



Eklavya University Damoh MP

M.Sc. Final

Chemistry

Session 2020-21 onwards

School of Basic & Applied Science

EKLAVYA UNIVERSITY, DAMOH (M.P.)

Scheme of Examination M.Sc. (Chemistry) II Year (Final)

/For batch admitted in Academic Session 2023-24/

Subject wise distribution of marks and corresponding credits

S. No.	Subject Name	Subject Code	Paper Name	Maximum Marks Allotted													Total Marks	Contact Periods Per week			Total Credits		
				Theory Slot											Practical Slot			L	T	P			
				Final Yearly					Half Yearly					Quiz/ Assignment/ Attendance	End Exam	Lab Work/ Sessional							
				P1	P2	P3	P4	P5	P1	P2	P3	P4	P5										
1	Common	MPROJ20Y201	Project (Beyond Class Room)														150			24	24		
2	Chemistry	MCHEM20Y201	Application of Spectroscopy Photochemistry and Solid State Chemistry (Paper -I)	60						30					10			100	4			4	
		MCHEM20Y202	Environmental Chemistry (Paper II)		60						30					10			100	4			4
		MCHEM20Y203	Elective Paper-III (Group-I): Organotransition Metal Chemistry, Bioinorganic and Supramolecular Chemistry, Group -I, 3A (Optional)			60						30				10			100	4			4
		MCHEM20Y204	Elective Paper -IV (Group-I): Photoinorganic Chemistry and Polymers , Group -I, 4A (Optional)			60						30				10			100	4			4
		MCHEM20Y205	Elective Paper - V (Group-II): - Organic Synthesis, Group -II, 3B (Optional)					60					30			10			100	4			4
		MCHEM20Y206	Elective Paper-VI (Group-II): Heterocyclic Chemistry and Chemistry of Natural Products, Group -II, 4B (Optional)				60						30			10			100	4			4
		MCHEM20Y207	Elective Paper - VII (Group-III): Chemical Dynamics , Group -III, 3C (Optional)					60						30		10			100	4			4
		MCHEM20Y208	Elective Paper -VIII (Group-III):Electrochemistry, Group -III, 4C (Optional)					60						30		10			100	4			4
		MCHEM20Y209	Paper-I & II Practical-I (Compulsory for all)														60	40	100			4	4
		MCHEM20Y210	Inorganic Chemistry Practical-II, Group -I (Optional)														60	40	100			4	4
		MCHEM20Y211	Organic Chemistry Practical-II, Group -II (Optional)														60	40	100			4	4
		MCHEM20Y212	Physical Chemistry Practical-II, Group -III (Optional)														60	40	100			4	4

Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.

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Class		M.Sc. Chemistry (FINAL)	
Semester/Year		II Year	
Subject & Subject Code		Chemistry - MCHEM20Y201	
Paper		Application of Spectroscopy Photochemistry and Solid State Chemistry Paper- I	
Max. Marks		100	
Credit		Total Credits	
L	T	P	4
4	0	0	

Course Objectives

- Imparting knowledge in the theory and applications of various spectroscopic techniques which are very important characterization techniques for different fields of science.
- To facilitate the understanding of the Ultraviolet and Visible spectroscopy ,Infrared Spectroscopy ,Instrumentation and Sample handling.
- To analyze the different aspects of NMR spectroscopy and Mass Spectrometry.
- Imparting knowledge in the synthesis and mechanisms of various reactions related to the synthesis by cycloaddition, photochemistry.
- Correlating the structure and property of materials for transport, optical and dielectric properties.

Course Outcome:

At the end of the course, learners will be able to:

- Acquire in depth knowledge in Vibrational Spectroscopy ,Electron Spin Resonance Spectroscopy ,Nuclear Magnetic Resonance of Paramagnetic Substances and Mossbauer Spectroscopy.
- Identify functional group of the compound by Ultraviolet and Visible spectroscopy.
- To enable the interpretation of spectra of unknown compounds by NMR spectroscopy and Mass Spectrometry
- Understand the concepts related to light induced organic synthesis, mechanisms and the functions of various reagents.
- Gets a general understanding of the Solid State Reactions and semiconductors and their applications.

Student Learning Outcomes (SLO):

The students will acquire knowledge to

- Analyze and quantify any given organic compound using spectroscopic method
- Having a clear understanding about Electronic spectra.
- Analyzing and interpreting spectral data of any unknown compound by Nuclear Magnetic Resonance Spectroscopy
- Having a clear understanding about the photochemical reactions of industrial significance.
- Identify appropriate material for a given application in conducting, magnetic, optical and dielectric applications.

Unit	Syllabus	Periods
UNIT - I	<p>Vibrational Spectroscopy Symmetry and shapes of AB₂, AB₃, AB₄, AB₅ and AB₆, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins.</p> <p>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)⁻.</p> <p>Nuclear Magnetic Resonance of Paramagnetic Substances in Solution The contact and Pseudo contact shifts, factors affecting nuclear relaxation, some applications including biochemical systems, an overview of NMR of metal nuclide with emphasis on ¹⁹⁵Pt and ¹¹⁹SnNMR.</p> <p>Mossbauer Spectroscopy Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe⁺² and Fe⁺³ compounds including those of intermediate spin, (2) Sn⁺² Sn⁺⁴ compounds nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms.</p>	15
UNIT - II	<p>Ultraviolet and Visible spectroscopy Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.</p> <p>Infrared Spectroscopy Instrumentation and Sample handling Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. Optical Rotatory Dispersion(ORD) and Circular Dichroism (CD) Definition, deduction of absolute configuration, octan rule</p>	15

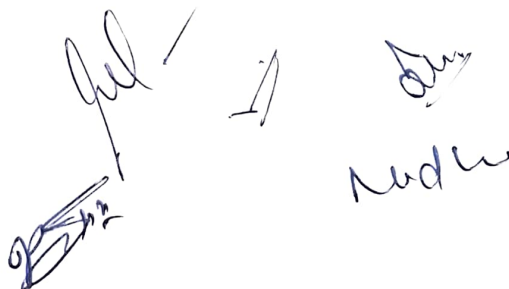
UNIT - III	<p>Nuclear Magnetic Resonance Spectroscopy General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin spin interaction between two, three, four and five nuclei (first order spectra) virtual coupling, Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE).</p> <p>Carbon-13 NMR Spectroscopy General considerations, chemical shift (aliphatic olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.</p> <p>Mass Spectrometry Introduction ion production E1, C1 FD and FAB, factors affecting fragmentation, ion analysis, ion abundance Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak. McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with respect to their structure determination.</p>	15
UNIT - IV	<p>Photochemical Reactions Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.</p> <p>Determination of Reaction Mechanism Classification, rate constants and life times of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions- photo dissociation, gas-phase photolysis.</p> <p>Miscellaneous Photochemical Reactions Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular Oxygen reaction. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.</p> <p>Photochemistry of Alkene Intramolecular reactions of the olefinic bond- geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.</p> <p>Photochemistry of Carbonyl Compounds Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation. isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.</p> <p>Photochemistry of Carbonyl Compounds Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cycloaddition reactions-dimerisations and oxetane formation.</p> <p>Photochemistry of Aromatic Compounds Isomerisations, additions and substitutions.</p>	15

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UNIT - V	<p>Solid State Reactions General principles, experimental procedure, co-precipitation as a precursory to solid state reactions, kinetics of solid state reactions. Crystal Defects and Non-Stoichiometry Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colourcentres, non-stoichiometry and defects.</p> <p>Electronic Properties and Band Theory Metals, insulators and semiconductors, electronic structure of solids band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, superconductors. Optical properties-Application of optical and electron microscopy. Magnetic Properties-Classification of materials : Effect of temperature calculation of magnetic moment, mechanism of ferro and anti ferromagnetic ordering super exchange. Organic Solids Electrically conducting solids. organic charge transfer complex, organic metals, new superconductors.</p>	15
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Reference Books:

- Physical Methods for Chemistry, R.S. Drago, Saunders Compnay.
- Infrared and Raman Spectral: Inorganic and Coordination Compounds K. Nakamoto, Wiley.
- Progress in Inorganic Chemistry vol., 8, ed., F.A. Cotton, vol., 15 ed. S.J. Lippard, Wiley.
- Transition Metal Chemistry ed. R.L. Carlin vol. 3 Dekker.
- Inorganic Electronic Spectroscopy, A.P.B. Lever, Elsevier.
- NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, .V. Parish, Ellis Haywood.
- Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassleradn T.C. Morrill, John Wiley.



Class		M.Sc. Chemistry (FINAL)	
Semester/Year		II Year	
Subject & Subject Code		Chemistry - MCHEM20Y202	
Paper		ENVIRONMENTAL CHEMISTRY Paper II	
Max. Marks		100	
Credit		Total Credits	
L	T	P	4
4	0	0	

Course Objectives:

- To make the student to learn about the Biogeochemical cycles and Atmospheric Chemistry .
- Learning the different aspects of pollutants in air and their analysis.
- Learning the different aspects of pollutants in water and their analysis
- Understanding the insights of soil analysis, soil based waste management and know about the Environmental Disasters
- Identifying the different industrial pollutants and their prevention methods.

Course Outcome:

At the end of the course, learners will be able to:


- To understand the types atmospheric constituents and Mechanism of photochemical decomposition .
- To learn the students about air pollution analysis and its control .
- To Analyze water quality through different analytical methods.
- To familiarize the various types the micro and macronutrients of soil , soil pollution and Environmental Environmental Disasters.
- Understand the concepts related to industrial pollutants and disposal of wastes and their managements.

Student Learning Outcomes (SLO):

Students will:

- Having a clear understanding of the Atmospheric Chemistry.
- Evaluate the industrial pollutants, understand their effects and adopt methods to reduce them.
- Analyze different parameters in water quality monitoring and adopt methods for their reduction.
- Able to know about the micro and macronutrients of soil , soil pollution and Environmental Environmental Disasters
- Evaluate the industrial pollutants, understand their effects and adopt methods to reduce them.







Unit	Syllabus	Periods
UNIT - I	<p>Atmosphere Atmospheric layers, Vertical temperature profile, heat/radiation budget of the earth atmosphere systems. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus oxygen. Residence times.</p> <p>Atmospheric Chemistry Sources of trace atmospheric constituents : Nitrogen oxides, Sulphur dioxide and other sulphur compounds, carbon dioxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons. Mechanism of photochemical decomposition of NO₂ and formation of ozone atoms, hydroxyl, hydroperoxy and organic radicals and hydrogen peroxide and their reactions</p>	15
UNIT - II	<p>Air Pollution Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health.</p> <p>Acid Rain Definition, Acid rain precursors and their aqueous and gas phase atmospheric oxidation reactions. Damaging effects on aquatic life, plants, buildings and health. Monitoring of SO₂ and NO_x. Acid rain control strategies.</p> <p>Stratospheric Ozone Depletion Mechanism of Ozone formation, Mechanism of catalytic Ozone depletion, Discovery of Antarctic Ozone hole and Role of chemistry and meteorology. Control Strategies.</p> <p>Green House Effect Terrestrial and solar radiation Spectra, Major green house gases and their sources and Global warming potentials. Climate change and consequences.</p> <p>Urban Air Pollution Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies.</p>	15
UNIT - III	<p>Aquatic Chemistry and Water Pollution Redox chemistry in natural waters. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water. Acid-base chemistry of fresh water and sea water. Aluminum, nitrate and fluoride in water. Eutrophication. Sources of water pollution. Treatment of waste and sewage. Purification of drinking water, techniques of purification and disinfection.</p>	15
UNIT - IV	<p>Soil and Environmental Disasters Composition, micro and macronutrients, soil pollution by fertilizers, plastic and metals. Methods of re-mediation of soil. Bhopal gas tragedy, Chernobyl, three mile island, Minimata Disease, Seveso (Italy), London smog.</p>	15
UNIT - V	<p>Industrial Pollution : Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants. Metallurgy, polymers, etc.. radionuclide analysis, disposal of wastes and their managements.</p>	15

REFERENCE BOOKS :

- Environmental Chemistry, Colin Baird, W.H. Freeman Co. New York, 1998
- Chemistry of Atmospheres, R.P. Wayne, Oxford.
- Chemistry of Atmospheres, R.P. Wayne, Oxford.
- Environmental Chemistry, S.E. Manahan, Lewis Publishers.
- Introduction to Atmospheric Chemistry, P.V. Hobbs, Cambridge.

Class			M.Sc. Chemistry (Final)
Semester/Year			II Year
Subject & Subject Code			Chemistry - MCHEM20Y205
Paper			ELECTIVE PAPER- V (Group-II): - Organic Synthesis
Max. Marks			100
Credit		Total Credits	
L	T	P	4
4	0	0	
<p>Course Objectives:</p> <ul style="list-style-type: none"> To impart knowledge in the theory and applications of various organometallic reagents. To facilitate the understanding of various aspects of oxidation and reduction. To provide comprehensive knowledge on name reactions and rearrangements and Metalloenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds. To introduce advanced level study in the disconnection approach. To train the students "hands-on" in qualitative inorganic semi-micro analysis and preparation of complexes. 			
<p>Course Outcome:</p> <ul style="list-style-type: none"> Know the synthesis, mechanisms and the functions of various organometallic reagents or catalysts. Understanding basic concepts about oxidation and reduction reaction mechanisms of various organic Compound. To acquire knowledge of the rearrangements and Metalloenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds. understanding about the disconnection approach for the organic synthesis Can detect ions given in micro quantities and prepare industrially useful complexes. 			
<p>Student Learning Outcomes (SLO): Students will:</p> <ul style="list-style-type: none"> Gets a general understanding of the essential organometallic compounds and their applications Will have knowledge about oxidation and reduction reaction of organic compounds. Will be able to identify the rearrangement occurring in a given reaction and Gets a general understanding of Metalloenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds Able to understand About one group and two group disconnections . Demonstrate the principle of complex synthesis 			

Unit	Syllabus	Periods
UNIT - I	<p>Organometallic Reagents Principle, preparations, properties and applications of the following in organic synthesis with mechanistic details. Group I and II metal organic compounds Li, Mg, Hg, Cd, Zn and Ce Compounds. Transition metals Cu, Pd, Ni, Fe, Co, Rh, Cr, and Ti compounds. Other elements S, Si, B and I compounds.</p>	15
UNIT - II	<p>Oxidation Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetroxide, iodobenzene diacetate and thallium. (III) Nitrate. Reduction Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Hydrogenolysis.</p>	15
UNIT - III	<p>Rearrangement General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hoffmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene and fluorine).</p>	15
UNIT - IV	<p>Disconnection Approach An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. Protecting Groups Principle of protection of alcohol, amine, carbonyl and carboxyl groups. One Group C-C Disconnections Alcohols and carbonyl compounds, regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis. Two Group C-C Disconnections Diels-Alder Reaction, 1,3-difunctionalised compounds, $\alpha\beta$-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.</p>	15

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UNIT - V	Ring Synthesis Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings aromatic heterocycles in organic synthesis. Synthesis of Some Complex Molecules Application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A.	15
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REFERENCE BOOKS:

- Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
- Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
- Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
- Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
- Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
- Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier.
- Designing Organic Synthesis, S. Warren. Wiley. Page 20 of 33 • Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
- Some Modern Methods of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.
- Modern Synthetic Reactions H.O. House, W.A Benjamin.
- Advanced Organic Chemistry : Reactions, Mechanisms and Structure, J. March. Wiley.
- Principles, of Organic Chemistry Part B, F.A. Carey and R.J. Sundberg, Plenum Press.
- Disconnection Approach: Ameta, Punjabi, Ameta, Jain, Sadguru Publications

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Class		M.Sc. Chemistry (Final)	
Semester/Year		II Year	
Subject & Subject Code		Chemistry - MCHEM20Y206	
Paper		ELECTIVE PAPER-VI (Group-II): Heterocyclic Chemistry and Chemistry of Natural Products	
Max. Marks		100	
Credit		Total Credits	
L	T	P	4
4	0	0	
<p>Course Objectives: On completion of the course, students are able to:</p> <ul style="list-style-type: none"> To introduce the aromatic and nonaromatic heterocyclic compounds, To introduce synthesis and reactivity of aliphatic and aromatic heterocyclic compounds. To impart knowledge of Synthesis and reactivity of fused, six membered and smaller heterocyclic compounds. To develop thorough knowledge of natural products relating with its synthesis, properties, medicinal applications . To impart advanced knowledge of Plant Pigments ,Biosynthesis of flavonoids,Prostaglandis,Pyrethroids and Rotenones. 			
<p>Course Outcome:</p> <ul style="list-style-type: none"> At the end of the course, learners will be able to: Will be familiar with the Nomenclature heterocyclic compounds. Understanding basic concepts about heterocyclic compounds. Acquire knowledge of Synthesis and reactivity of fused, six membered and smaller heterocyclic compounds. Will be familiar with the Plant Pigments ,Biosynthesis of flavonoids,Prostaglandis,Pyrethroids and Rotenones. 			
<p>Student Learning Outcomes (SLO): Students will:</p> <ul style="list-style-type: none"> Analyze the aromatic and nonaromatic heterocyclic compounds. Acquire knowledge of Synthesis and reactivity of heterocyclic compounds. Evaluate the heterocyclic reactions based on the influence of the substituents on substrate molecules and nature of solvent and the parametric conditions. Understand the chemistry, degradation, synthesis and biosynthesis of natural products like steroids, alkaloids, terpenoids. Having a clear understanding of Plant Pigments ,Biosynthesis of flavonoids,Prostaglandis,Pyrethroids and Rotenones. 			

Unit	Syllabus	Periods
UNIT - I	<p>Nomenclature of Heterocycles Replacement and systematic nomenclature (Hantzsch- Widman system) for monocyclic fused and bridged heterocycles.</p> <p>Aromatic Heterocycles General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ¹H NMR-spectra. Empirical resonance energy, delocalization energy and dewar resonance energy, diamagnetic susceptibility escalations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.</p> <p>Non-aromatic Heterocycles Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic/electrophilic interactions.</p>	15
UNIT - II	<p>Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.</p> <p>Small Ring Heterocycles Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes.</p> <p>Benzo-Fused Five-Membered Heterocycles Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes.</p> <p>Meso-ionic Heterocycles General classification, chemistry of some important mesoionicheterocycles of type-A and B and their applications.</p>	15
UNIT - III	<p>Six-Membered Heterocycles with one Heteroatom Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones</p> <p>Six Membered Heterocycles with Two or More Heteroatoms Synthesis and reactions of diazoles, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepinines, diazepines/thiazepines, azocines, diazocines, dioxocines and dithiocines.</p> <p>Heterocyclic Systems Containing P, As, Sb and B Heterocyclic rings containing phosphorus : introduction, nomenclature, synthesis and characteristics of 5- and 6-membered ring systems phosphorinanes, phosphorines, phospholanes and phospholes.</p>	15

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UNIT - IV	<p>Terpenoids and Carotenoids Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gerniol α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene</p> <p>Alkaloids Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Conine, Nicotine, Atropine, Quinine and Morphine.</p> <p>Steroids Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, Biosynthesis of Steroids</p>	15
UNIT - V	<p>Plant Pigments Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin 3- glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin,</p> <p>Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.</p> <p>Porphyrins Structure and synthesis of Haemoglobin and Chlorophyll</p> <p>Prostaglandins Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE₂ and PGF₂α.</p> <p>Pyrethroids and Rotenones Synthesis and reactions of Pyrethroids and Rotenones.</p>	15

REFERENCE BOOKS :

- Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
- The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
- Heterocyclic Chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
- Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
- Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
- An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
- Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds Pergamon Press
- Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthorpe and J.B. Harborne, Longman, Essex.
- Organic Chemistry : Vol. 2 IL. Finar, ELBS
- Stereoselective Synthesis : A Practical Approach, M. Ngoradi, VCH.
- Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
- Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston, Harwood Academic Publishers.
- Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers.
- New Trends in Natural Product Chemistry, Ata-ur-Rahman and M.L. Choudhary, Harwood Academic Publishers.
- Insecticides of Natural Origin, SukhDev, Harwood Academic Publishers.
- Chemistry of Natural Products: B. C. Joshi, S. C. Ameta, Himanshu Publication

Class			M.Sc. Chemistry (Final)
Semester/Year			II Year
Subject & Subject Code			Practical Chemistry - MCHEM20Y209
Paper			Practical (Compulsory for all)
Max. Marks			100
Credit		Total Credits	
L	T	P	
0	0	4	
			4

PRACTICALS

- Determination of copper by diethyl dithiocarbamate extraction by estimation by Spectrophotometry
- Analysis of oils and fats - Saponification and acid value
- Determination of benzoic acid in soft drinks by titrimetry
- AAS – determination of heavy metal content (Fe, Pb, Cr and Cd) in water.
- Analysis of water – COD, DO, BOD.
- Analysis of water – Alkalinity and hardness.
- Analysis of heavy metal ion in fruit juice
- Determination of calcium in water and milk by flame photometry.






Class		M.Sc. Chemistry (Final)
Semester/Year		II Year
Subject & Subject Code		Practical Chemistry - MCHEM20Y210
Paper		Inorganic Chemistry Practical
Max. Marks		100
Credit	Total Credits	
L	T	P
0	0	4
		4

PRACTICALS

Inorganic Chemistry Preparation

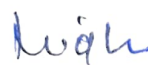
Preparation of selected inorganic compounds and their study by IR, electronic spectra, Moss Bauer. ESR and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following :

1. Sodium amide. Inorg. Synth., 1946, 2, 128.
2. Synthesis and thermal analysis of group II metal oxalate hydrate. J. Chem. Ed., 1988, 65, 1024.
3. Atomic absorption analysis of Mg and Ca.
4. Trialkoxyboranes-IR and NMR spectra.
5. PhBceDichlorophenylborane - Synthesis in vacuum line.
6. Preparation of Tin (IV) iodide, Tin (IV) chloride and Tin (II) iodide, Inorge, Synth., 1953, 4.119. Relative Stability of Tin (IV) and Pb (IV).
7. Preparation of ammonium hexachlorostannate (NH₄)₂SnCl₆, ammoniumhexachlorophlumbate (NH₄)₂PbCl₆.
8. Hexa-bis (4,nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiphenylantimony (V) hydrate. Inorg. Synth., 1985, 23, 194
10. Sodium tetrathionate Na₂S₄O₆.
11. Metal complexes of dimethyl sulfoxide (IR) : CuCl₂.2DMSO, PdCl₂. 2DMSO, RuCl₂. 4DMSO. J.Chem. Educ., 1982, 59, 57.
12. Synthesis of metal acetylacetonate : Magnetic moment, IR, NMR, Inorg. Synth, 1957, 5, 130, 1963, 1, 183.
13. Bromination of Cr (acac)₃. J. Chem. Edu., 1986, 63, 90.
14. Magnetic moment of Cu (acac)₂H₂O.
15. Cis and Trns [Co(en)2Cl₂]+.
16. Separation of optical isomer of cis-[Co(en)2Cl₂]Cl. J. Chem. Soc., 1960. 4369.







17. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ.
18. Determination of Cr (III) complexes. $[\text{Cr}(\text{H}_2\text{O})_6]\text{NO}_3 \cdot 3\text{H}_2\text{O}$, $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$, $[\text{Cr}(\text{en})_3]\text{Cl}_3$, $\text{Cr}(\text{acac})_3$. Inorg. synth., 1972, 13, 184.
19. Preparation of N, N bis (salicycladehyde) ethylenediamine, silane H_2 . Co(Silane) J. Chem. Educ., 1977, 54, 443; 1973, 50, 670.
20. Preparation of Fe(II) chloride (use it as Friedel-Craft chlorination source) J. Org. Chem., 1978, 43, 2423; J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
21. Reaction of Cr(III) with a multidentate ligand; a kinetics experiment (visible spectra Cr-EDTA complex) J.A.C.S., 1953, 75, 6570.
22. Preparation and use of Ferrocene. J. Chem. Edu. 1966, 43, 73; 1976, 53, 730.
23. Preparation of copper glycine complex-cis and transbis (glycinato Copper (II)). J. Chem. Soc. Dalton, 1979, 1901, J. Chem. Edu., 1982, 59, 1052.
24. Preparation of phosphine Ph_3P and its transition metal complexes.
25. Any other experiment such as conversion of p-xylene to terephthalic acid catalyzed by CoBr_2 (homogeneous catalysis).
26. Preparation of $[\text{Co}(\text{phenanthroline-5,6 quinone})]$.
27. **Spectrophotometric Determinations**
 - a. Manganese/Chromium/Vanadium in steel sample.
 - b. Nickel/molybdenum/tungston/vanadium/uranium by extractive pectrophotometric method.
 - c. Fluoride/nitrite/phosphate.
 - d. Zirconium-alizarin Red-S complex : Mole-ratio method.
 - e. Copper-Ethylene diaminecomplex : Sloperatio method.
 - f. Iron-phenanthroline complex : Job's method of continuous variations
28. **Flame Photometric Determinations.**
 - a. Sodium and potassium when present together.
 - b. Lithium/Calcium/barium/strontium.
 - c. Cadmium and magnesium in tap water.
29. **Quantitative determinations of a three component mixture** : One Volumetrically and two gravimetrically :
 - a. Cu^{+2} , Ni^{+2} , Zn^{+2}
 - b. Cu^{+2} , Ni^{+2} , Mg^{+2}
30. **Chromatographic Separations**
 - a. Cadium and zinc
 - b. Zinc and magnesium.
 - c. Thin-layer chromatography-separation of nickel, manganese, cobalt and zinc. Determination of R_f values.
 - d. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of R_f values.

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Class			M.Sc. Chemistry (Final)
Semester/Year			II Year
Subject & Subject Code			Practical Chemistry - MCHEM20Y211
Paper			Organic Chemistry Practical
Max. Marks			100
Credit		Total Credits	
L	T	P	4
0	0	4	

PRACTICALS

Organic Chemistry Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

Multi-step Synthesis of Organic Compounds

The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

Photochemical reaction

Benzophenone → Benzpinacol → Benzpinacolone

Beckmann rearrangement : Benzanilide from benzene

Benzene → Benzophenone → Benzphenoneoxime → Benzanilide

Benzilic acid rearrangement : Benzilic acid from benzoin

Benzoin → Benzil → Benzilic acid

Synthesis of heterocyclic compounds

Skraup synthesis : Preparation of quinoline from aniline

Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.

Enzymatic synthesis

Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S(+) ethyl-3-hydroxybutanoate and determine its optical purity.

Biosynthesis: ethanol from sucrose.

Synthesis using microwave : Alkylation of diethyl malonate with benzyl chloride.

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Synthesis using phase transfer catalyst : Alkylation of diethyl malonate or ethyl acetoacetate with an alkylhalide.

Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
3. Isolation of lactose from milk (purity of sugar should be checked by LC and PC and Rf values 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 oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
10. Isolation of eugenol from clove.
11. Isolation of (+) limonine from citrus rind.

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS) Spectrophotometric (UV/VIS) Estimations Amino acids Proteins Carbohydrates Cholesterol Ascorbic acid Aspirin Caffeine.

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Class		M.Sc. Chemistry (Final)	
Semester/Year		II Year	
Subject & Subject Code		Practical Chemistry - MCHEM20Y212	
Paper		Physical Chemistry Practical	
Max. Marks		100	
Credit		Total Credits	
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0	0	4	

PRACTICALS

Physical Chemistry

Number of hours for each experiment: 3-4 hours. a list of experiments under different headings are given below. Typical experiments are to be selected from teach type.

(A) Thermodynamics

- Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
- Determination of the temperature dependence of the solubility of a compound in two solvents having similar intramolecular interactions (benzoic acid in water and in DMSO-Water mixture and calculate the partial molar heat of solution.

(B) Spectroscopy





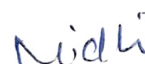
- Determination of pKa of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.
- Determination of stoichiometry and stability constant of Ferricisothiocyanation complex ion in solution.
- Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

(C) Polarography

- Identification and estimation of metal ions such as Cd²⁺, Pb²⁺, Zn²⁺, and Ni²⁺ etc. polarographically.
- Study of a metal ligand complex polarographically (using Lingane's Method).

(D) Chemical Kinetics

- Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce(IV) and Hypophosphorous acid at ambient temperature.
- Determination of energy and enthalpy of activation in the reaction of KMnO₄ and benzyl alcohol in acid medium.
- Determination of energy of activation of and entropy of activation from a single kinetic run.
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Kinetics of an enzyme catalyzed reaction.

(E) Electronics

This lab course will have theory as well as practical and the lectures shall be delivered during lab hours.

Basic Electronics: Notations used in the electronic circuit, study of electronic compounds and colour codes. Conversion of chemical quantities into electronic quantities. transducer, illustration with electrodes, thermocouples and thermistors. Passive components: Resistors, capacitors and inductors with some emphasis on solid state properties of materials. Net works of resistors. Thevenin's theorem, superposition theorem, loop analysis, RC circuits, LR Circuits, LCR circuits. Illustration of the use of circuits in NQR spectroscopy, Massbauer spectroscopy cyclic voltammetry and in power supplied as filter circuits.

Active components: Introduction to ordinary diodes and Zener diode with some emphasis on p-n junction as a solid state property. Use of diode as rectifiers, clipping and clamping circuits. Power supplies. Transistors : An extension of p-n-p and n-p-n transistors. Characteristics of transistors, hybrid parameters; transistor circuits as amplifiers, high impedance (preamplifier) circuits. Darlington pairs, differential amplifiers.

Operational Amplifiers: Ideal characteristics; inverter, summer, integrator, differentiator, voltage follower, illustrative use of operational amplifiers. Introduction to Fourier transformation in instrumentation. List of Experiments in electronics (Do at least five experiments from this section)

- (a) To plot the diode characteristics and find its dynamic resistance and cut in voltage.
(b) To plot the characteristics of transistor used as a diode and compare the results with those of (a)
- (a) To plot the diode characteristics and find its dynamic resistance and cut in voltage.
(b) To plot the characteristics of transistor used as a diode and compare the results with those of (a) wave form.
- To implement a diode damper circuit which damps the positive peak of the input voltage to
(a) Zero voltage and
(b) a given voltage. Verify the performance.
- (a) To plot the characteristics of an NPN transistor in CE configuration.
(b) To find the h-parameter of the transistor from the characteristics.
- (a) To plot the characteristics of an NPN transistor in CB configuration.
(b) To find the h-parameter of the transistor from the characteristics and compare it with the results of experiment No. 6.
- (a) To plot the drain and transfer characteristics of a JEET in CS configuration.
(b) To find out the pinch off voltage, maximum drain to source saturation current and the trans conductance.
- To obtain the frequency response of an RC coupled amplifier and estimate the bandwidth.
- (a) To plot the characteristics of Zener diode and find its dynamic resistance under reverse biased condition. To use zener diode for a voltage regulation.
(i) Plot the line regulation curve.
(ii) Plot the load Regulation curve.
- (a) To wire a Half wave Rectifier circuit using diode and measure the rms voltage, de voltage and to find Ripple factor.
(b) To study the performance of half way and full wave doubler circuits.
- To plot the characteristics of UJT and find the peak voltage, peak current and valley voltage and use as a relaxation oscillator.

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