Bohr's radius and most probable velocity from Maxwell's distribution etc-, exact and inexact differential with their applications to thermodynamic properties) Integral calculus, basic rules for integration, integration by parts. Partial fraction and substitution, reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar), curve sketching.

Elementary Differential Equations: Variables- separable and exact first order differential equations, homogeneous. Exact and liner equations, application to chemical kinetics secular equilibria quantum chemistry etc. second order differential equations and their solutions.

Permutation & probability: Permutation & combinations, probability & probability theorems, probability curves. Examples from kinetic theory of gases etc.

Module II

Introduction to Exact Quantum Mechanical Rules: The Schrödinger equation and postulates of quantum mechanics. Discussion of solutions of Schrödinger equation to some systems viz. Particle in a box, the

Approximation Methods: Harmonic oscillator the rigid rotator, the hydrogen atom. The variation-Chemistry n theorem finear variation principles. Perturbation theory (first order and non-degenerate) Applications of variation method and perturbation theory to the hemin atoms.

Angular Momentum: Ordinary angular momentum generalized angular momentum, eigen functions for angular momentum eigen value angular momentum, operator using ladder operations, additions, of angular momentum, spin, antisymmetry & pauli's exclusions principles.

Module III

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: The hybridization.. Bonding and hybridization involving d-orbitals.

Ionic Bonding: Ionic bonding and potential energy field. Lattice energy. Born theory and Born-Haber cycle. Elctronegativity: Pauling, Mullikan and Allred-Rochow scales. 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.

Module IV

Complex reactions: Reversible, consecutive, concurrent and branching reactions. Free radical and chain reactions. Steady state treatment. Reactions like H2-Cl2, H2-Br2, and decompositions of ethane, acetaldehyde and N2O5. Rice-Herzfeld mechanism. Unimolecular reaction. Lindemann treatment. Semenoff-Hinshelwood mechanism of chain reaction and explosion. Kinetics of fast reactions: Relaxation method, relaxation spectrometry, flow method, shock method, fast mixing method, field jump method and pulse method.

Module V

Dynamic chain: hydrogen-bromine reaction, pyrolysis of acetaldehyde decomposition of ethane) photochemical (hydrogen-bromine and hydrogen- chlorine reactions and oscillatory reactions (Belousov-Zhabotinsky reaction) homogenous catalysis, kinetics of enzyme reactions. General features of fast reactions, study of fast reactions by flow method, relaxation method. Flash photolysis and nuclear magnetic resonance method. Dynamics of molecular motion, probing the transition state, dynamics of barrier less chemical reactions in solution. Dynamic of unimolecular reactions (Lindemann—Hinshelwood and Rice – Ramsperger Kassel- Marcus [RRKM] theories of unimolecular reactions).

Suggested Readings:

1. Physical Chemistry, P.W. Atkins, Elbs.
2. Chemical Kinetics, K. J. Laidler, Mcgraw Hill.
3. Introduction to Quantum Chemistry, A. K. Chandra, Tata Mcgraw Hill.
4. Quantum Chemistry, Ira and Levine, Prentice Hall
5. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose. McMillan.
6. Mathematics for Chemists, Niranjan and Tripathi, Anusandhan Prakashan.
7. J.N.Gurtu and H.Sneji: “Advanced Physical Chemsitry”, Pragati Prakash
8. A.A.Frost and Pearson: “Kinetics and Mechanism”, John Wiley and sons
9. Advance physical chemistry - Gurdeep Raj

M.Sc. Chemistry
Semester I: Theory
Spectroscopy I
Code:
0902CH1104 **Credit: 4**
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Spectroscopy.
2. To train the students to pursue further education.
3. To be familiar with Spectroscopy tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of spectroscopy and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Unifying Principles: 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, non- rigid rotor, stark effect, nuclear & electron spin interaction and effect of external field. Applications.

Module II

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.

Module III

Infrared Spectroscopy: Review of linear harmonic oscillator, vibrational energies of diatomic molecules, Zero point energy, force constant and bond strengths, anharmonicity, Morse potential energy diagram.

Vibration- rotational 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 and band positions intensities, far IR region. Metal- ligand vibrations, normal co-ordinate analysis,

Overtones, combinations and Fermi resonance. Finger print and group frequencies. Introduction to instrumentation and FT-IR.

Module IV

Photoacoustic Spectroscopy: Basic principles of photoacoustic spectroscopy (PAS),. PAS- gasses and condensed system chemical and surface applications.

Raman Spectroscopy: Classical and quantum theories of Raman effect, Pure rotational, vibrational and vibrational - rotational Raman spectra, Selection rules, mutual exclusion principles. Resonance Raman Spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

Module V

Nuclear Magnetic Resonance Spectroscopy: Nuclear spin resonance, saturation, shielding of magnetic nuclei, chemical shifts and its measurements, factors influencing chemical shifts, de- shielding, spin-spin interactions, factors influencing coupling constant 'J" Classification (ABX, AMX, ABC, A2B2,etc). Spin decoupling basic ideas about instrument, Advantages of FT NMR use of NMR medicinal diagnostics, double resonance, NOE.

Suggested Readings:-

1. Modern Spectroscopy J. M. Hollas, John Willey.
2. Spectroscopy, H. Kaur, Pragati, Prakashan
3. Molecular Spectroscopy, Banwall.
4. Molecular Spectroscopy, P. S. Sindhu, New Age International.
5. NMR, NQR, EPR, and Mossbauer Spectroscopy in Inorganic Chemistry, R. B. Perish, Ellis Horwood.
6. An Introduction to Spectroscopy, S. S. Kalra, Anusandhan Prakashan
7. Introduction to Photo electron spectroscopy by P K Ghosh,John Willey
8. Spectrosocpy by P S Kalsi

M.Sc. Chemistry

Semester I: Practical

Lab Course I

Code:

0902CH1205

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Quantitative Analysis involving separation of two of the following in mixtures in solution, one by volumetric and other by Gravimetric methods
2. Preparation of selected inorganic compounds.
3. Qualitative analysis of mixture containing 08 radicals including two less common metals from among the following by semi micro method

   Basic radicals: AgI, PbII, BiIII, CuII, CdII, AsIII, SbIII, SnII, FeIII, AlIII, CrIII, ZnII, MnII, CoII, NiII, BaII, CaII, MgII, NaI, KI, CeIV, ThIV, ZrIV, WVI, TeIV, TiI, MoVI, UVI, VV, BeII, LiI, AuI, PtIV,

   Acid radicals: Carbonate, sulphide, sulphate, nitrite, nitrate, acetate, chloride, fluoride, bromide, iodide, borate, sulphonate, oxalate, phosphate, silicate, thiosulphate, ferrocyanide, ferricyanide, sulphocyanide, chromate, arsenate and permanganate
4. Estimation
   1. Phosphoric acid in commercial ortho- phosphoric acid.
   2. Boric acid in borax.
   3. Ammonia in ammonium salt.
   4. Manganese dioxide in pyrolusite.
   5. Available chlorine in bleaching powder.
   6. Hydrogen per oxide commercial sample.

   Two exercises will be given to students in the practical examination of 10 hrs duration

M.Sc. Chemistry

Semester I: Practical

Lab Course II

Code:

0902CH1206

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. General methods of separation and purification of organic compounds with special reference to:
   (a) Solvent extraction.
   (b) Fractional crystallization
   (c) Steam distillation and distillation under reduced pressure.
   (d) Column, paper and thin layer chromatography.

2. Analysis of organic binary mixtures: Separation and identification of organic binary mixtures containing atleast one component with two substituents. (A student is expected to analyze atleast 10 different binary mixtures).

3. Preparation of organic compounds: Single stage preparations by reactions involving nitration, halogenation, oxidation, reduction, alkylation, acylation, condensation and rearrangement. (A student is expected to prepare atleast 10 different organic compounds by making use of the reactions given above).

M.Sc. Chemistry
Semester I: Theory
Environmental & Analytical Chemistry
(Open Elective)
Code: 0902OE1307

Credit – 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Environmental and Analytical Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Environmental and Analytical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Environmental and Analytical Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Environment:

Introduction, composition of atmosphere, vertical temperature Profile, Heat/ Radiation budget of the earth atmospheric system, vertical stability, atmosphere. Biogeochemical cycles of C, N, P, S, and biodistribution elements.

Atmospheric Chemistry:

Chemical composition of atmosphere- particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect pollution by chemicals, petroleum, minerals. Chlorofluorohydrocarbons. Green house effect, acid rain air pollution controls and their chemistry. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

Module II

Aquatic Chemistry and Analysis of Water

Chemical composition of water bodies-lakes, streams, rivers and wetlands. Hydrological cycle. Aquatic pollution - inorganic, organic, pesticides, industrial, agricultural soil, detergents, oil spills, oil pollutants and radioactive wastes as source of pollution. Water quality parameters - dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, solids, and metals, content of chloride, sulphate, phosphate, nitrate and microorganisms. Water quality standards.

Water pollutants and their effects. Sources of water pollution. Heavy metal pollution-public health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury and arsenic. General survey of instrumental technique for the analysis of heavy metals in aqueous systems.

Module III

Industrial Pollution:

Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy, polymers, drugs, Radio nuclide analysis, Disposal of wastes and their management.

Soil and Environmental Disasters:

Soil composition, micro and macronutrients moisture, pH, total nitrogen, phosphorus, silica, lime, magnesia, manganese, sulphur and alkali, salts. Soil pollution by fertilizers, plastics and metals. Methods

of re-mediation of soil. Bhopal gas tragedy, Chernobyl, Three Mile Island Sewozo and Minimata disasters.

Module IV

Analysis of Fuel:

Solids, liquid and gas. Ultimate and proximate analysis heating values, Grading of cola, liquid, fuels-flash point, aniline point, octane number and carbon residue. Gaseous fuels producer gas and water gas calorific value.

Natural Resources, Energy and Environment: Mineral resources, Wood, Fuel and Energy resources: coal, petroleum and natural gas, Nuclear fission and Nuclear fusion, Solar energy, Hydrogen, Gasohol, World Energy Resources, Environmental management.

Module V

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. Recycled plastic manufacture and usage rules 1999, Municipal Solid Waste (Management and Handling) Rules 2000, The Noise Pollution (Regulation and Control) Rules 2000, Evironmental Impact Assessment Notification 2006, e-wastes Management and Handling Rules 2011.

Suggested readings:

1. Environmental Chemistry, Samir K. Banerji; Prentice Hall of India.
2. Environmental Chemistry, Sharma & Kaur; Krishna Publishes.
3. Environmental Chemistry, A. K. Dey, Wiley Eastern.
4. Chemistry of Atmosphere, R. P. Wayne; Oxford.
5. A Text Book of Environmental Chemistry and Pollution Control, S. S. Dara; S. Chand Publication.
6. Environmental Solution Analysis, S.M. Khopkar; Wiley Eastern.
7. Analytical Chemistry, G. D. Christian; J. Wiley
8. Environmental Solution Analysis, S.M. Khopkar; Wiley Eastern.
9. Principle of Instrumental Analysis, D. A. Skoog, J. L. Loary and W. B. Saunders
10. Basic Concepts of Analytical Chemistry, S.M. Khopkar; Wiley Eastern.
11. Analytical Chemistry, B. K. Sharma; Krishna Prakashan Media (P) Ltd. Meerut.
12. Environmental Science, Santra, Central
13. Pollution Control Acts, rules and Notifications issued under CPCB, New delhi
14. Environmental Laws, New Perspectives, K. C. Agrawal, Nidhi Publisher, Bikane
15. Environmental laws in India, Gurdip Singh, Quality Law Books

M.Sc. Chemistry
Semester I: Theory
Management in Practice
(Open Elective)
Code: 0902OE1308

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To understand the basic functions of management.
2. To know the basic qualities of a manager so that they can be utilized in practical situation.
3. To develop understanding of basic know-how of industrial planning, market assessment, future projections, etc.

Course Outcome:

Skills that students obtain after completion of the course:

1. To prepare business plan and its execution according to market available.
2. Ability to dissect a problem in to its key features.
3. Apply the basic concepts of management to different situations.

Module I

Introduction to Management: - Meaning, nature and importance. Evolution of Management-Classical, Neo-classical, Scientific Theory, Administrative Theory; Functions of a Manager. Qualities of a manager. Social Responsibilities of a Manager, Management as a Process-Planning-Meaning and Importance. Organizing-Meaning and Importance. Staffing- Meaning and Importance. Directing – Meaning and Function.

Module II

Human Resource Management-Meaning. Importance of Human Resource management. Manpower Planning- Meaning and Importance. Difference between Human Resource Development and Human Resource Planning. Recruitment-Meaning and Importance. Selection- Meaning and Methods Training Meaning. and Types. Performance Appraisal- Meaning and Types.

Module III

Organization Behavior- Introduction to Organization Behavior- Meaning, Importance and scope. Motivation- Meaning, Process and Importance. Motivational Theories- Maslow, Herzberg and McClelland. Attitude- Meaning and Importance, Components of attitude in Organization Behavior. Perception- Meaning and Importance in the context of Organization Behavior.

Module IV

Marketing Management- Meaning, Importance and Implications. Marketing Mix- Product- Meaning, types and Importance. Place- Meaning and Importance. Price- Meaning. Methods and Importance; Promotion- meaning. Instruments and Importance to make a marketing decision.

Module V

Financial Management- Meaning and Importance. Relationship with other managerial functions. Financial Analysis- Meaning and Importance; Tools of financial management, Fund Flow – Meaning, Process; Fixed and Working Capital- Meaning and Importance.

Suggested Readings:

- Principles of Management: L. M. Prasad
- Management by Robbins.
- Marketing Management-Raja Gopal.
- Financial Management for Non-Finance Executives by Dr. Prasanna Chandra
- Human Resource Management by C. V. Mamoria
- Organizational Behavior by S. Robbins
- Management by Stoner
- Financial Management by Khan and Jain
- Financial Management by Dr. Prasanna Chandra
- Marketing Management by Philip. A. Kotler
- Human Resource Management by Edward Flipo

M.Sc. Chemistry
Semester II: Theory
Inorganic Chemistry II
Code: 0902CH2101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Inorganic Chemistry.
2. To train the students to pursue further education.
3. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Inorganic Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Theories of Metal Complexes:

Valence bond theory and its limitations. Ligand field theory: Splitting of d orbitals in different ligand fields such as octahedral, tetragonal, square planar, tetrahedral trigonal bipyramidal and square pyramidal fields. Jahn-Teller effect. Ligand field stabilization energy (LFSE) and its calculations. Thermodynamic effect of LFSE. Factors affecting the splitting parameter Spectrochemical series. Molecular orbital theory based on group theoretical approach and bonding in metal complexes Σ and π bondings in complexes. MO diagrams of complexes with and without π bonds. Effect of π bond on the stability of Σ bond. Nephelauxetic series. Critical comparison of the three theories as applied to metal complexes.

Module II

Spectral properties of complexes:

Term symbols for d-ions. Characteristics of d-d transitions. Selection rules for d-d transitions. Orgel diagrams. Tanabe-Sugano diagrams. Effects of Jahn-Teller distortion and spin-orbit coupling on spectra. Charge transfer spectra.

Magnetic properties of metal complexes:

Types of magnetism shown by complexes. Magnetic susceptibility measurements. Gouy method. Spin-only value. Orbital contribution to magnetic moment. Ferromagnetism and antiferromagnetism in complexes. Application of magnetic measurements to structure determination of transition metal complexes.

Module III

Reaction Mechanism of Transition Metal Complexes Part I:

Energy profile of reaction, reactivity of metal complexes, 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 & indirect evidences in favour of conjugate mechanism, anquation reactions, reactions with out metal ligand bond clevage.

Module IV

Reaction Mechanism of Transition Metal Complexes Part II:

Substitution reaction in square planner complexes, the trans effect, mechanism of substitution reaction. Redox reactions, electron transfer reaction, mechanism of one – electron transfer reaction, outer sphere type reaction, cross reaction and Marcus-Huss theory, inner sphere type reactions.

Module V

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 reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes, tertiary phosphine as ligand.

Suggested Readings:

1. Advanced Inorganic Chemistry, F.A. Cotton John Wieley.
2. Inorganic Chemistry, J.E. Huhey Harper & Row.
3. Inorganic Electronic Spectroscopy, A.B. P. Lever.
4. Magneto Chemistry, Shyamal Dutta.
5. Comprehensive Coordination Chemistry, G.Wilkinson, R.D.Gillar, J. A Mecleverty.
6. Co-ordination Chemistry, S,S. Rao and Vani Rao, Kalyani Publishers
7. Advanced Inorganic Chemistry, Keemti Lal and Agrawala, Pragati Prakashan.

M.Sc. Chemistry
Semester II: Theory
Organic Chemistry II
Code: 0902CH2102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Organic Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Organic Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Free Radical Reaction:

Types of free radical reactions, free radical substitution mechanism, mechanism at aromatic substitution, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridge head. The reactivity in the attacking radicals. The effect of solvents reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto oxidation coupling of alkynes and arelation of aromatic compounds by diazonium salts, Sand Meyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Elimination Reactions:

The E1 and E2, EC B mechanisms and their spectrum. Orientation of double bond. Reactivity effects of substrate structures, attacking base, the living group and the medium. Mechanism and orientation in pyrolytic elimination.

Module II

Addition to Carbon –Carbon Multiple Bonds:

Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals regio and chemo selectivity, orientation and reactivity. Addition to cyclopropane ring, Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation.

Module III

Addition to Carbon –Hetero Multiple Bonds:

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

Module IV

Pericyclic Reactions:

M. O. symmetry, frontier orbitals of ethylene, 1,3-Butadiene, 1,3,5 –hexatriene and allyl system. Classification of Pericyclic reactions, Woodward –Hoffmann correlation diagrams. FMO & PMO approach. Electrocyclic reactions conrotatory and disrotatory motions, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cyclo additions and cheleotopic reactions. Sigmatropic rearrangements suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3 and 5, 5 sigmatropic rearrangements Claisen , Cope and Aza - Cope rearrangements, Fluxional tautomerism end reaction

Module V

Newer synthetic reaction and regent

Mannich, Reimer-Tiemann, , reformatsky and Ullmann reations. Stork enamine reaction. Shapiro, Witting – Horner, Peterson, Heck, Stille and McMurray reactions. Robinson ring annulation. Synthesis of small rings. Simon-Smith reaction. Catalytic hydrogenation. Birch reduction. Wolff-Kishner reduction. Huang-Milon modification. Clemmenson reduction. Boranes, N-Bromosucinimide, lead tetra-acetate.

Reagent

LAH, Sodium borohydride as reductants. Oppenauer oxidation. HIO_4, OsO_4, $C_6H_5CO_3H$, Hydride transfer reagents: sodium cyanoborohydride, Gilman's reagent, lithium dimethylcuprate, lithium disopropylamide(LDA) dicyclohexylcarbodimine (DCC), 1,3-diethanes (reactivity umpolung). Trimethylsilyl iodide, tri-n-butyltin hybride. Woodward and prevost hydroxylation, selenium dioxide, peterson's synthesis, Wilkinson's catalyst,Baker yeast.

Suggested Readings:

1. Advanced organic chemistry – reactions, mechanism & structure, Jerry March.
2. Advanced organic chemistry, F.A. Careu & R. J. Sunberg Plenum.
3. A Guide book of mechanism in organic chemistry, C. K. Ingold, Cornell Univ. Press.
4. Organic chemistry, R. T. Morrison & R. N. Boyd, Prentice Hall.
5. Structure & mechanism in organic chemistry, Peter Skyes, Longman.
6. Modern organic reactions, H. O. House, Benjamin.
7. Pericyclic Reactions, S. M. Mukherjee, Macmillan, India.
8. Reaction Mechanism in Organic chemistry S. M. Mukherjee & S. P. Singh.

M.Sc. Chemistry
Semester II: Theory
Physical Chemistry II
Code: 0902CH2103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Physical Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To gain experience with standard chemical tools.
5. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Physical Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Classical Thermodynamics:

Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. partial molar properties, Partial molar free energy, partial molar volume and partial molar heat constant and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity Non- ideal system: Excess functions for non –ideal solutions. Activity coefficient, Debye –Huckel theory for activity coefficient of electrolytic solutions. Determination of activity and activity coefficients, ionic strength. Application of phase rule to three component systems, second order phase transition

Module II

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 Lagranges method of undetermined multipliers). Partition functions—Transnational rotational, vibrational and electronic partition functions, calculation of thermodynamic properties in terms of partition functions. Applications of partition functions. Heat capacity behaviour of solids chemical equilibria and equilibrium constant in terms of partition functions, Fermi – Dirac Statistics , Distribution law and application to metal Bose- Einstein Statistics—distribution law and application to Helium.

Non- Equilibrium Thermodynamics:

Thermodynamics 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 Onsagers reciprocity relations, electrokinetic's phenomena diffusion, electric conduction, irreversible , thermodynamics for biological systems, coupled. Reactions

Module III
Electrodics:

Different types of electrodes. Electrochemical cells. Concentration cell and activty coefficient determination. Origin of electrode potential. Liquid junction potential. Evaluation of thermodynamic properties. The electrode double layer: Electrode-electrolyte interface. Theory of multiple layer capacity. Electrocapillary. Loppmann potential. Membrane potential. Elecrokinetic phenomena. Mechanism of charge transfer at electrode-electrolyte interface. Electrolysis. Current-potential curves. Dissolution, deposition and decomposition potentials. Energy barriers at metal-electrolyte interface. Different types of over potentials. Butter-Volmer equation. Tafel and Nemst equations. Rate determining step in electrode kinetics. The hydrogen over voltage. The oxygen over voltage. Theories of over voltage.

Module IV
Electrochemistry:

Electrochemistry of solutions Debye – Huckel theory, mathematical derivation of Debye – Huckel equation. Debye – Huckel - Onsager treatment and its extention. Wien effect, Debye – Falkenhagen effect. Ion solvent interactions - thermodynamics of electrified interfaces, Lippmann equations. Structure of electrified interfaces – the parallel plate condenser model (Hemholtz-perrien theory), Guoy – Chapman theory, Stern's theory. Overpotentials (types, measurement, theories, importance and factors affecting overpotentials), exchange current density, derivation of Butler-Volmer equation, Tefel equation. Polarography theory - Ilkovic equation, half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

Module V
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 film on liquids (Electro kinetic phenomenon), and Catalytic activity of surfaces.

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

Books Suggested:-

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Statistical Thermodynamics, Gupta and Kumar.
3. Mechanical Statistics, D. M. Hirst.
4. Modern Electrochemistry Vol. 1 and 2, J.O.M. Bockrisad and A.K.N. Reddy, Plenum.
5. Electrochemistry, L. Andropov.
6. Modern Electrochemistry, Roger Philip.
7. Micelles, Theoretical & applied aspects, V. Mori, Plenum.

M.Sc. Chemistry
Semester II: Theory
Spectroscopy II
Code: 0902CH2104

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart in-depth knowledge of Spectroscopy.
2. To train the students to pursue further education.
3. To be familiar with Spectroscopy tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Spectroscopy and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Carbon- 13 NMR Spectroscopy: - General consideration, chemical shift (aliphatic, olefinic, alkynes, aromatic, heteroaromatic and carbonyl carbon), coupling constant. Two dimension NMR spectroscopy-COSY, NOES, DEPT, APT and Inadequate techniques.

Nuclear Quadruple Resonance Spectroscopy: -Quadruple nuclei, quadruple moments, electric field gradient, coupling constant, splitting application

Electron Spin Resonance Spectroscopy: - Hyperfine coupling. Spin polarization for atoms and transition metal ions. Spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron) including biological systems and to inorganic free radicals such as PH4, F2 and [BH3].

Module II

Mass Spectroscopy: Theory, instrumentation base peak, meta stable peak, fragmentation cleavage pattern, mclafferty rearrangement, ring rule, nitrogen rule and application α and β allylic and benzylic clevage

X-Ray Diffraction:

Bragg condition Miller indices, Laue Method, Bragg Method, Debye- Scherer method of X-ray structural analysis of crystals, index reflections, identifications 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, face problem. Description of the procedure for an X-ray. Structure analysis, absolute configuration of molecules, Ramchandran diagram.

Module III

Electron Diffraction:

Scattering intensity vs scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecule. Low energy electron deffraction and structure of surfaces.

Neutron Diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

Mossbauer Spectroscopy: - Basic principles, spectral parameters and spectrum display. Application of

the technique to the studies of (1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds-nature of M-L bond, coordination number, structure (3) Detection of oxidation state and in equivalent MN atoms.

Module IV

Atomic Absorption Spectroscopy:

Introduction, Principle, Classification, Measurement, Instrumentation and Application.

Atomic Emission Spectroscopy:

Introduction, Principle, Origin of Spectra, Measurement, Instrumentation, Applications and Advantages & disadvantages.

Plasma Emission and Flame Emission Spectroscopy:

Introduction, Principle, Instrumentation and Applications.

Module V

Symmetry & Group Theory:

Symmetry elements & symmetry operations, definition of group , sub- group, relation between orders of finite group & its sub – group, conjugacy relation and classes, point symmetry group Shonflies symbols representation of group by metrices (Representation for the Cn, Cnh, Cnv, Dnh etc. group to be worked out explicitly) Character tables & their use.

Suggested Readings:

1. Modern Spectroscopy J. M. Hollas, John Willey.
2. Applied Electran Spectroscopy for chemical analysis Ed. H. Windawi and F. I. Willey Interscience.
3. Spectroscopy, H. Kaur, Pragati, Prakashan
4. Molecular Spectroscopy, Banwall.
5. Introduction to Photoelectron Spectroscopy, P. K. Ghosh, John Wiley.
6. Molecular Spectroscopy, P. S. Sindhu, New Age International.
7. An Introduction to Spectroscopy, S. S. Kalra, Anusandhan Prakashan
8. Group Theory by Cotton.
9. Group Theory, Bhattacharya, Goel Publisher.
10. Molecular Symmetry and its application, Shukla and Kumar, Anusandhan Prakashan.

M.Sc. Chemistry
Semester II: Practical
Lab Course III (Physical)
Code: 0902CH2205

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Adsorption

To study surface tension – concentration relationship for solution (Gibb, s equation)

2. Phase Equilibrium

a. Determination of congruent composition and temperature of a binary system (eg. Diphenylamine –benzophenone system).
b. Determination of glass transition temperature of a given salt (eg. $CaCl_2$) conductometrically.
c. To conduct the phase diagram for three component system (eg. Chloroform –acetic acid, acid-water).

3. Chemical Kinetics

a. Determination of effect of temperature, change of concentration of reactants and catalyst and ionic strength of the media on the velocity constant of hydrolysis of an ester /ionic reactions
b. Determination of velocity constant of the hydrolysis of an ester /ionic in micellar media.
c. Determination of rate constant of oxidation of iodide ions by hydrogen peroxide by studying the Kinetics as an iodine clock reaction.
d. Flowing clock reaction (Ref. Experiment in physical chemistry by showmaker
e. Determination of primary salt effect on kinetics of ionic reactions and testing the Bronsted relationship (iodide ion reaction with persulphate ion) .
f. Oscillatory reaction.

4. Solutions

a. Determination of molecular weight of non-volatile and non –electrolyte / electrode by cryoscopic method and to determine the activity coefficient of an electrolyte.
b. Determination of the degree of dissociation of weak electrolytes and to study the deviation from ideal behaviour that occurs with a strong electrolyte.

5. Electrochemistry-

a. Conductometry

1. Determination of velocity constant, order of reaction and energy of activation for saponofication of ethyl acetate of ethyl acetate by NaOH conduct metrically.
2. Determination of solubility and solubility product of sparingly soluble salts ($PbSO_4$, $BaSO_4$) Conduct metrically.

3. Determination of strong and weak acids in a given mixture conduct metrically.
4. To study the effect of solvent on conductance of $AgNO_3$ / acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and their mixtures (DMSO, DMF, Dioxane, acetone, water) and to test the validity of Debye-Huckel –Onsager theory.
5. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye-Huckel'S law.

b. Potentiometry pH metry

1. Determination of strength of halides in a mixture potentiometrically.
2. Determination of the valence of Mercurous ions potentiometrically.
3. Determination of strength of strong and weak acids in a given mixture using potentiometer /pH meter.
4. Determination of temperature dependence of EMF of a cell.
5. Determination of formation constant of Silver-ammonia complex and stoichiometry of the complex potentiometrically.
6. Acid base titration in non –aqueous media using a pH meter.
7. Determination of activity and activity coefficient of electrolytes
8. Determination of the dissociation constant of acetic acid in DMSO, DMF, acetone and dioxane by titrating it with KOH.
9. Determination of dissocationconstant of mono-basic/di-basic acid by Albert Sergeant method.
10. Determination of thermodynamic constants DG, G, S and H for reaction by EMF method $Zn + H_2SO_4 \rightarrow ZnSO_4 + 2H$.

c. Polarimetry

1. Determination of rate constant for hydrolysis /inversion of sugar using a polar meter.
2. Enzyme kinetics –inversion of sucrose.

M.Sc. Chemistry
Semester II: Practical
Lab Course IV (Analytical)
Code: 0902CH2206

Credit: 2
Total Marks: 50 (35+15)

Course Objectives:
1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:
Skills that students obtain after completion of the course:
1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

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. Volumetric Analysis

   Determination of iodine and saponofication values of oil samples

   Determination of DO, COD, BOD, hardness of water samples.

3. Chromatography

   Seperation of cations and anions by paper chromatography, column chromatography.

4. Flame Photometry/AAS/FIA

   Determination of cations, anions and metal ions e.g. Na, K, Ca, SO_4, NO_2, Fe, Mo, Ni, Cu, etc.

5. Spectrophotometry

   Verification of Beer s; law. Molar absorptivity calculations, plotting graph to obtain λmax etc.

6. Effect of pH in aqueous colored system.

   Determination of metal ions e.g. Fe, Cu, Zn, Pb, etc. using inorganic reagent like SCN and organic chelating agent like dithiazone, cupferon, 8-hydroxyquinoline, etc in aqueous / organic phase in the presence of surface active agents.

7. Nephlometry / Turbidimetry

   Determination of chloride, sulphate, phosphate, turbidity etc.

M.Sc. Chemistry
Semester II: Theory
Material Chemistry
(Open Elective)
Code: 0902OE2307

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Material Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Material chemistry and its properties

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Material Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I:

Structures of solids .

Introduction to solids – crystalline and amorphous. Unit cell, Bravais lattices and X-ray structure determination (NaCl and KCl only) – powder and single crystal- methods and applications-identification of the cubic lattice and indexing of the X-ray diffraction lines.

Radius ratio rules – Coordination number. Packing arrangement -different structure types in solids – rock salt, zinc blende, wurtzite, fluorite and antifluorite, spinel and inverse-spinel and perovskite structures.

Module II:

Preparative methods and characterization

Solid state reactions – Ceramic method, sol-gel, hydrothermal, high pressure, zone refining, CVD, Czochralski and Bridgman and Stockbarger methods.

Physical methods – Thermogravimetric and differential thermal analysis and scanning electron microscopy (only introduction and application).

Module III:

Electrical and optical properties

Defects in solid state – Point defects – Frenkel and Schottky defects and non-stoichiometric defects.

Conductors – variation of conductivity with temperature – semiconductors – p and n types, pn- junction, photoconduction, photo voltaic cell and photogalvanic cell – solar energy conversion, organic semiconductors.

Piezoelectric, pyro-electric and ferroelectrics (introduction and application). Photoluminescence.

Module IV:

Magnetic properties

Magnetic properties – classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferri magnetic — magnetic susceptibility.

Variation with temperature – Curie-Wiess law, Curie temperature and Neel temperature. Permanent and temporary magnets.

Module V:
Special materials
Superconductivity – Introduction, Meissner effect – mention of Bardeen, Cooper and Schrieffer theory and Cooper pairs – examples of superconducting oxides, Chevrel phases – applications of superconducting materials.
Ionic conductors – Sodium-β alumina, sodium-sulphur battery. Intercalation – layered compounds – graphitic compounds. Special applications of solid state materials. High energy battery, lithium cells. Liquid crystals: Nematic, Cholesteric and Smectic types and applications.

Suggested Readings:

1. Solid State Chemistry-An Introduction by Lesley Smart and Elaine Moore, Chapman Hall, London, 1992.
2. Solid State Chemistry by M. G. Arora, Anmol Publications, New Delhi, 2001. Dept of Chemistry, Loyola College (Autonomous), Ch-34, B. Sc (Chem) Syllabus 45.
3. Materials Science by P. K. Palanisamy, Scitech Publications, Chennai, 2003.
4. Modern Inorganic Chemistry by W. L. Jolly, Mc Graw Hill Book company, NY, 1989.
5. Inorganic Chemistry by D. F. Shriver and P. W. Atkins, Longford, Oxford University press, 1990.
6. Introductory Solid State Physics by H. P. Meyers, Viva Books Private Limited, 1998.
7. Solid State Chemistry and its applications by A. R. West, John-Wiley and Sons, 1987.
8. Modern aspects of Inorganic Chemistry by H. J. Emelius and A. G. Sharpe, Universal Book Stall, 1989.
9. Ionic crystals, Lattice defects and Nonstoichiometry, N. N. Greenwood, Butterworths, London, 1968.
10. Solid State Physics by Charles Kittel, John-Wiley and sons, NY, 1966.

M.Sc. Chemistry
Semester II: Theory
Computer Application and Statistics
(Open elective)
Code: 0902OE2308

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Computer Application and statistics
2. To be familiar with computer hardware and software.
3. To have experience of virtual world and statistical databases.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Computer Application and statistics and key principles of it.
2. Awareness of its major application.
3. Ability to use Computer for chemical applications or related problems.

Module I:

Computer

Introduction to computers and computing: Basic structure and functioning of computers with a PC an illustrative examples. Memory I/O devices, secondary storage, computer languages, oprating systems with DOS as an example. Introduction to UNIX & WINDOWS. Data processing, principles of programming Alogorithms and flow charts.

Computer Programming in FORTAN / C / BASIC: The language features of listed here with reference to FORTAN. The instructor may choose another language such as BASIC or C and the feature may be replace appropriately). Elements of computer language, Constant and Variables. Operations and Symbol. Expressions. Arithmetic assignment statement. Input and Output. Format statement, Termination statement. Braching statements such as IF or GO to statement LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement

Module II:

Function & Sub Routine Common and Data Statement:

Function and Sub-Routing common and data statement (students learning programming logic and language features by hands –on experience on a PC from very beginning of this topic).

Programming in Chemistry:

Development of small computer course involving simple formulae in chemistry, such as Vander-walls equation. pH titration, kinetics, radioactive decay. Evolution of lattice energy and ionic radio from experimental data linear simultaneous equation to solve secular equations within the Huckel theory. Elementary structural feature such as lengths, bond, dihedral angles etc. of molecules extract base such as Cambridge database.

Module III:

Introduction to statistics; Kinds of chemical data, Frequency distribution, Cumulative frequency distributions. Descriptive Statistics – Measures of Central tendency, Arithmetic Mean, Median, and Mode. Measures of dispersion – Standard deviation and Coefficient of Variations. Random Variable:

Expectation and variance. Probability distribution, Mean Variance, Binomial, Poisson, Mean, Variance.

Module IV:
Normal distribution and standard normal distribution: Area properties, mean, variance, Testing of Hypothesis, Types of Hypothesis, Types of errors; z-test, t-test, F-test; Testing goodness of fit, Chi Square (χ^2) test.

Module V:
Technique for analyzing Variance and Covariance, Principle of ANOVA, One-way ANOVA, Two-way ANOVA; Non Parametric tests: Sign test, Wilcoxon matched pairs test, Wilcoxon-Mann-Whitney test, Kruskal –Wallis test, Runs test (Test for randomness). Spearman's Rank Correlation, Kendall's coefficient.

Suggested Readings:

1. Computer for Chemists; K.V. Raman.
2. Computer Programming in FORTRAN IV and V, Rajaraman, Prentice Hall.
3. Computational Chemistry, A. C. Norris.
4. Computer for Chemists, Singh and Mishra, Anusandhan Prakashan.
5. Fundamentals Spectroscopy, S.P.S. Jadon, Anusandhan Prakashan
6. Fundamentals of Mathematical Statistics : S C Gupta and V K Kapoor
7. Statistical Methods: Snedecor and Cochran
8. Research Methodology- Methods and Techniques: C. R. Kothari.

M.Sc. Chemistry
Semester III: Theory
Organotransition Metal Chemistry
Code: 0902CH3101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Organotransition Metal Chemistry.
2. To train the students to pursue further education.
3. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Organotransition Metal Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Introduction: Organotransition metal, Classification Nature of metal-carbon bond, Nomenclature, Reactions of Organotransition metallic compounds such as Oxidative addition, Reductive – elimination, insertion and deinsertion reaction, Nucleophlilic and Electrophilic attack on coordinated ligands.

Module II

Alkyls and Aryls of Transition Metals: -Types, routes of synthesis stability and decomposition pathways organ copper in organic synthesis Compounds of Transition Metal-Carbon Multiple Bonds: -Alkylidenes, alkylidynes, low valent carbenes and carbines-synthesis, nature of bond, structural characteristics, nucleophilic sand electrophilic reactions on the ligands, role in organic synthesis.

Module III

Transition Metal π- Complexes: - Transition metal π-complexes with unsaturated organic molecules, alkenes, alkynes, allyl, dienes, dienyl, and arene and trienyl complex- preparations. Properties, nature of bonding and structure features. Important reaction relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.

Module IV

Homogenous Catalysis: -Stoichimetric reactions for catalysis, homogenous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalysis reaction involving carbon mono oxide such as hydrocarbonylation of olefins, oxo reaction, oxo pallaadation reaction, activation of C-H bonds.

Module V

Transition Metals Compound with Bond to Hydrogen: - Transition metal compounds with bonds to hydrogen.Fluxional Organometallic Compounds: -Fluxionality and dynamic equillibria in compounds such as n2 - olefin, n3 –allyl and dienyl complexes.

Suggested Readings:

1. Principles and Application of Organotransition Metal Chemistry J.P. Colliman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of “The Transition Metals”, Rh Crabtree, John Wiley.

3. Metallo-Organic Chemistry, A. J. Pearson, Wiley.
4. Organometallic Chemistry, R. C. Mehrotra and A. Singh, New Age International.

M.Sc. Chemistry
Semester III: Theory
Biochemistry and Natural Products
Code: 0902CH3102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Biochemistry and Natural Products.
2. To train the students to pursue further education.
3. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Biochemistry and Natural Products and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Alkaloids: - Definition, nomenclature and physiological, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant, synthesis of following Ephedrine, (±) Conline, Nicotine, Quinine and Atropine, Morphine.

Module II

Terpenoids and Carotenoids: -Classification, nomenclature, occurrence, isolation, general methods of determination of Citral, Geranial, A- Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.

Module III

Steroids: - Isolation, structure, determination and synthesis Cholesterol, Bile acid, Androsterone, Testosterone, Estrone, progesterone, Aldostrone and Biosynthesis of Cholesterol.

Antibiotics: - Cell wall biosynthesis, inhibitors, β-lactum rings, antibiotics, inhibiting protein synthesis, synthesis of Pencilin-G, Penicillin-V, Ampicillin, Amoxycillin, Chloramphenicol, Cephalosporin, Tetracycline and Streptomycin.

Module IV

Metal Storage Transport and Biomineralization: -Ferritia, transferring and siderophores.

Na+/K+ Pump: - Role of metals ions in biological processes.

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

Metals in Medicine: - Metal deficiency and disease, toxic effects of metals for diagnosis and chemotherapy with particular reference to anti cancer drugs.

Module V

Biogenetics and ATP Cycle: - DNA polymerization, glucose storage metal complexes in transmission of energy, chlorophylls, photosystem-I and photosystem-II in cleavage of water model system.

Electron Transfer in Biology: - Structure and function of metalloproteins in electron transport processes-cytochoromes and ion-sulphur proteins, synthetic models.

Transport and storage of Dioxygen: -Heme proteins and oxygen uptake, structure and function of

haemoglobin, myoglobin, haemocyanins and haemoerythrin model synthesis complexes if iron cobalt and copper.

Metalloenzymes: Metalloenzymes: - Zinc enzymes-carboxypeptidass and carbonic anhydrase. Iron enzymes-catalyses, peroxidase and cytochrome P-450. Copper enzymes-super oxide dismutase Molybdenum oxatranferase enzymes-xanthine oxidase.

Suggested Readings:

1. Natural Products Chemistry and Biological Significance: J. Mann, R.S. Davidson, J.B. Hobbs.
2. Organic Chemistry: D.V. Banthrope, Longman Essex, J. B. Harbrone.
3. Streoselective Synthesis: M. Nogradi and CHV. Odds Chemistry of Carbon Compounds, ED.S. Coffey, Elsevier.
4. Biological and Pharmacological Properties of Medicinal Plants from Americans: M. P. Gupta and A. Marston, Harwood Academic Publishers.
5. New Trends in Natural Products: Rahman and M.I. Choudhary.
6. Insecticides of Natural Origin: Sukh Dev.
7. Text Book of organic Medicinal and Pharmaceutical Chemistry: Robert F. Dorde.
8. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock.
9. Berger's Medicinal Chemistry and Drug Discovery: Vol-I (Chapter-9 and Ch-14). Goodman and Gillman's Pharmacological Basis of Therapeutics, McGraw Hill.
10. The Organic Chemistry of Drug Design and drug Action: R.B. Silverman. Strategies for Organic Synthesis and Design, D. Lednicer, John Wiley. Bioinorganic Chemistry. I. Bertini, H.B. Gray, S. L. Lippard and J. S. Valentine, University Science Books.
11. Inorganic Biochemistry: Vols-II and I. Ed G.L. Eichhorn, Elsevier.
12. Enzyme Chemistry Impact and Applications: Ed. Collin J. Suckling, Chapman and Hall.
13. Enzyme Mechanisms: M.I. Page and A. Williams, Royal Society of Chemistry.
14. Fundamentals of Enzymology: N.C. Price and L. Stevens Oxford University Press.

M.Sc. Chemistry
Semester III: Theory
Industrial Chemistry
Code: 0902CH3103

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Industrial Chemistry.
2. To train the students to pursue further education.
3. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Industrial Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Industrial fuels

Energy Sources: non-renewable, classification of fuels: solid, liquid and gaseous. Calorific value of fuels and its determination.

Solid fuels Coal: types – properties and uses – lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal.

Liquid fuels Refining of crude petroleum and uses of fractions. Hydrodesulphurisation. Cracking: thermal and catalytic (fixed bed and fluidised bed cataylsis). Octane number. Production and uses of tetraethyl lead, ETBE and MTBE.

Gaseous fuels Natural gas and gobar gas: production, composition and uses., Gobar electric cell.

Module II

Dyes And Paints

Dyes: General introduction and classification with special reference to textile and edible dyes and fabric brighteners. Industrial preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

Oils, soaps and Detergents: Refining of edible oils, Manufacturing of soaps, Detergents, Liquid Soaps. Manufacturing of fatty Acids and glycerol, greases from fatty acids, turkey – red oil

Paints, Varnishes and Inks. Constitutions, examples of preparation and applications.

Module III

Water treatment

Introduction Sources of water. Hardness of water-temporary or carbonate hardness, permanent hardness or non-carbonate hardness. Units of hardness, disadvantages of hard water – In domestic, in industry and in steam generation in boilers. Effect of iron and manganese in water. Estimation of hardness – EDTA method – Estimation of total hardness – O. Hehner's method or alkali titration method. Water softening methods Industrial purpose Lime – soda process, Zeolite process; Ion-exchange - Demineralisation - deionisation process. Mixed – bed deionisation. Domestic purpose Removal of suspended impurities. Removal of microorganism – Chlorination . Break point chlorination. Reverse osmosis. Desalination. Waste water treatment

Module IV

Pollution and chemical toxicology

Pollution: Air pollution - Acid rain. Green house effect (global warming), ozone layer depletion - photochemical oxidants. Control of air pollution. Water pollution – organic pollutants, Chemical oxygen demand (COD), Biological oxygen demand (BOD), total organic carbon. International standards for water and air quality and regulations

Chemical toxicology: Effect of toxic chemicals on enzymes. Lead, mercury and cyanide pollution and their biochemical effects. Carbon monoxide, sulfur dioxide, oxides of nitrogen, ozone – biochemical effects.

Quality control: ISI specification. Patent: Purpose and procedures

Module V

Industrial Applications

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

Suggested Readings

1. Norris Shreve, R. And Joseph A. Brink, Jr. Chemical Process Industries, 4th ed.; Mc Graw – Hill Kogakusha, Ltd: 1977.
2. George t. Austin. Shreve's Chemical Process Industries, 5th Ed.; Mc Graw – Hill: 1984.
3. Subba Rao, N. S. Biofertilizers In Agriculture; Oxford and IBH Publishing Co.: New delhi, 1982.
4. Jain, P. C. And Jain, M. Engineering Chemistry, 10th ed.; Dhanpat Rai and Sons: Delhi, 1993
5. Kamaraj, P.; Jeyalakshmi, R. And Narayanan, V. Chemistry in Engineering and Technology; Sudhandhira Publications: Chennai, 2001.
6. Kuriakose, J. C. And Rajaram, J. Chemistry in Engineering and Technology. Vol 2.; Tata Mc Graw – Hill: New Delhi, 1988.
7. De, A. K. Environmental Chemistry 2nd ed.; Wiley Eastern Ltd., 1987.
8. Stanley E. Mahanen: Introduction to Industrial Chemistry.
9. Jugal, Kishore, Agrawal, Practicals in Engineering Chemistry; Oxford and IBH Publishing Co., New Delhi, 1976.

M.Sc. Chemistry
Semester III: Theory
Polymer Chemistry
Code: 0902CH3104

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:
1. To impart basic knowledge of Polymer Chemistry.
2. To train the students to pursue further education.
3. To increase expertise of the course.

Course Outcome:
Skills that students obtain after completion of the course:
1. Understanding of the fundamentals of Polymer Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I
INTRODUCTION TO POLYMER
Classification of polymers and their characteristics, Natural, synthetic, linear, Cross linked polymers .Introduction to plastics, elastomers, fibres, Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy and decomposition of polymers.
Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) viscosity (ii) Light scattering method **(iii)** Gel Permeation Chromatography (iv) osmometry and ultracentrifuging.

Module II
KINETICS AND MECHANIISM FOR POLYMERIZATION
Addition polymerization: Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers : Ziegler Natta polymers.
Condensation polymerization,non catalysed, acid catalysed polymerization, molecular weight distribution Step growth polymers .

Module III
TECHNIQUES OF POLYMERIZATION AND POLYMER DEGRADATION
Bulk, Solution, Emulsion, Suspension, Melt polycondensation, solution polycondensation interfacial and gas phase polymerization
Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers.

Module IV
INDUSTRIAL POLYMERS
Raw material, preparation, fibre forming polymers, elastomeric material. Thermoplastics : Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester.
Elastomers : Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene. Conducting Polymers Elementary ideas ; examples : poly sulphur nitriles, poly phenylene, poly pyrrole and poly acetylene.

polyimides, polyamides, polyurethanes, polyureas, polyethylene and polypropylene glycols

Module V

Glass transition temperature and degradation of polymers (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg). Degradation of polymers by thermal, oxidative, mechanical and chemical methods.

Suggested Readings:

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996.
3. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
4. P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).
5. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).
6. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
7. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
8. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
9. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.
10. A. Kumar and S. K. Gupta, Fundamentals and Polymer Science and Engineering, Tata McGraw-Hill, 1978.

M.Sc. Chemistry
Semester III: Theory
Medicinal and Pharmaceutical Chemistry
Code: 0902CH3105

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Medicinal and Pharmaceuticals Chemistry.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.
4. To increase expertise of the course.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Medicinal and Pharmaceuticals Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

Module I

Local Anti Infective Drugs: - Introduction and general mode of action, synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole and griseofulvin.

Module II

Antimalarials: - Synthesis and properties of the following Anti malarial, 8-amino quinoline derivatives-pamaquine, primaquine, pentaquine, isopentaquine, 4-amino quinoline, derivatives- santoquine, camaquine, acridine derivatives-mepacrine, azacrin, pyrimidine and biquanide, derivatives-paludrine, pyremethamine.

Module III

Cardiovascular Drugs: - Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators synthesis of amylnitrate, quindine methylopa, sorbitrate and atenolol.

Antineoplastic Drugs: - Introduction, cancer chemotherapy, special problems, role of alkylating agents and anti metabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine.

Module IV

Drug Design: - Development of new drugs, procedure followed in drug design, concept of lead compound and lead modification, concept of prodrug and soft drug, Structure activity relationship (SAR), factors affecting bioactivity, Quantitative structure activity relationship (QSAR), Concept of drug receptors, Physico-chemical parameter, lipophylicity, partition coefficient, Free-Wilson analysis, Hansch analysis, relationship between Free-Wilson and Hansch analysis, LD-50, ED-50 (Mathematical derivation of equations. excluded).

Module V

Pharmacokinetics:- Introduction to drug adsorption, disposition, elimination using pharmacokinetics, important pharmacokinetic, parameter in defining drug disposition and in therapeutics', Mention of uses of pharmacokinetics in drug development process.

Pharmacodynamics: - Introduction, elementary, treatment of enzyme stimulation, enzyme inhibition, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry

Suggested Readings:

1. Natural Products Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs.
2. Organic Chemistry, D.V. Banthrope, Longman Essex, J. B. Harbrone.
   Streoselective Synthesis, M.Nogradi and CHV. Odds Chemistry of Carbon Compounds, ED.S. Coffey, Elsevier.
3. Biological and Pharmacological Properties of Medicinal Plants from Americans, M. P. Gupta and A. Marston, Harwood Academic Publishers.
4. Introduction to Flavonoids, B. A. Bohm. Harwood Academic Publishers.
5. New Trends in Natural Products, Rahman and M.I. Choudhary.
6. Insecticides of Natural Origin, Sukh Dev.
7. Text Book of organic Medicinal and Pharmaceutical Chemistry, Robert F. Dorde.
8. An Introduction to Drug Design, S.S. Pandeya and J.R. Dimmock.
9. Berger's Medicinal Chemistry and Drug Discovery, Vol-I (Chapter-9 and Ch-14). Goodman and Gillman's Pharmacological Basis of Therapeutics, Mc Graw Hill.
10. The Organic Chemistry of Drug Design and drug Action, R.B. Silverman. Strategies for Organic Synthesis and Design, D. Lednicer, John Wiley.
11. Burger. Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley (1994).
12. Goodman & Gilman. Pharmacological Basis of Therapeutics, McGraw-Hill (2005).
13. S. S. Pandeya & J. R. Dimmock.Introduction to Drug Design, New Age International.(2000).
14 D. Lednicer. Strategies for Organic Drug Synthesis and Design, John Wiley (1998).
15. Graham & Patrick. Introduction to Medicinal Chemistry (3rd edn.), OUP (2005)

M.Sc. Chemistry
Semester III: Theory
Nanoscience and Green Chemistry
Code: 0902CH3106

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Nanoscience and Green Chemistry.
2. To be familiar with different tools of Nanotechnology
3. To train the students to pursue further education.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Nanoscience and Green Chemistry and key principles of it.
2. Awareness of the major issues at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Introduction Nano Science

Introduction and definition of nanoparticles and nanomaterials, emergence of nanotechnology, Challenges of nanotechnology. Nanotechnology in relation to other branches of science. Structure of solids: crystalline and non-crystalline. Types of common materials and advanced materials inorganic, organic, biological. Types of nanomaterials depending upon their properties:

Module II

Preparation techniques and Applications: Various Preparation techniques in nanoscience synthesis-ceramic methods, solid solution, solgel, spray, pyrolysis, and combustion, electrosynthesis. Preparation of nanoscale materials, Applications Nanotechnology in modern technology in relation to electronic, biological, consumer and domestic applications. Energy related application: photo-volatile cells. Energy storage nanomaterials. Sensors: Agriculture, health and medical, food, security. Applied nanobiotechnology and nanobiomedical science drug delivery, drug targeting, biosensors, bioimaging, neutron capture therapy.

Module III

Basic Principles of Green Chemistry:- Prevention of waste by products, maximum incorporation of the reactants into the final product, prevention or minimization of hazardous products, designing safer chemicals, energy requirements for synthesis, selection of appropriate solvent, selection of starting materials, use of protecting groups, use of catalyst, productsdesigned be biodegradable, designing of manufacturing plants & strengthening of analytical techniques.

Module IV

Green Reagent

Dimethylcarbonate, polymer supported reagent, polymer supported peracids, poly, eric thioanisolyl resin. Poly-N-bromosuccinimide (PNBS), sulfonazide polymer, polystyrene wittig reagent & polymer supported peptide coupling agent.

Module V

Green Catalyst

Acid catalyst, oxidation catalyst, basic catalyst, polymer supported catalyst, polystyrene – aluminium chloride, polymer supported photosensitizers, miscellaneous illustration & solid support reagents.

Suggested Readings:

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
2. P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).
4. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
7. Introduction to nanotechnology, C. P. Poole Jr, F. J. Owens, 2 nd edition, Wiley-India, Delhi, 2008.
8. Nanostructures and nanomaterials, G. Cao, Imperial College Press, University of Washington, USA, 2004.
9. Biomaterials, S. V. Bhat, 2nd edition, Narasa Publishing house, New Delhi, 2005.
10. Nanotechnology Fundamentals and applications, M. Karkare, I. K. international publishing house pvt. Ltd., Bangalore, 2008.
11. Nanomaterials: Synthesis, properties and applications, A. S. Edelstein, T. C. Cammarata, Inst. Of. Physics, UK, 1966.
12. Springer Handbook of Nanotechnology, B. Bhusan, 3rd edition, Springer-Verlag, 2009.
13. Chemistry of Nanomaterials: Synthesis, Properties and Applications, CNR Rao and T. Cheetham, Wiley & Sons, 2005.
14. Encyclopedia of Nanotechnology, Hari Singh Nalwa, American Scientific Publishers, 2004.

M.Sc. Chemistry

Semester III: Practical

Lab Course V

Code:

0902CH3207

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

A. Quantitative Analysis:

1. Quantitative separation and determination of three-component system using standard volumetric and gravimetric methods of analysis. The system can be any one of the following.

(I) Cu, Ag & Zn

(II) Cu, Ni & Zn

(III) Fe, Al & Ca

(IV) Fe, Ca & Mg

(V) Ag, Ni & Zn

B. Analysis of alloys ores and minerals.

(I) Ni alloy

(II) Cu, Ni, Zn alloy

(III) Steel

(IV) Lime stone and dolomite: - Silica, Sesqui oxide (R3O3), Ca, Mg, L.O.I.etc.

(V) Haematite: - Iron, Al, Ca, Mg. Acid insoluble & silica etc.

(VI) Bauxite: - Silica, Fe, Al, Be, Ti etc.

(VII) Cement: - Silica, Fe, Al, Ca, and Mg & SO-24 etc.

C. **Inorganic Reaction Mechanism:** Kinetic and mechanism of following reaction:

(I) Substitution reaction in octahedral complexes (acid hydrolysis and base hydrolysis).

(II) Redox reaction in octahedral complexes.

(III) Isomerisations reaction of octahedral.

D. **Preparation:** Preparation of selected Inorganic complexes and other inorganic compounds and their study by IR, electronic, Mossbauer and ESR, spectra and magnetic susceptibility

Measurements.

1. Sodium amide, Lnorg Synth.1946, 2,128.
2. Synthesis & thermal analysis of group II metal oxalate hydrate. Chem., Ed., 1988, 65, 1024.

3. Preparation of Tin (IV) & Iodide, Tin (IV). Chloride and Tin (II) Iodide. Inorg. Synth., 1953, 4,119.
4. Synthesis of metal acetylacetonate; Magnetic moment, IP, & NMR, Inorg Synth 1957, 5, 130,
5. Bromination of Cr (acac) 3 J. Chem. Educ. 1986, 63, 90,
6. Cis and Trans [Co(en)2Cl2]+.
7. Separation of optical isomer of cis [$Co(en)_2Cl2$] NO_3. 3H2O, [Cr(H2O)4 Cl2]Cl.2H2O and [Cr(en)Cl3]. [Cr(acac)3], Inorg.Synth.1972, 13, 184.
8. Reaction of Cr (III) with a multidentare ligand; a kinetic experiment (visible spectra Cr.-EDTA complex) J.A.C.S., 1953, 76, 5670.
9. Preparation of [Co (phenonthroline –5, 6-quinone] J. Chem. Soc, A., 1970, 447; J. Chem. Edu. 1977. 54, 710.
10. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43,73; 196,53,730.
11. Preparation of copper glycine complex – cis and transbis [glycinato Copper (II)]. J. Chem. Soc. Dalton, 1979, 1901, J. Chem. Edu. 1982, 59, 1052.
12. Preparation of phosphine PH3P and its transition metal complexes.
13. Any other experiment such as conversion of p-xylene to terphthalic acid catalyzed by $CoBr_2$(homogeneous catalysis).

E. **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.

F. Titrimetric/ Gravimetric Determinations

1. Mn in steel/ Iron by Bismuthal/ Linganare-Karplns/ Iodate method.
2. Mn in Pyrolusite ore.
3. Ni in steel by DMG method.
4. Pb by Dithiozone precipitation method.
14. Preparation of copper glycine complex – cis and transbis [glycinato Copper (II)]. J. Chem. Soc. Dalton, 1979, 1901, J. Chem. Edu. 1982, 59, 1052.
15. Preparation of phosphine PH3P and its transition metal complexes.
16. Any other experiment such as conversion of p-xylene to terphthalic acid catalyzed by $CoBr_2$(homogeneous catalysis).

E. **Bio-Inorganic Chemistry**:

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5. Mn in steel/ Iron by Bismuthal/ Linganare-Karplns/ Iodate method.
6. Mn in Pyrolusite ore.
7. Ni in steel by DMG method.
8. Pb by Dithiozone precipitation method.

M.Sc. Chemistry

Semester III: Practical

Lab Course VI

Code:

0902CH3208

Credit: 2

Total Marks: 50 (35+15)

Course Objectives:

1. To impart practical knowledge hands-on experience
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
2. Ability to dissect a problem in to its key features.
3. Ability to design experiments and understand the limitations of the experimental approach

1. Multi step Synthesis of Organic Compounds

1. Beckmann rearrangement: Benzanilide from brenzene (Benzene BenzophenoneBenzophenoneoximeBenzanilide).
2. Benzilic acid rearrangement: Benzilic acid from Benzoin (BenxoinBenzilBenzillic acid)
3. Skraup's synthesis (Synthises of heterocyclic compounds) Quinoline from o-amino phenol
4. m-nitroaniline from benzene (Benzene nitrobenzene m-dinitrobenzene m-nitroaniline)
5. Acridone from anthracitic acid (Anthracitic acid o-chlorobenzoic acid N-phenylanthranilic acid acridone).
6. Enzymatic synthesis: Enzymatic reduction: Reduction of ethylacetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ethyl-3–hydroxybutanoate and determine its optical purity. Biosynthesis of ethanol from sucrose.

2. Extraction of Organic Compounds from Natural Sources

1. Isolation of caffine from tea leaves.
2. Isolation of casein from milk: perform colour reaction of protein.
3. Isolation of lactose from milk: purity of sugar should be checked by TLC and PC and Rf value reported.
4. Isolation of nicotine dipicrate from tobacco.
5. Isolation of cinchonine from cinchona bark.
6. Isolation of piperine from black pepper.
7. Isolation of lycopene from tomatoes.
8. Isolation of β-carotene from carrots.
9. Isolation of limonene from citrus rinds.
10. Isolation of protein and carbohydrates from seeds – colour test.
11. Extraction of fatty oil from seeds and determination of refractive index of the oil.
12. Isolation of protein and carbohydrate (as reducing sugars) from seed-colour test.

3. Spectrophotometric Determination

1. Mn, Cr and V in steel sample.
2. Ni, Mo, W, V and U by extractive spectrophotometric method.
3. Fe- phenonthrolein complex, Jobs' method of continuous variation.
4. Zirconium-alizarin red – S complex: Mole ratio method.
5. Cu-ethylene diamines by slope ratio method.

4. Nephelometric/ Turbidimetric Determination

1. Sulphate
2. Phosphate
3. Silver

5. Chromatography

1. Separation and identification of the Sugars present in given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.
2. Thin - layer chromatography:- Separation of Ni, Mn, Co, and Zn and determination of Rf values.

6. Industrial Chemistry

1. Estimation of available chlorine in bleaching powder.
2. Estimation of hardness of water.
3. Estimation of active matter content in a detergent.
4. Estimation of nitrogen in the fertilizer.
5. Estimation of phosphate in a superphosphate sample.
6. Estimation of potassium by flame photometric method.
7. Estimation of Iron (III) by colorimetry.
8. 8. Estimation of calcium in calcium tablet.
9. Determination of viscosity and flashpoint in lubricating oil.
10. Preparation of Aspirin.
11. Preparation of a dye.
12. Preparation of polyvinylacetate or polyacrylamide.
13. Laboratory method of preparation of Iron sulphate.




M.Sc. Chemistry
Semester III: Theory
Instrumental Method of Analysis
Code: 0902OE3309

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of Instrumental Method of Analysis.
2. To train the students to pursue further education.
3. To be familiar with Chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of Instrumental Method of Analysis and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

BASICS OF MEASUREMENT: Classification of methods – calibration of instrumental methods – electrical components and circuits – signal to noise ratio – signal – noise enhancement, Principle and instrumentation of pH meter, Conductometer, Potentiometer

Module II

OPTICAL METHODS: General design – sources of radiation – wavelength selectors – sample containers – radiation transducers – types of optical instruments – Fourier transform measurements.

Module III:

MOLECULAR SPECTROSCOPY: Measurement of transmittance and absorbance – beer's law – spectrophotometer analysis – qualitative and quantitative absorption measurements - types of spectrometers – UV – visible – IR – Raman spectroscopy – instrumentation – theory.

Module IV:

THERMAL METHODS AND CHROMATOGRAPHY: Thermo-gravimetric methods – differential thermal analysis – differential scanning calorimetry.

Chromatography: Solvent extraction – principles of ion exchange, paper, thin layer and column Chromatography techniques – Columns, adsorbents, methods, Rf values, McReynold's constants and their uses – HPTLC, HPLC techniques – Adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques: methods, principles and uses.

Module V

SEPARATION METHODS: Introduction to chromatography – models – ideal separation – retention parameters – van – deemter equation – gas chromatography – stationary phases – detectors – kovats indices – HPLC – pumps – columns – detectors – ion exchange chromatography – size exclusion chromatography – supercritical chromatography – capillary electrophoresis.

Suggested Readings:

1. Instrumental Methods of Analysis; Willard and .H. Merrit, Phi, 1999.
2. Instrumental Methods of Analysis, D. Skoog, 2000.

3. D.B.Hibbert and J.J. Gooding, Data Analysis for chemistry, Oxford University Press, 2006
4. J.Topping, Errors of Observation and their treatment, Fourth Edn., Chapman Hall, London, 1984
5. R. Stock and C. B. F. Rice, Chromatographic Methods, Chapman and Hall, New York.
6. V.K.Srivastava & K.K. Srivastava, Introduction to Chromatography, S. Chand & Co., New Delhi, 2nd ed, 1981.
7. Willard, Merrit, Dean and Settle, Instrumental methods of Analysis CBS Publishers and Distributors, 6th ed., 1986.
8. A.Sharma, S.G. Schulman, Introduction to Fluoresceence Spectroscopy, Wiley-Interscience. New York,1999
9. C.N.Banwell and E.M.McCash, Fundamentals of Molecular spectroscopy, 4th ed., Tata McGraw-Hill, New Delhi, 1994.

M.Sc. Chemistry

Semester III: Theory

IPR and Research Methodology

Code: 0902OE3310

Credit: 4

Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of IPR and Research Methodology.
2. To train the students to pursue further education.
3. To be familiar with laws of IPR.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of IPR and Research Methodology and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I

Introduction to Intellectual Property; Types of IP; Importance of IPR; Patents, Trademarks, Copyright and Related rights, Industrial Design; Traditional knowledge; Geographical indications; Patent life, Legal protection of biotechnological inventions; World Intellectual Property Rights Organization (WIPO); Protection of GMOs; Relevance of IP in Biotechnology.

Module II

History of Indian Patent System and Law; Patent file procedures; Types of Patent; Status of the patent applications; Precautions during patenting; Patentable and Non-Patentable items; Patent cooperation treaty (PCT); Patent and compulsory licensing. Indian Patent Act 1970 and Recent Amendments; GATT and TRIPS agreement; WIPO Treaties.

Module III

Introduction, Meaning, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods Versus Research Methodology, Research & Scientific Method, Significance of knowledge of Research Methodology, Process of Research, Criteria of Good Research, Limitations of Research, Research Problem, Selecting a Problem, Necessity of defining the Problem, Techniques involved in defining a Problem, Hypothesis- Meaning & Characteristics, Research Design – Meaning, Need for Research Design, Features of good design, Developing a Research Plan Information sources for Literature search.

Module IV

Data Analysis: Elements of Analysis, Central tendency, Dispersion, Asymmetry (Skewness), Correlation and Regression analysis; t – test, f – test, chi-square test, Analysis of variance (ANOVA). Sampling: Steps in sample design, Sampling procedure, Characteristics of a Good Sample Design, Different types of Sample design.

Module V

Meaning of Interpretation, Why Interpretation?, Technique of Interpretation, Precaution in Interpretation, Significance of Report writing, Different steps in writing report, Layout of the Research

Report, Types of Reports, Mechanics of writing a Research report, Precautions for writing Research Reports, Conclusions, Oral presentation.

Suggested Readings:

1. Biotechnologies and Development: Sasson A., UNESCO Publications, 1988.
2. Singh K., Intellectual Property Rights on Biotechnology, BCIL, and New Delhi
3. Research Methodology Methods and Techniques: C. R. Kothari
4. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, SAGE Publications (April 5, 1999)
5. Research Methodology: Dr. Vijay Upagade and Dr. Arvind Shende.

M.Sc. Chemistry
Semester IV: Theory
Nuclear and Solid State Chemistry
Code: 0902CH4101

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:
1. To impart basic knowledge of nuclear and solid state Chemistry.
2. To train the students to pursue further education.
3. To be familiar with tools of nuclear chemistry.

Course Outcome:
Skills that students obtain after completion of the course:
1. Understanding of the fundamentals of nuclear and solid state Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I:

Systematic of alpha, beta and gamma decays : Electronic structure of atom, Radio activity ,Decay, Alpha decay, energy curve, spectra of alpha particles, Giger-Nuttal law, theory of alpha decay, penetration of potential barrier, beta decay, range of energy relationship, beta spectrum, sergeants curve, Fermi theory of beta decay, matrix elements, allowed and forbidden transitions, curie plots, gamma decay, Nuclear energy levels, selection rule, isomeric transitions, Internal conversion, Auger effect.

Module II:

Radiactive Equiliberia – Types of Neclear reactions – Nuclear fision Nuclear Reactors – Atomic Power Project in India – Radiation hazards – Radiation desimetry – Nuclear fusion – Stellar Energy. Radio active Isotopes, Methods of separation of Isotopes Application of Radioactivity – Tracer Techniques – Neutron - Activation analysis – Isotope Dilution Analysis – Application of Radioisotopes in biological and industrial field.

Module III: Detection of Nuclear Radiations: - Techniques, equipments, G.M. counter, proportional counter, Scintillation counter, counting statistics, Q-values, energetic, cross sections, resonance, compound nucleus theory of nuclear reaction, types of nuclear reactions chemical effects of nuclear transformations, Szilard- Chalmer Reaction and recoil chemistry, retention.

Module IV: Solid State:-Introduction to different types of Solid, Crystal Structures, Bravices lattices, X-Ray diffraction, Bragg's equation, Electron and Neutron diffraction, Band theory of conductors, semiconductors an insulators, Superconductivity

Crystal Defects: - Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defects formation, colour centers, non-stoichiometry and defects.

Module V: Electronic Properties and Band Theory: - Metals, insulator and semiconductors, electronic, structure of solids-band theory, band structure of metals, insulator and semiconductors. Intrinsic optical properties- optical reflectance, photoconduction photoelectric effects

Magnetic Properties- Classification of materials, Theory of paramagnetic cooperative phenomena magnetic domains, hysteresius.

Organic Solids: - Electrically conducting solids, organic charge transfer complex, organic metals, and new super conductors

Suggested Readings:

1. Introduction of Solids L.V Azaroff , Tata McGraw Hill
2. Principles of the solid state H. V. Keer, Wiley Eastern (1993)
3. Selected topics in solid state physics Vol. 12, The growth of crystals from liquids –J. C. Brice, North Holland/American Elsevier (1973)
4. Defects and diffusion in solids. S. Mrowec Elseivier publ.(1960)
5. Treatise on solid state chemistry, ED-N.B. Hannay, Plenum press Vol –2 (1975)
6. Essentials of Nuclear Chemistry H. J. Arnikar, 4th Edition (1995), New Age International (p) Ltd., Wiley Eastern Ltd., New Delhi.

M.Sc. Chemistry
Semester IV: Theory
Photochemistry
Code: 0902CH4102

Credit: 4
Total Marks: 100 (70+30)

Course Objectives:
1. To impart basic knowledge of Photochemistry.
2. To train the students to pursue further education.
3. To be familiar with tools of Photochemistry.

Course Outcome:
Skills that students obtain after completion of the course:
1. Understanding of the fundamentals of Photochemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.

Module I
Basics of Photochemistry:
Absorption, excitation, photochemical laws, quantum yield, electrically excited states-life times-measurement of the times, flash photolysis, Absorption spectra, frank-Condon principle, photochemical stages-primary and secondary processes, structure dipole moment, acid base strength, reactivity of excited state.

Module II
Photophysical processes in electronically excited molecules:
Types ofphotophysical pathways, Radiation less transition Fluorescence, Phosphorescence, State diagrams, Delayed Fluorescence, effect of Temperature on emission. Photo-physical kinetics of unimolecular and Bimolecular processes, Bimolecular collision in gases and vapors and the Mechanism of Fluorescence Quenching, Kinetics of collisional quenching: Stern-Volmer Equation.

Module III: **Photo-Inorganic**
Ligand Field Photochemistry:
Photo substitution, photo oxidation and photo reduction, liability and selectivity, water photolysis, Nitrogen fixation and photosynthesis.
Redox Reactions by Excited Metal Complexes:
Energy transfer under conditions of weak interaction and strong interaction-exciplex formation, conditions of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2, -bipyridine and 1,10-phenonthroline complexes), illustration of reducing and oxidizing character of Ruthenium^{II}(bipyridal) complex.

Module IV: Photo-organic chemistry
Photochemistry of carbonyl compounds:
Norrish Type I and II process, Intramolecular reaction of Acyclic carbonyl compounds,, Intramolecular Photoreaction of saturated and β,γ- unsaturated carbonyl compounds, intramolecular reaction in α, β-unsaturated carbonyl compounds, intramolecular reaction in cyclic carbonyl compounds, Cycloaddition reaction, Oxetane Formation, PhotocycloDimerisation of Carbonyl compounds.

Module V: **Miscellaneous Photochemical Reactions**

Photo-Fries Rearrangement, Photo fries reaction of Anilides, Barton reaction, Photo oxygenation, singlet molecular oxygen reaction, photochemical formation of Smog, photodegradation of polymers, Photochemistry of Vision.

Photoaddition of aromatic Compounds, Photochemical aromatic substitution.

Suggested readings:

1. Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
2. Inorganic Photochemistry, J. Chem. Educ, Vol.60, no. 10,1983.Progress in inorganic Chemistry, Vol.30, ed. S.J. Lippard, Wiley.
3. Fundamental of Photochemistry, K KRohatgi-Mukherjee New Age International.
4. Principles and Applications of Photochemistry , Brian Wardle.
5. Photo chemistry chemistry, Alka L Gupta.