PROGRAM PROJECT REPORT (PPR)

MASTER OF SCIENCE

IN

CHEMISTRY
(M. Sc. Chemistry)

MATS Centre for Distance and Online Education (MCDOE)

MATS University, Raipur, Chhattisgarh

MATS UNIVERSITY: VISION

To become a world-class center in providing globally relevant education. MATS will be the Global University, known for the quality academic Programs and outstanding faculty, products, and services to students and clients independent of place and time constraints. MATS University will be a benchmark institution for lifelong partnerships with students, the workforce, and public and private enterprises. Building on its proud tradition, MATS University will extend educational opportunities to those who will make our state (Chhattisgarh), our nation, and global society a better place to live and work.

MATS UNIVERSITY: MISSION

To foster an intellectual and ethical environment in which the spirit and skills within MATS will thrive so as to impart high quality education, training, research and consultancy services with a global outlook and human values. To create and develop technocrats, entrepreneurs and business leaders who will strive to & improve the quality of human life. To create truly world class schools of Management Sciences, Engineering Sciences, Information Technology, Life Science, Basic and Applied Sciences, Humanities & Social Sciences and Life Skills.

[Dr. Ashish Saraf]
Prof. & Head
School of Sciences

[Dr. Sandhyarani Panda]
Professor

[Dr. Nitin Jaiswal]
Professor

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A. Program's Mission and Objectives:

Mission:

The mission of the Open and distance learning Master of Science in Chemistry (M.Sc. Chemistry) Program is to create technocrats in the applied branches of Chemical Sciences to convey updated scientific knowledge. Chemistry is the Industry & research-oriented science including Inorganic, Organic, Physical, & Analytical Chemistry and Chemical technology. Chemistry can be applied in developing various Drugs & Medicines, Dyes, Paints, Plastics, Waste treatments, improving energy production and increasing productivity. The updated knowledge of the subject both theoretical and practical will make them compatible to secure plenty of opportunities in Chemistry field through distance learning education.

Objectives:

The open and distance learning Master of Science in Chemistry (M.Sc. Chemistry) Program is a two-year postgraduate Program that focuses on business administration.

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 issuesrelated to Chemistry applications nationally and globally.
7. To Gain experience with standard Chemistry tools and approaches.

B. Relevance of the Program with University's Mission and Goals:

The open and distance learning M. Sc. Chemistry Program aligns with MATS University's mission to cultivate a learning environment that encourages creativity, innovation, and critical thinking. It is designed to offer a high-quality education in chemical sciences, equipping students with the knowledge and skills needed to excel in the field of science. The Program focuses on developing competent professionals capable of making meaningful contributions to industry and society. The Chemical Industry is constantly growing and in the past 10 years, human resources in the field have grown drastically. Indian Chemical industry comprises of Research, New drug discovery, Chemo-informatics, R&D, Pharmaceuticals etc. The programme offer practical and project-based learning, students enhance their teamwork, problem solving approach,communication skills and essential qualities in the vibrant field of chemical science.

C. Nature of Prospective Target Group of Learners:

The program is exclusively for learners who are unable to achieve their educational goals through the traditional method of instruction are the target audience for this program, which was developed expressly to satisfy their needs. Our target population of learners consists of individuals who are working professionals, housewives, who live in tribal or rural areas, and who are unable to participate in the normal curriculum for a variety of reasons. Individuals who are interested in enrolling themselves in this particular program are required to have a degree that is equivalent to or equivalent to a graduation from any field.

D. Project Base Learning of Program to Acquire Specific Skills and Competence:

The open and distance learning mode of MATS University system places greater emphasis on the learner, where most of the instruction is delivered through distance mode with only a minimal component of face-to-face communication. Students will have the flexibility to learn at their intellectual strength. The content of teaching learning has been prepared in such a way that the students taking admission in open distance learning education system will not face any problem in studying and understand the content they can easily access course materials and resources available. Those students who are enrolled in classes that are provided through Open Distance Learning will have the opportunity to learn in an environment that is driven by technology. This environment will include learning materials, classroom discussions, and a range of tools that can be used to collaborate with both classmates and instructors. In order to facilitate the development of analytical, problem-solving, and critical-thinking skills, this provides a learning environment that is not only immersive but also interesting.

Designed to give flexibility, the open and distant learning M.Sc. Chemistry program lets students manage employment, family life, and education at their own speed. It provides thorough educational materials meant to encourage autonomous, independent study.

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E. Instructional Design:

Curriculum Design, Detailed Syllabi and Duration:

The M.Sc. Chemistry Program of MATS Centre for Open and Distance Education, offers run for the period of two years which is divided in four semesters. This Program comes under the MATS School of Sciences. M.Sc. Chemistry is a postgraduate Program designed to provide in-depth knowledge of chemical science, covering fundamental to advanced concepts and their applications.

Credit Points:

All courses within this program provided by MATS Distance Learning Education assign "credit points," which represent a numerical value attributed to a course, indicating the requisite effort and study for successful completion, and are employed to determine if the conditions for an award have been met. Maintain a specific value as credit points. A credit point denotes the number of learning hours necessary to complete a specific unit of a course. One credit point corresponds to 30 learning hours, which encompassself-study, contact classes, assignments, projects, and all activities associated with the program required toobtain the postgraduate degree.

Total credits of the M.Sc. Chemistry Program are 92. The Teaching and Examination Scheme is asfollows:

Semester-wise distribution of Credits for M.Sc. Chemistry:

Srl. No.	Semester	Number of Credits
1	Semester – 1	24
2	Semester – 2	24
3	Semester – 3	24
4	Semester – 4	20
	Total Credits	**92**

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Teaching & Examination Scheme (Matrix M.Sc. Chemistry)

M.Sc. Chemistry Semester I						
	Code	**Subject**	**Credit (L+T+P)**	**External**	**Internal**	**Total**
Core Course	ODL/MSS/MSCCH/101	Inorganic chemistry I	4	70	30	100
	ODL/MSS/MSCCH/102	Organic chemistry I	4	70	30	100
	ODL/MSS/MSCCH/103	Physical chemistry I	4	70	30	100
	ODL/MSS/MSCCH/104	Spectroscopy I	4	70	30	100
Laboratory	ODL/MSS/MSCCH/105	Lab Course I	2	35	15	50
	ODL/MSS/MSCCH/106	Lab Course II	2	35	15	50
Open Elective	ODL/MSS/MSCCH/107	Environmental and Analytical Chemistry **OR** Management in Practice	4	70	30	100
		Total	**24**	**420**	**180**	**600**
M.Sc. Chemistry Semester II						
Core Course	ODL/MSS/MSCCH/201	Inorganic chemistry II	4	70	30	100
	ODL/MSS/MSCCH/202	Organic chemistry II	4	70	30	100
	ODL/MSS/MSCCH/203	Physical chemistry II	4	70	30	100
	ODL/MSS/MSCCH/204	Spectroscopy II	4	70	30	100
Laboratory	ODL/MSS/MSCCH/205	Lab Course III	2	35	15	50
	ODL/MSS/MSCCH/206	Lab Course IV	2	35	15	50
Open Elective	ODL/MSS/MSCCH/207	Material Chemistry **OR** Computer Application and Statistics	4	70	30	100
		Total	**24**	**420**	**180**	**600**
M.Sc. Chemistry Semester III						
Core Course	ODL/MSS/MSCCH/301	Organotransition Metal Chemistry	4	70	30	100
	ODL/MSS/MSCCH/302	Biochemistry and Natural Products	4	70	30	100
Core/ Discipline Based Elective	ODL/MSS/MSCCH/303	Industrial Chemistry **OR** Polymer Chemistry	4	70	30	100

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	ODL/MSS/MSCCH/304	Medicinal and Pharmaceutical Chemistry **OR** Nanoscience and Green Chemistry	4	70	30	100
Laboratory	ODL/MSS/MSCCH/305	Lab Course V	2	35	15	50
	ODL/MSS/MSCCH/306	Lab course VI	2	35	15	50
Open Elective	ODL/MSS/MSCCH/307	Instrumental Methods of Analysis **OR** IPR and Research Methodology	4	70	30	100
		Total	**24**	**420**	**180**	**600**
M.Sc. Chemistry Semester IV						
Core Course	ODL/MSS/MSCCH/401	Nuclear and Solid StateChemistry	4	70	30	100
	ODL/MSS/MSCCH/402	Photochemistry	4	70	30	100
	ODL/MSS/MSCCH/403	Project	8	140	60	200
	ODL/MSS/MSCCH/404	Project Seminar	2	35	15	50
	ODL/MSS/MSCCH/405	Viva-Voce	2	35	15	50
		Total	**20**	**350**	**150**	**500**
	L = Lecture T = Tutorial P = Practical		**92**	**1610**	**690**	**2300**

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M.Sc. Chemistry Semester I:
Theory Inorganic Chemistry I

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

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, □ 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.

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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.

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M.Sc. Chemistry
Semester I:
Theory Organic
Chemistry I

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

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 □ 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

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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

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M.Sc. Chemistry
Semester I:
Theory Physical
Chemistry I

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

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.

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Module III

Applications of Quantum Mechanics-

MO theory of hydrogen molecule ion. Secular equation and its solution. Electron density distribution and stability of H_2^+ ion. MO and VB theories of H_2. 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 H_2-Cl_2, H_2-Br_2, and decompositions of ethane, acetaldehyde and N_2O_5. 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

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M.Sc. Chemistry
Semester I:
Theory
Spectroscopy I
Code:
0902CH1104

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

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.

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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

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M.Sc. Chemistry
Semester I:
Practical Lab
Course I

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

Laboratory

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

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M.Sc. Chemistry
Semester I:
Practical Lab
Course II

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

Laboratory

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).

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

Credit – 4
Total Marks: 100 (70+30)

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

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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

MATS UNIVERSITY ★ RAIPUR ★

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

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

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

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- Financial Management by Khan and Jain
- Financial Management by Dr. Prasanna Chandra
- Marketing Management by Philip. A. Kotler
- Human Resource Management by Edward Flipo

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M.Sc. Chemistry
Semester II: Theory
Inorganic Chemistry
II

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

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

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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.

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M.Sc. Chemistry
Semester II:
Theory Organic
Chemistry II

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

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.

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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.

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M.Sc. Chemistry
Semester II:
Theory Physical
Chemistry II

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

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

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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.

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M.Sc. Chemistry
Semester II:
Theory
Spectroscopy II

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

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

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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.

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

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

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.

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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 $Zn + H_2SO_4 \square ZnSO_4 + 2H$.

c. Polarimetry

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

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M.Sc. Chemistry
Semester II: Practical

Lab Course IV

(Analytical)

Credit: 2

Total Marks: 50 (35+15)

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 □max 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.

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

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

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.

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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.

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

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

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:

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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.

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M.Sc. Chemistry
Semester III:
Theory
Organotransition Metal Chemistry

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

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.

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

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

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

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

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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.

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M.Sc. Chemistry
Semester III:
Theory Industrial
Chemistry

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

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

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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.

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M.Sc. Chemistry
Semester III:
Theory Polymer
Chemistry

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

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.

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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.

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M.Sc. Chemistry
Semester III:
Theory
Medicinal and Pharmaceutical Chemistry

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

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).

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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-HilI (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)

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M.Sc. Chemistry
Semester III:
Theory
Nanoscience and Green Chemistry

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

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

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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.

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M.Sc. Chemistry
Semester III:
Practical Lab
Course V

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

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.

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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**:
   (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

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.

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M.Sc. Chemistry
Semester III:
Practical Lab
Course VI

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

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**

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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.

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

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

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.

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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.

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M.Sc. Chemistry
Semester III:
Theory
IPR and Research Methodology

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

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.

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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.

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

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

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.

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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.

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M.Sc. Chemistry
Semester IV:
Theory
Photochemistry

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

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.

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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.

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Project
ODL/MSS/MSCCH/403

Credit 8
Total Marks 200 (140+60)

Selection of organization/ institution / industries for project

When selecting a research organization for your project work, prioritize access to relevant resources, a supportive and conductive research environment, and a strong faculty/mentor with expertise in your program area.

- Ensure the organization has access to the necessary data, equipment, and facilities for your research project.
- Relevant databases and online resources is crucial for literature reviews and research.
- Assess if the organization provides access to the software and tools required for data analysis and research tasks.
- Seek out organizations with faculty members whose research interests align with your dissertation topic and who can provide guidance and mentorship.
- Look for opportunities to connect with other intern or students and attend conferences or workshops within the organization.

Practical Considerations:

Evaluate the time commitment required for research and ensure it aligns with your project/ dissertation timeline and other academic commitments.

TOPIC OF THE PROJECT: This should be explicitly mentioned at the beginning of the Synopsis. Since the topic itself gives a peep into the project to be taken up, candidate is advised to be prudent on naming the project. This being the overall impression on the future work, the topic should corroborate the work.

OBJECTIVE AND SCOPE: This should give a clear and specified idea and image of the project. Objective should be clearly written and justifying the title of project. What the project ends up to and in what way this is going to help the end user has to be mentioned.

INTRODUCTION: The introduction establishes the framework for your research by offering context, delineating your topic and scope, articulating your research questions or aims, and succinctly summarising the structure of your project/ dissertation.

REVIEW OF LITERATURE: In the context of a dissertation, a literature review is a comprehensive and critical summary of existing research and scholarly work relevant to your project/ dissertation topic, demonstrating your understanding of the field and establishing the context for your own research and at the closer of review research gap should be clearly mentioned.

MATERIAL AND METHODS: In this section details how the research was conducted, including the specific materials, techniques, and procedures used, ensuring the study can be replicated and evaluated by others.

RESULT AND DISCUSSION: The "Results" section presents the findings of your research objectively, it should present the findings of your research in a clear, concise, and unbiased manner including statistical data, tables, figures, or qualitative data summaries. "Discussion" section should include the meaning of the results, explaining what they

mean and why they are significant interprets the findings of results, placing them in context, and drawing conclusions and implications.

CONCLUSION: The write-up must end with the concluding remarks-briefly describing innovation in the approach for implementing the Project, main achievements and also any other important feature that makes the system stand out from the rest.

The following suggested guidelines must be followed in preparing the Final project Report:

Good quality white executive bond paper A4 size should be used for typing and duplication. Care should be taken to avoid smudging while duplicating the copies.

Page Specification: (Written paper and source code)

- Left margin - 3.0 cms
- Right margin- 2.0 cms
- Top margin 2.54 cms
- Bottom margin 2.54 cms
- Page numbers - All text pages should be numbered at the bottom center of the pages.

Normal Body Text: Font Size: 12, Times New Roman, Double Spacing, Justified. 6 point above and below para spacing

Paragraph Heading Font Size: 14, Times New Roman, Underlined, Left Aligned. 12 point above & below spacing.

Chapter Heading Font Size: 20, Times New Roman, Centre Aligned, 30 point above and below spacing.

Binding:: The project report should be book binding (Spiral binding and other forms of bindings are not permitted)

Submission of Project Report to the MATS: The student will submit his/her project report in the prescribed format. The Project Report should include:

1. One copy of the summary/abstract.
2. Two hard Copy of the Project Report.
3. Soft copy of project on CD in a thick envelope pasted inside of the back cover of the project report.
4. The Project Report may be about 75 pages.

FORMAT OF THE STUDENT PROJECT REPORT ON COMPLETION OF THE PROJECT

- Cover Page as per format
- Acknowledgement
- Certificate of the project guide as at Annexure III
- Certificate of the Company/Organization
- Synopsis of the Project
- Main Report
    - Objective & Scope of the Project
    - Theoretical Background Definition of Problem
    - Methodology adopted,

Annexure:

1. List of abbreviations, Figures, Tables

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2. References
   Bibliography
   Website
3. Soft copy of the project on CD

Formats of various certificates and formatting styles are as follows:

1) Certificate from the Guide

Guide Name & Designation Full Address

CERTIFICATE

This is to certify that this project entitled "xxxxxx xxxxx xxxxx xxxx xxxx xxx" submitted in partial fulfillment of the degree of Master of Science in Chemistry to the MATS, Raipur, done by Mr. /Ms. _____, Roll No. _____ is and is an authentic work carried out by him/her at _____ under my guidance. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

Signature of the student Signature of the Guide

2) Project Report Cover Page Format:

Title of the thesis/report (Times New Roman, Italic, Font size = 24)

Submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Computer Applications (Bookman Old Style, 16 point, center)

Guide Submitted by:

(Guide Name) (Student's name) Roll No.:

Submitted to MATS, RAIPUR
LOGO

3) **Declaration by the students**

This is to certify that the dissertation/project report entitled "_____" is done by me is an authentic work carried out for the partial fulfilment of the requirements for the award of the degree of Master of Science in Chemistry under the supervision of _____. The content and matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

Signature of the student

Name of the Student

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Roll No

ACKNOWLEDGEMENTS

In the "Acknowledgements" page, the writer recognizes his indebtedness for guidance and assistance of the thesis adviser and other members of the faculty. Courtesy demands that he also recognize specific contributions by other persons or institutions such as libraries and research foundations. Acknowledgements should be expressed simply, tastefully, and tactfully.

Project Seminar

Credit 2
Total Marks 50 (15+35)

Part of the scientific supervision carried out by the dissertation supervisor and is aimed at ensuring student autonomy in the writing of their dissertation. It allows students to evaluate their progress in their research and enables the supervisor to make comments and offer advice.

Viva Voce

Credit 2
Total Marks 50 (15+35)

In the context of a Project/ dissertation thesis, a "viva voce" (often shortened to "viva") is a formal oral examination where a student defends their research before the examiner appointed by University. It's essentially the final assessment, determining if the student has met the requirements for their degree.

Duration of the Program:

The minimum duration of the Program is 02 years and maximum duration is 04 years.

Medium of the Program:

English is the medium of the Program and examination may be written in English or Hindi as per the learner's choice of the medium.

Requirement of Faculty and Supporting Staff:

Supporting staff will be deputed at the learner supported Centre as per the need of course curriculum.

Category	Existing
Professor	01
Associate Professor	01
Assistant Professor	00

Instructional Delivery Mechanism and Usage of Media:

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As the Program will offer in MATS Centre of Open and Distance Education mode, the there are various instructional delivery mechanisms and media will be used to effectively deliver content to the learners. The Program delivery mechanism used by MCDOE follows a multimedia approach for instructions, which are as follows:

- The printed self-learning material (SLM) which covers all the metrics of the Program will be deliver to the learners for every course.
- Learning Management System (LMS) is an online platform that provides a centralized location for students to access learning content, engage in discussions, submit assignments, and take assessments. The LMS provides a user-friendly interface that is accessible on multiple devices, such as desktops, laptops, tablets, and smartphones.
- Discussion forums can be used to facilitate group discussions, peer-to-peer learning, and to provide feedback and support. Online and face-to-face counselling will be provided by academic counsellors appointed for the Program.
- The counseling sessions are held as per schedule drawn by the MCDOE. These counselling sessions are held in non-working hours for the learners so they can attend the counselling session properly and regularly to enhance their learning skills.
- Programs which have industrial training/practical/ project component are held at University's learners support centers and Attendance of the leaner in this part of the courses is compulsory. As per guidelines Project Work of the Program will be done by the learners and regarding this a complete guide will be deliver to the learner along with study material.
- The SLM will be dispatched periodically to the enrolled learners for each course of the Program. These SLM's will be very helpful to the learners in effective learning. The assignment for internal assessment of learner's shall be deliver to the learners along with the SLM. Online modules are also available in the University's website for some Program.
- The contact classes and counselling schedule will be of 30 days in a year which will be divided as 15 days in each semester. The schedule of contact classes of

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the Program shall be communicated to the student through the various medium.

Learner Support Services:

- MATS Centre for Open and Distance Education has a fully-fledged Learner Support Services to provide guidance and help to its learners. All the necessary information has been provided to all the learner via various medium like website, helpdesk, email and by person-to-person interaction via teleconferencing and calling.

Learning Management System (LMS) to Support Course Delivery for ODL Mode:

- The Learning Management System (LMS) is designed to facilitate the students to have a Global learning experience. LMS has user friendly interface approach through which the learning is made easy, interesting and meeting the global standards of learning. The audio-visual mode of teaching, the self-learning materials, discussion forums and evaluation patterns are unique and meeting the requirements of the industry and as per UGC guidelines of four quadrants approach.

  The students can experience uninterrupted learning 24x7 through web and mobile at the pace chosen by them. The user interface will be simple and easy to navigate through the e-learning modules; the LMS will provide seamless accessibility with all the learning tools designed as per standard norms for an easy and interesting learning experience.

Nature of Contact Classes:

Based on the course material, the counsellors for Online Education, are expected to guide and talk with the learners during the contact class sessions. By talking with their coworkers and the counsellor during contact sessions in online mode, the learners can work through their problems and this will help them to understand the Program objectives to learn with ease. In addition to these online contact sessions, learners must participate in various training Programs run by the relevant learner support system provided by the University which also including practical training approach as per Program's structure.

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Counseling Session & Structure of Study in ODL Mode:

Delivery in ODL Mode: The credit structure and study hours are of credit defined as per the regulation and structure are mentioned in table given below:

course	No. of Credits	Total Hours of Study	Face to Face Counselling	Self-Study	Practical Work	Assignments	Project
Semester I							
Inorganic chemistry I	4	120	16	68		36	
Organic chemistry I	4	120	16	68		36	
Physical chemistry I	4	120	16	68		36	
Spectroscopy I	4	120	16	68		36	
Lab Course I	2	60	8	34		18	
Lab Course II	2	60	8	34		18	
Environmental and Analytical Chemistry **OR** Management in Practice	4	120	16	68		36	
Semester II							
Inorganic chemistry II	4	120	16	68		36	
Organic chemistry II	4	120	16	68		36	
Physical chemistry II	4	120	16	68		36	
Spectroscopy II	4	120	16	68		36	
Lab Course III	2	60	8	34		18	
Lab Course IV	2	60	8	34		18	
Material Chemistry **OR** Computer Application and Statistics	4	120	16	68		36	
Semester III							
Organotransition Metal Chemistry	4	120	16	68		36	

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Biochemistry and Natural Products	4	120	16	68		36	
Industrial Chemistry/ Polymer Chemistry	4	120	16	68		36	
Medicinal and Pharmaceutical Chemistry/ Nano science and Green Chemistry	4	120	16	68		36	
Lab Course V	2	60	8	34		18	
Lab Course VI	2	60	8	34		18	
Instrumental Methods of Analysis/ IPR and Research Methodology	4	120	16	68		36	
Semester IV							
Nuclear and Solid State Chemistry	4	120	16	68		36	
Photochemistry	4	120	16	68		36	
Project	8	240	25	20		20	175
Project Seminar	2	60	6	20		20	14
Viva-Voce	2	60	6	20		20	14

F. Procedure for Admission, Curriculum Transaction and Evaluation:

Candidate to be eligible for admission to the M.Sc. Chemistry program in MATS Open and Distance Education mode, candidates must possess a bachelor's degree or an equivalent certification from an accredited university. M.Sc. Chemistry applicants can conveniently access all admission-related information, including the application process, through the University's website or by contacting the helpdesk. The admission form can be downloaded from the website and submitted via online or offline mode. Upon receipt, the University will review the documents and process the fee payment. Once the payment is completed, the admission will be confirmed, and an enrollment number will be issued to the student.

- Fee Structure:

  The fee structure of the Program in ODL mode is as follows:

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Program	Semester Tuition Fees	Semester Examination Fees	Registration Fees (One Time)
M.Sc. Chemistry Program	10000	1500	1000

- **Examination and Evaluation System:**

Evaluation shall be based on continuous assessment, in which sessional work and the terminal examination shall contribute to the final grade. Sessional work shall consist of class tests, mid-semester examination(s), homework assignments, etc., as determined by the faculty in charge of the courses of study. Progress towards achievement of learning outcomes shall be assessed using the following: time-constrained examinations; closed-book and open-book tests; problem-based assignments; practical assignment laboratory reports; observation of practical skills; individual project reports, oral presentations, including seminar presentation; viva voce; computerized adaptive assessment, examination on demand, modular certifications, etc.

Each course shall correspond to an examination paper comprising of external and internal evaluations.

The semester end theory examinations for Major, Minor, Open/Generic and DSC (Discipline specific Course) vocational, value added, SEC (Skill Enhancement Course) and AEC (Ability Enhancement Course) shall be of a duration as promulgated through the examination's regulations approved by the Academic Council of the University. The credit structure for theory/Practical/tutorial, internal, external examinations and total marks for an examination shall be as per the program structure approved by the Academic Council of the University as per UGC norms. Students shall acquire a minimum passing mark in internal and external examinations separately to be declared as pass in the respective courses, as prescribed by the Academic Council.

1. The academic performance of a candidate shall be evaluated in respect of
2. The courses of study prescribed for each semester through the evaluation. The evaluation of students admitted in the program shall be based on:
   - 2.1. End Semester Examinations - 70% marks of total marks and
   - 2.2. Continuous Internal Assessment - 30% of total marks
3. The End Semester examinations shall be held as per the academic calendar notified by the

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University and the duration of end semester examination shall be of three or two hours.

4. The minimum percentage of marks to pass the program in each semester shall be 40% in each course comprising of end semester examinations and continuous evaluation.
5. A program shall have a specified number of credits in each semester. The number of credits along with grade points that the student has satisfactorily cleared shall measure the performance of the student.
6. Semester examination results shall have following categories:
   - 6.1. Passed, i.e., those who have passed in all courses of the semester examination in internal and external examination separately.
   - 6.2. Promoted (ATKT), i.e., those who have earned minimum 50% of credits in a particular year including both the semesters (even and odd) or those who have earned any number of credits in odd semester.
   - 6.3. Detained, i.e., those who are not promoted as per the above provisions shall be detained. Such students have to appear in the examination of next academic session to earn required credits (excluding the credits already earned) as per the provisions of this ordinance and only then he/she may continue the Program within stipulated period as per the provisions of this ordinance.

However, a student of any semester who has been detained/ not appeared in examination due to less attendance/ not applied for examination/ applied but not appeared shall be out from the Program. Such a student has to take admission in the next session as an ex- student through the procedure adopted/notified by the University.

- **Continuous Internal Assessment:**

1. Continuous Internal Assessment shall be of 30% marks of total marks allotted for the course.
2. The components for continuous internal assessment for each course shall be decided by the Board of Studies of concerned subject.
3. Continuous Internal assessment shall be carried forward in case of ATKT students, there shall not be any provision of conducting internal assessment tests for ATKT students at any circumstances.

4. Evaluation and Certification of MOOCS and Vocational Courses:

The guidelines of the University/SWAYAM portal/UGC shall be followed for evaluation and

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certification of MOOCs, Vocational Courses, Field Projects/ Internship/ Apprenticeship/ Community engagement and service/ Honours with Research Project.

5. Letter Grades and Grades Point:

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the Program of study.

The University may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

Grading System

Letter Grade	Grade Points	Description	Range of Marks (%)
O	10	Outstanding	>90 to <=100
A+	9	Excellent	>80 to <=90
A	8	Very Good	>70 to <=80
B+	7	Good	>60 to <=70
B	6	Above Average	>50 to <=60
C	5	Average	>40 to <=50
P	4	Pass	=40
F	0	Fail	<40
Ab	0	Absent	Absent

- **Computation of SGPA and CGPA:**

UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

I. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$SGPA\ (Si) = \sum (Ci \times Gi) / \sum Ci$$

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the learner in the ith course.

Example of Computation of SGPA

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Semester	Course	Credit	Letter Grade	Grade point	(Credit x Grade)
1	Course 1	3	A	8	3 x 8 = 24
1	Course 1	4	B +	7	4 x 7 = 28
1	Course 1	3	B	6	3 x 6 = 18
1	Course 1	3	O	10	3 x 10 = 30
1	Course 1	3	C	5	3 x 5 = 15
1	Course 1	4	B	6	4 x 6 = 24
		20			139
SGPA					139/20=6.95

II. The Cumulative Grade Point Average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a Program, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example of Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit 20 SGPA 6.9	Credit 20 SGPA 7.8	Credit 20 SGPA 5.6	Credit 20 SGPA 6.0
CGPA= (20 x 6.9 + 20 x 7.8 + 20 x 5.6 + 20 x 6.0)/80 = 6.6			

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. On completing all requirements for the award of the undergraduate certificate/ diploma/ degree, the CGPA shall be calculated, and this value shall be indicated on the certificate /diploma/degree. The 3-years (6 semester) and 4-years (8 semester) undergraduate degrees should also indicate the Division obtained as per following Table:

Division	Criterion
First division with distinction	The candidate has earned minimum number of credits for the award of the degree with CGPA of 7.5 or above

First division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 6.0 above but less than 7.5
Second division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 4.5 or above but less than 6.0
Third Division	The candidate has earned minimum number of credits required for the award of the degree with CGPA of 4.00 or above but less than 4.5

- **Note:** The conversion of CGPA into percentage shall be as followed to facilitate its application in other academic matters.

  Equivalent Percentage = CGPA×10. The percentage shall be rounded off up to the second decimal point.

  The candidate shall be awarded a certificate/diploma/degree when he/she successfully earns the minimum required credits for the certificate/diploma/degree.

- **Issue of Transcript:**

  Based on the recommendations on Letter grades, grade points and SGPA and CGPA, the university shall issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

- **Credit Transfer:**

1. The credit transfer shall be implemented as per the policy of the University framed in accordance with the guidelines issued by the UGC from time to time.
2. The member institutions of the Academic Bank of Credit established vide University Grants Commission (Establishment and Operation of Academic Bank of Credits in Higher Education) Regulations 2021 shall accept and transfer the credits as per the provisions of this regulation as amended from time to time.
3. Except for the cases of provisional promotions, the university shall facilitate credit transfer of students between them however, the student may be required to fulfil some eligibility criteria, drawing parity for a course, framed by the University in which the student seeks admission.

G. Requirement of the Laboratory Support and Library Resource:

In open and distance learning M.SC. Chemistry program, laboratory support will be provided

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through various means such as virtual labs, cloud-based labs, or remote access to physical labs. Simulations and virtual labs will be used to provide students with a virtual environment in which they can perform practical tasks. In some cases, it may be possible to provide students with remote access to physical labs. Moreover, Instructors will record practical demonstrations and provide students with access to these videos. Students can watch these videos and practice the tasks on their own computers. Instructors will use video conferencing tools to demonstrate practical tasks and answer students' questions.

H. Cost Estimates of the Program and the Provision:

This program was already designed and developed in the conventional mode. In this process of overall development according to the current scenario, the cost estimate of all the metrics, components, equipment, advanced lab & maintenance cost for this Program comes to amount of Rs. 2495700 and provision is made of Rs. 2500000.

I. Quality Assurance Mechanism and Expected Program Outcomes:

The Program structure of the open distance learning M.Sc. Chemistry Program is designed under the guidance of an expert committee, the Board of Studies, and the Faculty Board. It is developed in accordance with the guidelines of statutory bodies and is approved by the Board of Studies, Faculty Board, and Academic Council of the University. The curriculum is reviewed annually to align with the evolving needs of the industry and research activities. Any necessary updates and improvements are forwarded to the Board of Studies, Faculty Board, and Academic Council for approval. The changes in the course curriculum as per the needs and requirements from time to time. The University will help the passed-out students in their placement in different industries through the training and placement cell.

Expected Outcomes of the Program:

- Post graduates will have ability to identify problems related to their subjects.
- Post graduates will have ability to analyze and derive valid conclusions with fundamental knowledge in their respective subjects.
- 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.
- Post graduates will have ability to design, conduct experiments, analyze and interpret data for investigating problems in their respective fields.
- Post graduates will have ability to select and apply appropriate tools and techniques.

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- Post graduates will have knowledge for assessing societal, health, safety and legal aspects and the duties as responsible citizen of country.
- Post graduates will have the knowledge for the need of sustainable development.
- Post graduates will have the knowledge of ethics and regulatory norms of their respective course.

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