EKLAVYA UNIVERSITY
ज्ञान प्राप्तये लक्ष्य संधानम्

School of Basic and Applied Sciences

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				**60 (ETE) + 40 (IA) =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 andsemiconductors 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	**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 ofmetalloproteins. **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)-. **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 119 SnNMR. **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.	15
UNIT - II	**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. **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	15
UNIT - III	**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). **Carbon-13 NMR Spectroscopy** General considerations, chemical shift (aliphatic olefinic, alkyne, aromatic, heteroaromatic and carboynl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques. Mass Spectrometry Introduction ion production E1, C1 FD and FAB, factors affecting fragmentation, ion analysis, ion abundance Mass spectral	15

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	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.	
UNIT - IV	**Photochemical Reactions** Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. **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. **Miscellaneous Photochemical Reactions**Photo-Fries reactions of anilides, Photo- Fries rearrangement. Barton reaction. Singlet molecular Oxygen reaction. Photochemical formation of smog. Photodegration of polymers. Photochemistry of vision. **Photochemistry of Alkene**Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. **Photochemistry of Carbonyl Compounds**Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. **Photochemistry of Carbonyl Compounds**Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. **Photochemistry of Aromatic Compounds**Isomerisations, additions and substitutions.	15
UNIT - V	**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. **Electronic Properties and Band Theory Metals**, insulators and **semiconductors**, electronic structure of solidsband theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. 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.	15

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.

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (FINAL)**
Semester/Year				**II Year**
Subject & Subject Code				**Chemistry - MCHEM20Y202**
Paper				**ENVIRONMENTAL CHEMISTRY Paper II**
Max. Marks				**60 (ETE) + 40 (IA) =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 .
- ToAnalyze 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 - I	**Atmosphere** Atmospheric layers, Vertical temperature profile, heat/radiation budget of theearth atmosphere systems. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus oxygen. Residence times. **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	15
UNIT - II	**Air Pollution** Air pollutants and their classifications. Aerosols-sources, size distribution and effect on visibility, climate and health. **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 NOx. Acid rain control strategies. **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. **Green House Effect** Terrestrial and solar radiation Spectra, Major green housegases and their sources and Global warming potentials. Climate change and consequences. **Urban Air Pollution** Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies.	15
UNIT - III	**Aquatic Chemistry and Water Pollution** Redox chemistry in natural waters.Dissolvedoxygen, 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.	15
UNIT - IV	**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, Sevoso (Italy), London smog.	15
UNIT - V	**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.	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.

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Chemistry - MCHEM20Y203**
Paper				**Elective Paper-III (Group-I): Organotransition Metal Chemistry, Bioinorganic and Supramolecular Chemistry**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	0	0		

Course Objectives:

On completion of the course, students are able to:

- To introduce the synthesis, nature of bond, structural characteristicsof Alkyls and Aryls of Transition Metals,Compounds of Transition Metal-Carbon Multiple Bonds, Transition Metal π-Complexes.
- To impart the knowledge of Homogeneous Catalysis and Fluxional Organometallic Compounds.
- To introduce the concepts and importance of Metal Storage and Transport and Biomineralizationand Calcium in Biology and Metalloenzyms.
- To impart the knowledge of Metals in Medicine andMetal-Nucleic Acid Complexes and their applications.
- To impart knowledge of types of supramolecules, structures their applications as electronic, ionic and switching devices.

Course Outcome:

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

- Will have better understanding of synthesis, nature of bond, structural characteristics of Alkyls and Aryls of Transition Metals,Compounds of Transition Metal-Carbon Multiple Bonds, Transition Metal π-Complexes.
- To acquire knowledge andApplication of homogeneous Catalysis in chemical synthesis and Fluxional Organometallic Compounds.
- Acquire in depth knowledge of Metal Storage and Transport and Biomineralizationand Calcium in Biology and Metalloenzyms.
- Acquire in depth knowledge in Metals in Medicine andMetal-Nucleic Acid Complexes and their applications.
- Have a good overview of the core concepts in supramolecularchemistry.

Student Learning Outcomes (SLO):

Students will:

- know the significance of Compounds of Alkyls and Aryls of Transition Metals, Transition Metal-Carbon Multiple Bonds and Transition Metal π-Complexes.
- Understanding of Industrially important homogenous catalysis and Fluxional Organometallic Compounds.
- Students should be able to understand concepts of of Metal Storage and Transport and Biomineralizationand Calcium in Biology and **Metalloenzyms**.
- Identify the medicinal applications of inorganic compounds.
- Be able to describe some of the applications of supramolecular chemistry including industrial applications and supramolecular catalysis.

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Unit	Syllabus	Periods
UNIT - I	**Alkyls and Aryls of Transition Metals** Types,routesof synthesis, stability and decomposition pathways organocopper in organic synthesis. Transition metal compounds with bonds to hydrogen. **Compounds of Transition Metal-Carbon Multiple Bonds**Alkylidenes,alkylidynes, low valentcarbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis **Transition Metal π-Complexes** Transition metal π-Complexes with unsaturated organic molecules, alkenes, alkynes, allyl, diene, dienyl, arene and trienyl complexes, preparation, properties, nature of bonding and structural features. Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.	15
UNIT - II	**Homogeneous Catalysis** Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxoreaction), oxopalladation reactions, activation of C-H bond. **Fluxional Organometallic Compounds** Fluxionalityand dynamic equilibrium in compounds such as η2_ olefine, η3-allyl and dienyl complexes.	15
UNIT - III	**Metal Storage and Transport and Biomineralization** Ferritin transferrin, and siderophores. Calcium in Biology Calcium in living cells, transport and regulation, molecular, aspects of intramolecular processes, extracellular binding protein. **Metalloenzyms** Zinc enzymes – carboxypeptidase and carbonic anhydrase. Iron enzymes- catalase, peroxidase and cytochrome P-450. **Metallo enzyme-II** Copper enzymes-superoxide dismutase. Molybdenum oxatransferase enzymes-xanthine oxidase. Coenzyme vitamin B12.	15
UNIT - IV	**Metals in Medicine** Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs. **Metal-Nucleic Acid Complexes** Metal ions and metal complex interactions. Metal complex nucleic acids.	15
UNIT - V	**Supramolecular Chemistry- I** Molecular recognition : Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of co receptor molecules and multiple recognition. Supramolecular reactivity and catalysis.Page 14 of 33 **Supramolecular Chemistry-II** Transport processes and carrier design. Supramolecular devices. Supramolecular photochemistry, supramolecular electronic, ionic and switching device	15

REFERENCE BOOKS :

- The Organometallic Chemistry of the Transition Metals, R.H. Crabtree. John Wiley.
- Metallo-organic Chemistry, A.J. Pearson, Wiley.
- Organometallic Chemistry, R.C. Mehrotra and A. Singh New Age International.
- Principles of Bioinogranic Chemistry. S.J. Lippard and J.M. Berg University Science Books.
- Bioinorganic Chemistry, I Bertini, H.B. Gray. S.J. Lippard and J.S. Valentine, University Science Books.
- Inorganic Biochemistry Vols I and II Ed.G.L. Eichhorn, Elesevier.
- Progress in Inorganic Chemistry Vols. 18 G.L. Eichhorn, Elsevier and 38 Ed J.J. Lippard Wiley.
- Supramolecular Chemistry, J.M Lehn, VCH

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Chemistry - MCHEM20Y204**
Paper				**ELECTIVE PAPER-IV (Group-I): Photoinorganic Chemistry and Polymers**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	0	0		

- **Course Objectives:**

On completion of the course, students are able to:

- To introduce the students regarding the fundamentals of photochemistry and various photochemical reactions in detail.
- To make the students conversant with theories of Ligand Field Photochemistry and Redox Reactions by Excited Metal Complexes
- To provide basic understanding of the fundamental concepts of polymers and their characteristics.
- To introduce the Analysis and testing of polymers.
- To impart the knowledge of Structure, Properties and Application of various type of inorganic polymers.

Course Outcome:

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

- Becomes conversant with basics of photochemistry.
- Will be familiar with the Ligand Field Photochemistry andRedox Reactions by Excited Metal Complexes.
- Analyze the molecular weight of polymers and Polydispersity.
- Understanding basic concepts about Analysis and testing of polymers
- To be able to get familiarized with Structure, Properties and Application of various type of inorganic polymers.

Student Learning Outcomes (SLO):

Students will:

- Understand fundamentals of photochemistry and laws governing and itSolve various problems on photochemical transformations.
- Students should be able to explain Ligand Field Photochemistry and Redox Reactions by Excited Metal Complexes
- Will develop capacity to characterize polymers and draw a parallel to their properties.
- Will have better understanding about Analysis and testing of polymers.
- To acquire knowledge of Structure, Properties and Application of various type of inorganic polymers.

Unit	Syllabus	Periods
UNIT - I	**Basic of Photochemistry** Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques Energy dissipation by radiative and non-radiative processes, absorption spectra, Frank-Condon principle, photochemical stages-primary and secondary processes. **Properties of Excited States** Structure, dipole moment, acid-base strengths,reactivity.Photochemical kinetics-calculation of rates of radiative processes. Bimolecular deactivation- quenching. **Excited States of Metal Complexes** Excited states of metal complexes : Comparison with organic compounds, electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations. **Metal Complex Sensitizers** Metal complex sensitizer, electron relay, metal colloid systems, semiconductor supported metal or oxide systems, water photolysis, nitrogen fixation and carbon dioxide reduction.	15
UNIT - II	**Ligand Field Photochemistry** Photosubstitution, photooxidation and photoreduction,lability and selectivity, zero vibrational levels of ground state and excited state, energy content of excited state, zero-zero spectroscopic energy, development of the equations for redox potentials of the excited states. **Redox Reactions by Excited Metal Complexes** Energy transfer under conditions of weak interaction and strong interaction-exciplex formation; condition of the excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates, (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidising character of Ruthenium+2 (bipyridal complex, comparsion with Fe (bipy)3; role of spin-orbit coupling-life time of these complexes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants into high energyproducts, chemical energy into light.	15
UNIT - III	**Polymers** Importance of polymers. Basic concepts,Classification of polymers. Polymerization , Polymerization in homogeneous and heterogeneous systems. **Polymer Characterization** **Polydispersion**-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights, end- group, viscosity, light scattering, osmotic and ultracentrifugation methods.	15
UNIT - IV	**Analysis and testing of polymers** Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. **Thermal analysis and physical testing** tensile strength. Fatigue, impact. Tear resistance, hardness and abrasion resistance. **Inorganic Polymers**	15

	A general survey and scope of Inorganic Polymers special characteristics, classification, homo and hetero atomic polymers.	
UNIT - V	**Structure, Properties and Application of** Polymers based on Phosphorous-Phosphazenes, Polyphosphates Polymers based on Sulphure-Tetrasulphurtetranitride and related compounds. **Structure, Properties and Applications of** Polymers based on boron-borazines, boranes and carboranes.Page Polymers based on Silicon, silicones polymetalloxanes and polymetallosiloxanes, silazanes. **Structure, Properties and Applications** of Metal clusters. Co-ordination and metal chelate polymers.	15

REFERENCE BOOKS:

- Concepts of Inorganic Photochemistry, A.W. Adamson and P.D. Fleischauer, Wiley.
- Inorganic Photochemistry, J.Chem. Educ. vol. 60 No. 10, 1983.
- Progress in Inorganic Chemistry, Vol. 30ed. S.J. Lippard. Wiley.
- Elements in Inorganic Photochemistry, G.J. Ferraudi, Wiley.
- Inorganic Chemistry, J.E. Huheey, Harper Row.
- Developments in Inorganic polymer Chemistry, M.F. Lappert and G.J. Leigh.
- Inorganic polymers- N.H. Ray.
- Inorganic polymers, Graham and Stone.
- Inorganic Rings and Cages : D.A. Armitage.
- Textbook of Polymers Science, F.W. Billmeyer Jr. Wiley.
- Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall.
  Polymer science, V.R.Gowariker, N.V.Viswanthan and J.Shreedhar Wiley-Eastern

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Estd by Madhya Pradesh Rajya Vishwavidyalaya (Sthapna Avam Sanchalan Adhiniyam) 2019

School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Chemistry - MCHEM20Y205**
Paper				**ELECTIVE PAPER- V (Group-II): - Organic Synthesis**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	0	0		

Course Objectives:

- 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 **Metallocenes,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.

Course Outcome:

- 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 Metallocenes,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.

Student Learning Outcomes (SLO):

Students will:

- 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 Metallocenes,Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds
- Able to understand About one group and two group disconnections .
- Demonstrate the principle of complex synthesis

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Unit	Syllabus	Periods
UNIT - I	**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.	15
UNIT - II	**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 tetraoxide, iodobenzenediacetate 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.	15
UNIT - III	**Rearrangement** General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzillic 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).	15
UNIT - IV	**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, αβ- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.	15
UNIT - V	**Ring Synthesis** Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings aromatic hetereocycles in organic synthesis. **Synthesis of Some Complex Molecules** Application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortsone,	15

	Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A.	

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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School of Basic and Applied Sciences

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				**60 (ETE) + 40 (IA) =25**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	0	0		

Course Objectives:

On completion of the course, students are able to:

- 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.

Course Outcome:

- 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.

Student Learning Outcomes (SLO):

Students will:

- 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.

	for monocyclic fused and bridged heterocycles. **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. **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 nucleophilicelctrophilic interactions.	
UNIT - II	**Heterocyclic Synthesis**Principles of heterocyclic synthesis involing cyclization reactions and cycloaddition reactions. **Small Ring Heterocycles** Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, oxetanes and thietanes. **Benzo-Fused Five-Membered** Heterocycles Synthesis and reactions including medicinal applications of benzopyrroles, bezofurans and benzothiophenes. **Meso-ionic Heterocycles** General classification, chemistry of some important mesoionicheterocycles of type-A and B and their applications.	15
UNIT - III	**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 **Six Membered Heterocycles with Two or More Heteroatoms** Synthesis and reactions of diazones, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepinesthiazepines, azocines, diazocines, dioxocines and dithiocines. **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.	15

UNIT - IV	**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. **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. **Steroids** Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids.	15
UNIT - V	**Plant Pigments** Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, LuteolinQuercetin, Myrcetin, Quercetin 3- glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7arabinoside, Cyanidin, Hirsutidin, **Biosynthesis of flavonoids**: Acetate pathway and Shikimic acid pathway. **Porphyrins** Structure and synthesis of Haemoglobin and Chlorphyll **Prostaglandis** Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2α. **Pyrethroids and Rotenones** Synthesis and reactions of Pyrethroids and Rotenones.	15

REFERENCE BOOKS :

- Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar andV.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 ScietificTechinal.
- Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley- Inter Science.
- An Introductiion to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
- Comprehensive Heterocyclic Chemistry, A.R. Katritzkyand C.W. Rees, eds.Pergamon Press
- Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
- Organic Chemistry : Vol. 2 IL. Finar, ELBS
- StereoselectiveSynthesis : 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.
- Insecteides of Natural Origin, SukhDev, Harwood Academic Publishers.

Sharma Gupta

Class			**M.Sc. Chemistry (Final)**
Semester/Year			**II Year**
Subject & Subject Code			**Chemistry - MCHEM20Y207**
Paper			**ELECTIVE PAPER- VII (Group-III): Chemical Dynamics**
Max. Marks			**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**
L	**T**	**P**	**4**
4	0	0	

CourseObjectives:

On completion of the course, students are able to:

- To impart knowledge of ofPhysical structure and chemical composition Atmosphere.
- To introduce the concepts and importanceEnzymes and InhibitionsMicelles catalysis and inhibition.
- To facilitate the understanding of the Radiation Chemistry and Dynamics of Gas-surface Reactions.
- To impart knowledge of Classification of ligand substitution mechanism.
- Learning the different aspects ofMetal ion Catalysis and Induced Phenomena.

Course Outcome:

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

- Will have better understanding of Physical structure and chemical composition Atmosphere.
- To acquire knowledge andApplication of Enzymes and InhibitionsMicelles catalysis and inhibition.
- Acquire in depth knowledge of Radiation Chemistry and Dynamics of Gas-surface Reactions.
- Acquire in depth knowledge in Classification of ligand substitution mechanism.
- To familiarize the various types the Metal ion Catalysis and Induced Phenomena.

Student Learning Outcomes (SLO):

Students will:

- know the significance of Atmospheric Reactions.
- Students should be able to understand concepts of Enzymes and InhibitionsMicelles catalysis and inhibition
- Gets a general understanding of the Radiation Chemistry and Dynamics of Gas-surface Reactions.
- Have a good overview of Classification of ligand substitution mechanism
- Having a clear understanding about the Metal ion Catalysis and Induced Phenomena.

Unit	Syllabus	Periods
UNIT - I	**Atmospheric Reactions** Physical structure of the atmosphere, chemical composition of the atmosphere, Kinetics and mechanism of NOx, ClOx cycles and H2 + O2 reaction. Mechanism of general methane oxidation. Kinetics and mechanism of low temperature oxidation of methane. Concept of global warming.	15

UNIT - II	**Enzymes and Inhibitions** Kinetics of one enzymes-Two substrate systems and their experimental characteristics. Enzyme inhibitors and their experimental characteristics. Kinetics of enzyme inhibited reactions. **Micellescatalysis and inhibition** Kinetics and mechanism of micelle catalyzed reactions (Ist order and second order) Various type of micelle catalyzed reactions. Micelle inhibited reactions.Transition State A brief aspect of statistical mechanics and transition state theory. Application in calculation of second order rate constant for reactions involving collision of (1) atom + atom (2) atom + molecule (3) molecule + molecule reactions. Static solvent effects and thermodynamics formulations. Adiabatic electron transfer reactions, energy surfaces.	15
UNIT - III	**Radiation Chemistry** Radiation chemistry and photochemistry. Radiation chemistry of water and aqueous solutions. Hydrogen atom and hydroxyl radical-oxidizing and reducing conditions. Kinetics and mechanism of photochemical and photosensitized reactions (One example in each case). Stern-Volmer equation and its application. Hole-concept in the presence of semiconductor type photocatalysts. Kinetics and mechanism of electron transfer reaction in the presence of visible light. Kinetics of exchange reactions (Mathematical analysis) **Dynamics of Gas-surface Reactions** Adsorption/desorption kinetics and transition state theory. Dissociative adsorption and precursor state. Mechanism of Langmuir's adsorption of the oxidation of carbon monoxide to carbon dioxide. True and apparent activation energies. Industrial importance of heterogeneous catalysis.	15
UNIT - IV	**Substitution Reactions** Substitution reactions Classification of ligand substitution mechanism.Anation and base catalyzed kinetics of anation reactions. Aquation and acid catalyzed kinetics of aquation reactions (octahedral complexes). Inner-sphere electron transfer reactions and mechanism. Various types of inner sphere bridges, adjustment and remote attack. Linkage isomerism. Chemical and resonance mechanism. Marcus-Cross relation in outersphere reactions (no mathematical derivation). Its application in reactions Bridged outer-sphere electron transfer mechanism. Kinetics of reactions in the presence ofcyclodextrines.Considering one full case study, Nucleophilic and electrophilie catalyst and their mode of action.	15
UNIT - V	**Metal ion Catalysis and Induced Phenomena** Metal ion catalyzed reactions, their kinetics and reaction mechanism in solutions. Induced reactions, their characteristics. Mechanism of (i) Fe(II) induced oxidation of iodine by Cr(VI). (ii) As(III) induced oxidation of Mn(II) by chromate in acid solutions. Kinetics and mechanism of induced reactions in metal complexes (octahedral complexes of Cobalt (III) only). Oscillatory ReactionsAutocatlysis and oscillatory reactions, Kinetics and mechanism of Belousov-Zhabotinski (B-Z) reactions.	15

REFERENCE BOOKS:

- Progress in Inorganic Chemistry, Vol. 30.
- R. Lumry and R.W. Raymond, Electron Transfer Reactions, Interscience.
- N.L. Bender, Mechanism of Homogeneous Catalysis from protein to protein, Wiley.
- A.G. Sykes, Kinetics of Inorganic reactions, Pergamon.

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Chemistry - MCHEM20Y208**
Paper				**ELECTIVE PAPER-VIII (Group-III):Electrochemistry**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
4	0	0		

Course Objectives:

On completion of the course, students are able to:

- To introduce the concepts and importance of Conversion and Storage of Electrochemical Energy.
- To develop an understanding of electro chemistry principles upon which various applications such as Classical Batteries and Modern Batteries.
- To impart the knowledge of Corrosion and Stability of Metals, Inhibiting Corrosion and Passivation.
- To facilitate the understanding of the Methods of determining kinetic parameters for quasi-reversible and irreversible waves.
- To provide comprehensive knowledge on Potential Sweep Method , Bulk Electrolysis Methods.

Course Outcome:

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

- Will have better understanding of Conversion and Storage of Electrochemical Energy .
- To acquire knowledge andApplication of Classical Batteries and Modern Batteries.
- Acquire in depth knowledge of Corrosion and Stability of Metals, Inhibiting Corrosion and Passivation.
- Understanding basic concepts about Methods of determining kinetic parameters for quasi-reversible and irreversible waves.
- understand About Potential Sweep Method , Bulk Electrolysis Methods.

Student Learning Outcomes (SLO):

Students will:

- Know the significance of Conversion and Storage of Electrochemical Energy .
- Understanding of Industrially important Classical Batteries and Modern Batteries
- Students should be able to understand concepts of ofCorrosion and Stability of Metals, Inhibiting Corrosion and Passivation.
- Will have knowledge about Methods of determining kinetic parameters for quasi-reversible and irreversible waves.
- Gets a general understanding of the Potential Sweep Method , Bulk Electrolysis Methods

Unit	Syllabus	Periods
UNIT - I	**Conversion and Storage of Electrochemical Energy** **Present status of energy consumption** : Pollution problem. History of fuel cells, Direct energy conversion by electrochemical means. Maximum intrinsic efficiency of an electrochemical converter. Physical interpretation of the Carnot efficiency factor in Electrochemical energy converters. Power outputs. Electrochemical generators (Fuel Cells) : Hydrogen oxygen cells, Hydrogen Air cell, Hydrocarbon air cell, Alkaline fuel cell, Phosphoric and fuel cell, direct NaOH fuel cells, applications of fuel cells. **Electrochemical Energy Storage** : Properties of Electrochemical energy stores : Measure of battery performance, Charging and discharging of a battery, Storage Density, Energy Density.	15
UNIT - II	**Classical Batteries** : (i) Lead Acid (ii) Nickel-Cadmium, (iii) Zinc-Manganese dioxide. **Modern Batteries** : (i) Zinc-Air (ii) Nickel-Metal Hydride, (iii) Lithium Battery, Future Electricity storers : Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non aqueous solutions. Bioelectrochemistry :Bioelectrodics, Membrane Potentials, Simplistic theory, Modern theory, Electrical conductance in biological organism: Electronic, Protonic electrochemical mechanism of nervous systems, enzymes as electrodes.	15
UNIT - III	**Corrosion and Stability of Metals** : Civilization and surface mechanism of the corrosion of the metals; Thermodynamics and the stability of metals, Potential -pH (or Pourbaix) Diagrams; Corrosion current and corrosion potential - Evans diagrams. Measurement of corrosion rate : (i) Weight Loss method, (ii)Electrochemical Method. **Inhibiting Corrosion**: Cathodic and Anodic Protection. Inhibition(i) by addition of substrates to the electrolyte environment, (ii) by charging the corroding metal from external source, anodic protection. Organic inhibitors. The fuller Story. Green inhibitors. **Passivation** Structure of Passivation films, Mechanism of Passivation, Spontaneous Passivation Nature's method for stabilizing surfaces.	15
UNIT - IV	**Kinetics of Electrode Processes** : Essentials of Electrode reaction. Current Density, Over potential, Tafel Equation, Butler - Volmer equation. Standard rate constant (Ko) and Transfer coefficient, Exchange Current. **Irreversible Electrode processes** : Criteria of irreversibility, information from irreversible wave. **Methods of determining kinetic parameters for quasi-reversible and irreversible waves** : Koutecky's methods, Meites Israel method, Gelling's method. **Electrocatalysis** : Chemical catalysts and Electrochemical catalysts with special reference to purostates, porphyrin oxides of rare earths. Electrocatalysis in simple redox reactions, in reaction involving adsorbed species. Influence of various parameters.	15
UNIT - V	**Potential Sweep Method** :	15

	Linear sweep Voltammetry, Cyclic Voltammetry, theory and applications. Diagnostic criteria of cyclic voltammetry. Controlled current microelectrode techniques : comparison with controlled potential methods, chronopotentiometry, theory and applications. **Bulk Electrolysis Methods** : Controlled potentialcoulometry, controlled coulometry. Electro-organic synthesis and its important applications. **Stripping analysis** : anodic and cathodic modes, pre electrolysis and stripping steps. Applications of stripping analysis.	

REFERENCE BOOKS:

- Modern Electrochemistry Vol. I, IIA, Vol. IIB J'OM Bockris and A.K.N. Reddy, Plenum Publication, New York.
- Polarographic Techniques by L. Meites, Interscience.
- "Fuel Cells : Their electrochemistry". McGraw Hill Book Company, New York.
- Modern Polarographic Methods by A.M. Bond, Marcell Dekker.
- Polarography and Allied techniques by K. Zutshi, New age International publicatin.New Delhi.
- Electroanalytical Chemistry by Basil H. Vessor& Galen W., Wiley Interscience.
- Topics in Pure and Applied Chemistry, Ed. S. K. Rangrajan, SAEST Publication, Karaikudi (India).

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Practical Chemistry - MCHEM20Y209**
Paper				**Practical (Compulsory for all)**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
0	0	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.

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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Practical Chemistry - MCHEM20Y210**
Paper				**Inorganic Chemistry Practical**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
0	0	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 $(NH4)_2SnCl_6$,ammoniumhexachlorophlumbate $(NH4)_2PbCl_6$.
8. Hexa-bis (4,nitrophenoxy) cyclotriphosphazene.
9. Synthesis of trichlorodiphenylantimony (V) hydrate. Inorg. Synths., 1985, 23, 194
10. Sodium tetrathionate Na_2S4O6.
11. Metal complexes of dimethyl sulfoxide (IR) : $CuCl_2$.2DMSO, PdC_{l2}. 2DMSO, $RuCl_2$. 4DMSO. J.Chem. Educ., 1982, 59, 57.
12. Synthesis of metal acethylacetonate : Magnetic moment, IR, NMR, Inorg. Synths, 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 $[Co(en)2Cl_2]+$.
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. $[Cr(H_2O)_6]NO_3.3H_2O$, $[Cr(H_2O)4Cl_2]Cl.2H2O$, $[Cr(en)3]Cl_3$, $Cr(acac)_3$. Inorg. synths., 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 terephtalic acid catalyzed by $CoBr_2$ (homogeneous catalysis).
26. Preparation of [Co(phenathroline-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 Rf values.
    d. Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

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Estd. by Madhya Pradesh Niji Vishwavidyalaya (Sthapna Avam Sanchalanal Adhiyadesh, 2020)

School of Basic and Applied Sciences

Class			**M.Sc. Chemistry (Final)**
Semester/Year			**II Year**
Subject & Subject Code			**Practical Chemistry - MCHEM20Y211**
Paper			**Organic Chemistry Practical**
Max. Marks			**60 (ETE) + 40 (IA) =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(+) ehtyl-3-hydroxybutanoate and determine its optical purity.

Biosynthesis: ethanol from sucrose.

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

Extraction ofOrganic Compounds from Natural Sources

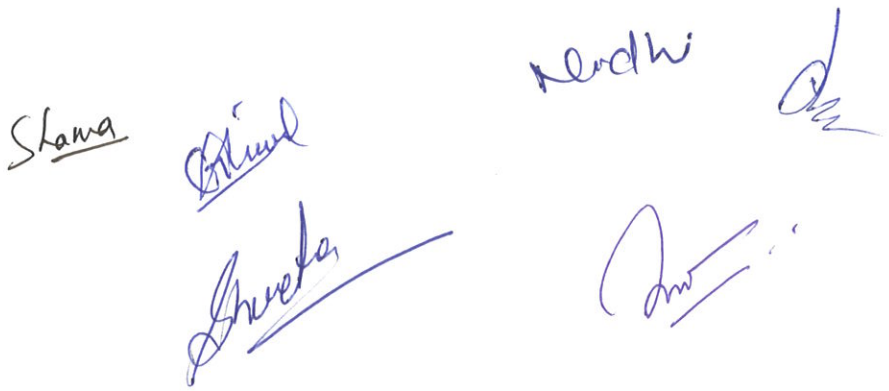
1. Isolation of caffeine from tea leaves.
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins). 3. Isolation of lactose from milk (purity of sugar should be checked by LC and PC and Rf values reported). 4. Isolation of nicotine dipicrate from tobacco.
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 of 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.



EKLAVYA UNIVERSITY
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School of Basic and Applied Sciences

Class				**M.Sc. Chemistry (Final)**
Semester/Year				**II Year**
Subject & Subject Code				**Practical Chemistry - MCHEM20Y212**
Paper				**Physical Chemistry Practical**
Max. Marks				**60 (ETE) + 40 (IA) =100**
Credit			**Total Credits**	
L	**T**	**P**	**4**	
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

i. Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.

ii. Determination of the temperature dependence of the solubility of a compound in two solvents having similar intromolecular in interactions (benzoic acid in water and in DMSO-Water mixture and calculate the partial molar heat of solution.

(B) Spectroscopy

i. Determination of pKa of an indicator (e.g. methyl red) in (a) aqueous and (b) micellar media.

ii. Determination of stoichiometry and stability constant of Ferricisothiocyanation complex ion in solution. iii. Determination of rate constant of alkaline bleaching of Malachite green and effect of ionic strength on the rate of reaction.

(C) Polarography

i. Identification and estimation of metal ions such as Cd2+, Pb2+, Zn2+, and Ni+2 etc. polarographically.

ii. Study of a metal ligand complex polarographically (using Lingane's Method).

(D) Chemical Kinetics

i. Determination of rate constant and formation constant of an intermediate complex in the reaction of Ce(IV) and Hypophosphorous acid at ambient temperature.

ii. Determination of energy and enthalpy of activation in the reaction of KMnO4 and benzyl alcohol in acid medium.

iii. Determination of energy of activation of and entropy of activation from a single kinetic run. iv. 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, M ssbauer 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. Darlinction 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)

1. (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)
2. (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.
3. 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.
4. (a) To plot the characteristics of an NPN transistor in CE configuration.
(b) To find the h-parameter of the transistor from the characteristics.
5. (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.
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.
7. To obtain the frequency response of an RC coupled amplifier and estimate the bandwidth.
8. (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.
9. (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.
10. To plot the characteristics of UJT and find the peak voltage, peak current and valley voltage and use as a relaxation oscillator.