SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

SYLLABUS FOR

Master of Science (Chemistry)

School of Basic and Applied Sciences

(W.E.F 2021-2022)

Master of Science (Chemistry)

OUTCOME BASED EDUCATION

Programme outcome (POs)

PO 1	Scientific exploration: Capability of comprehending basic scientific principles, and theories to propose solutions.
PO2	Conduct experimentation: Use explorative aptitude and analytical methods for design of experiments, analysis and interpretation of data and synthesis of information to provide effective conclusions.
PO3	Ethics: Apply ethical principles and commit to professional ethics and responsibilities for societal benefits.
PO4	Communication: Communicate effectively scientific findings, and to be able to assimilate, write and present effective reports to give and receive clear instruction.
PO5	Societal Impact: Acquire and apply advanced knowledge of concepts and participate in sustainable development.
PO6	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO7	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of upcoming scientific change.
PO8	Research Problem Solving:Ability to assimilate, evaluate and present research results objectively.

Program Specific Outcome (PSOs)

PSO 1	Understand the advanced concepts of organic and inorganic synthesis, Molecular and Interpretative spectroscopy and quantum chemistry.
PSO2	Perform procedures as per laboratory standards in the areas of analytical chemistry, organic and inorganic synthesis and structure interpretation.
PSO3	Exhibit the ability of comprehending the problem and building research oriented solutions.
PSO4	Understand and apply applications of organic and inorganic synthesis in pharmaceutics.

Eligibility for admission:

B.Sc. with Chemistry as one of the subjects with 45% aggregate. For SC/ST categories as per university norms.

Duration of the Programme :2 years

STUDY & EVALUATION SCHEME

Choice Based Credit System

Master of Science (Chemistry)

First Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core Paper	MCHC101	Inorganic Chemistry I	4	0	0	4	40	60	100
2	Core Paper	MCHC102	Organic Chemistry I	4	0	0	4	40	60	100
3	Core Paper	MCHC103	Physical Chemistry I	4	0	0	4	40	60	100
4	Core Paper	MCHC104	Spectroscopy and Group theory	4	0	0	4	40	60	100
Practical										
1	Core	MCHL105	Laboratory Course I	0	0	3	3	40	60	100
2	Core	MCHL106	Laboratory Course II	0	0	3	3	40	60	100
			Total				22			600

Second Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MCHC201	Inorganic Chemistry II	4	0	0	4	40	60	100
2	Core	MCHC202	Organic Chemistry II	4	0	0	4	40	60	100
3	Core	MCHC203	Physical Chemistry II	4	0	0	4	40	60	100
4	Core	MCHC204	Spectroscopy and separation methods	4	0	0	4	40	60	100
Practical										
1	Core	MCHL205	Laboratory Course I	0	0	3	3	40	60	100
2	Core	MCHL206	Laboratory Course II	0	0	3	3	40	60	100
			Total				22			600

Third Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MCHC301	Organic Synthesis & Photochemistry	4	0	0	4	40	60	100
2	Core	MCHC302	Heterocyclic Chemistry	4	0	0	4	40	60	100
3	Elective I	MCHE313	Bioinorganic, Bioorganic & Biophysical Chemistry	4	0	0	4	40	60	100
4	Elective II	MCHE315	Polymers	4	0	0	4	40	60	100
5	Elective III	MCHE317	Medicinal Chemistry	4	0	0	4	40	60	100
6	Elective IV	MCHE322	Instrumental methods of analysis	4	0	0	4	40	60	100
7	Self Study	MCHS320	Pesticide Chemistry	0	0	0	3	40	60	100
Practical										
1	Core	MCHL303	Laboratory Course I	0	0	3	3	40	60	100
2	Core	MCHL304	Laboratory Course II	0	0	3	3	40	60	100
Total							22			600

***Students have to study any two elective papers in IIIrdSemester**

Total credits=22 (14 core credits + 08 elective credits) and 03 credits of MCHS320 self study paper.

Fourth Semester

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Core	MCHC401	Chemistry of Natural Products.	4	0	0	4	40	60	100
2	Core	MCHC403	Dissertation				9			300
3	Elective I	MCHE410	Computer and Biostatistics	4	0	0	4	40	60	100
4	Elective II	MCHE411	Environmental Chemistry	4	0	0	4	40	60	100
Practical										
1	Core	MCHL402	Laboratory Course I	0	0	3	3	40	60	100
			Total				20			600

***Students have to study any one elective papers in IVthSemester**

Total credits=20 (16 core credits + 04 elective credits)

ExaminationScheme:

Components	Ist internal	IInd Internal	External (ESE)
Weightage(%)	20%	20%	60%

MSc Chemistry(Ist Semester)

Course code	**:MCHC101**			
Course Name	**: Inorganic Chemistry I**			
Semester /Year	**: Ist**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to make students familiarize with stereochemistry, bonding in main group compounds, stability of complexes,theories and structure of coordination compounds andreaction mechanism of transition metal complexes.

Unit I **[No of hours 15]**

Stereochemistry and Bonding in Main Group Compounds

VSEPR model and its shortcomings. Hybridization and three-center bonds. Bents rule and energetic of hybridization.Walsh's diagrams for tri and tetra atomic molecules. pπ-pπ and pπ-dπbonding.

Unit II **[No of hours 15]**

Theories of Coordination Compounds

Crystal field theory, factors affecting the magnitude of Δ_O. Consequences of crystal field splitting. Merits and limitations of CFT Jahn-Teller distortion and its consequences on complex formation. Evidence of covalent character in Metal-Ligand bonding. Molecular orbital theory as applied to octahedral, tetrahedral and square planar complexes.

Unit III **[No of hours 15]**

Metal-Ligand Equilibria in Solution

Thermodynamic and kinetic stability of complexes. Stepwise and overall formation constants and their interaction.Trends in K value. Irving-Willams series. Chelate effect and its thermodynamic origin. Factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand.

Unit IV **[No of hours 15]**

Reaction Mechanism of Transition Metal Complexes

Energy profile of a reaction and reactivity of metal complexes. Inert and labile complexes. Ligand substitution reactions in octahedral complexes i.e.SN1, SN2 and SN1CB mechanism.

Anation reactions without metal ligand bond cleavage. Electron transfer reactions (Redox reactions).Outer and inner sphere mechanism (OSM and ISM). Reactions of coordinated ligands. Substitution reactions in square-planer complexes

Text Books:

TB1. Advanced Inorganic Chemistry Vth Ed., F.A. Cotton and G.Wilkinson, JohnWiley,(1988).
TB2. Advanced Inorganic Chemistry VIth Ed., F.A.Cotton,G. Wilkinson, C.A.Murillo and MBochmann, JohnWiley, (1999).
TB3. Inorganic Chemistry, J.E.House, Academic Press,(2008)

Reference Books:

RB1. Inorganic chemistry, A Unified Approach, IIndEd.,WW.Porterfield, Academic Press,(1993).
RB2. Coordination Chemistry,IIIrdEd.,DBanerjea, Asian Book Pt. ltd.,(2009)
RB3. Inorganic Chemistry,3th Ed.,GLMiessler and D.A.Tarr, Pearson Education, nc.(2004)

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Gain Knowledge about stereochemistry and bonding in main group compounds.
CO2	Describe stability of complexes.
CO3	Apply various mechanisms of reactions involved in coordination complexes.
CO4	Understan theories, structure and bonding in coordination complexes.

CO- PSO-PO Mapping:

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PS O1	PS O2	PS O3	PSO 4
CO1	2	1	1	2	1	1	3	1	3	1	1	1
CO2	3	1	1	2	1	1	3	1	3	1	1	3
CO3	3	1	1	2	1	1	3	1	3	1	1	3
CO4	3	1	1	2	1	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC102**			
Course Name	**: Organic Chemistry I**			
Semester /Year	**: Ist**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to make students familiarize withstructure,bonding,orientation and reaction mechanism involved in organicchemistry.

Unit I **[No of hours 10]**

Nature of Bonding in Organic Molecules

Hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non benzenoid compounds, alternant and non alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent, crown ether complexes and cryptands, inclusion compounds, cyclodextrin, catenanes and rotaxanes.

Unit II **[No of hours 15]**

Stereochemistry

Conformational analysis of cycloalkane, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis. Asymmetric synthesis, chirality due to helical shape. Stereochemistry of the compounds containing nitrogen, sulphur and phosphorus.

Unit III **[No of hours 15]**

Reaction Mechanism : Structure and Reactivity

Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Effect of structure on reactivity – resonance and field effects, steric effect, quantitative treatments. Hammett equation and linear free energy relationship, Substituent and reaction constants, Taft equation. Methods of determining Reaction mechanism

Unit IV **[No of hours 15]**

Aliphatic Nucleophilic Substitution

SN1, SN2 and mixed SN1 and SN2 mechanism. The neighbouring group mechanism, neighbouring group participation (by π- and σ bonds). Anchimeric assistance. SN1 mechanism- Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophilic group, leaving group and reaction medium, ambident nucleophile.

Unit V **[No of hours 5]**

Aliphatic Electrophilic Substitution

Bimolecular mechanism- SE2 . The SE1 mechanism, electrophilic substitution accompanied by double bond shift. Effect of substrates, leaving group and the solvent polarity on the reactivity.

Text Books:

TB1. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
TB2. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
TB3. Reaction Mechanism in Organic Chemistry, Mukherji and Singh, Macmillan.

Reference Books:

RB1. Advanced Organic Chemistry, Reaction, Mechanism and Structure, Jerry March, 6th Ed., John Wiley.
RB2. Advanced Organic Chemistry, Carey and Sundberg, Springer Verlag, Germany.
RB3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes.

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Understand the concept of bonding in organic molecules and application of organic reactions.
CO2	Explain the orientation of organic compound andsubstitutionreactions.
CO3	Identify structure and bonding in organic molecules.
CO4	Gain Knowledge about stereospecific and stereoselective synthesis.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	1	1	3	1	3	3	1	1
CO2	3	1	1	2	1	1	3	1	3	2	1	3
CO3	3	1	1	2	1	1	3	1	3	3	1	1
CO4	3	1	1	2	1	1	3	1	3	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC103**

Course Name : Physical Chemistry I				
Semester /Year : Ist				
	L	T	P	C
	4	0	0	4

CourseObjective:

The objective of this course is to gain knowledge about quantum mechanics,quantum mechanical results,approximate methods andchemical bonding in diatomics andclassical thermodynamics.

Unit I **[No of hours 10]**

Quantum Chemistry: Basic Principles of Quantum Mechanics

Operators , Eigen values and Eigen functions ,Normalisation ,HiensenbergUncertainity Principle , de Broglie equation, Momentum,Ladder operators ,Hermitian adjoint.

Unit II **[No of hours 10]**

Quantum Chemistry: Introduction to Exact Quantum Mechanical Results

The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz. particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

Unit III **[No of hours 5]**

Quantum Chemistry: Approximate Methods

The variation theorem, linear variation principle, perturbation theory (first order and nondegenerate).

Unit IV **[No of hours 10]**

Quantum Chemistry: Chemical Bonding InDiatomics

Elementary Concepts of Molecular Orbital and Valence Bond Theory,Huckel Molecular Orbital Theory for conjugated $\prod$-electron systems.

Unit V **[No of hours 15]**

Thermodynamics: Classical Thermodynamics

Brief resume of concepts of laws thermodynamics, free energy, chemical potential and entropies. Partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significance. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient. Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength.

Unit VI **[No of hours 10]**

Surface Chemistry: Adsorption

Surface tension, capillary actions, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomenon), catalytic activity at surfaces.

Text Books:

TB1. Physical Chemistry, P.W. Atkins, ELBS.
TB2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

Reference Books:

RB1. Quantum Chemistry, Ira N. Levine, Prentice Hall.
RB2. Coulson's Valence, R. McWeeny, ELBS

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Differentiate between classical mechanics and quantum mechanics of different atoms andmolecules.
CO2	Apply appropriate approximation techniques for the analysis of multi electron molecules.
CO3	Understand molecular orbital theory to explain bonding and molecular structure on thebasis of quantum mechanics.
CO4	Illustrate the laws of classical thermodynamics and to explore the ideas of non-ideal systems and phase diagrams.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	1	1	3	1	3	1	1	1
CO2	3	1	1	2	1	1	3	1	3	1	1	1
CO3	3	1	1	2	1	1	3	1	3	1	1	1
CO4	3	1	1	2	1	1	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC104**

Course Name :Spectroscopy and Group Theory				
Semester /Year : Ist				
	L	T	P	C
	4	0	0	4

CourseObjective:

The objective of this course is to gain knowledge about EMR, different spectroscopic techniques (i.e UV-VIS, IR),symmetryelements and group theory.

Unit I **[No of hours 10]**

Unifying Principles

Electromagnetic radiation, interacton of electromagnetic radiation with matter. Absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, result of the time dependent perturbation theory, transition moment, selection rules, intensity of special lines, Born-oppenheimer approximation, rotational, and electronic energy levels.

Unit II **[No of hours 5]**

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

Unit III **[No of hours 15]**

Ultra Violet and Visible Spectroscopy: Electronic transitions (185-800 nm), Beer- Lambert Law, Effect of solvent on electronic transitions, Ultra Violet bands of carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Steric effect in biphenyls, Fieser- Woodward rules for conjugated dienes and carbonyl compounds, ultra violet spectra of aromatic and heterocyclic compounds.. Applications of UV- visible spectroscopy in organic chemistry.

Unit IV **[No of hours 15]**

Infrared Spectroscopy: Review of linear harmonic oscillator, vibrational energies of diatomic molecules, Zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, virbration-rotation spectroscopy; P,Q,R branches. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region., metal-ligand vibrations.

.**Unit V** **[No of hours 15]**

Symmetry and Group Theory in Chemistry: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroups, conjugacy relation and classes. Point symmetry group, Schonflies symbols, representations of

groups by matrices (representation for the Cn, Cnv, Cnh, Dnh etc. group to be worked out explicitly).

Text Books:

TB1. Modern Spectroscopy, J.M. Hollas, John Wiley.
TB2. Physical Methods for Chemistry, R.S. Drago, Saunders Company.

Reference Books:

RB1. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
RB2. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, New Age International.

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Gain knowledge about propertiesof electromagnetic radiations, its interaction with matter and atomic electronic spectroscopy of hydrogen, alkali metal atoms.
CO2	Understand concept ofvibrational rotational spectroscopy w.r.t its principle, theory and application in organic
CO3	Apply theory of UV-VIS and IR spectroscopy to evaluate the structure of spectroscopy in organic compounds
CO4	Understanding aboutsymmetry and group theory in chemistry.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	3	3	3	1	1	3
CO2	1	3	1	2	1	3	3	3	3	1	1	3
CO3	3	3	1	3	1	3	1	1	3	1	1	3
CO4	3	1	1	2	1	1	3	11	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHL105**			
Course Name	**: Laboratory Course I**			
Semester /Year	**: Ist**			
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

CourseObjective:

The objective of this course is to gain practical knowledge about semi-micro analysis of mixtures, separation, identification of mixtures by Chromatography and interpretation of results.

Part1: Inorganic Chemistry

Qualitative analysis of mixtures by semi micro methods containing not more than six cation and anions including:

(i). Rare-earth elements

(ii).Anions, which have not been done in under graduate practicals.

(iii).Insolubles.

Part2: Organic Chemistry

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (solid-solid or liquid

and solid) using TLC and Paper Chromatography, Chemical tests and spectroscopic analysis.

Part3: Physical Chemistry

Chemical Kinetics

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

2. Determination of the velocity constant of hydrolysis of an ester.

3. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics of the reaction.

4. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Showmaker).

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

Text Books:

TB1. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi
TB2. Inorganic Chemistry: A Laboratory Manual, Mala Nath. Narosa Publishing House

Reference Books:

RB1. Vogel's textbook of Practical Organic Chemistry Vth Edition,Brian S. Furniss, Antony J. Hannaford, Peter W.G Smith. Pearson
RB2. Advanced Practical Physical Chemstry,J B Yadav. Educational Publishers

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Understand semi-micro analysis of mixtures (cations and anions)
CO2	Apply Paper and Thin Layer Chromatography to separate and identify organic binary mixtures.
CO3	Analyze and interpret the results of different experiments

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	1	1	1	3	3	2
CO2	1	3	1	2	1	3	1	1	1	2	3	2
CO3	1	3	1	2	2	3	1	1	1	3	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHL106

Course Name :Laboratory Course II				
Semester /Year : Ist				
	L	T	P	C
	0	0	3	3

CourseObjective:

The objective of this course is to gainpractical knowledge about chromatography, synthesis of organic compounds and experiments related to physical chemistry.

Part 1: Inorganic Chemistry

Chromatography

Separation of cations and anions by:Paper Chromatography, Thin Layer Chromatography,Ion Exchange Chromatography

Part 2: Organic Chemistry

Organic Synthesis

Acetylation: Acetylation

Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.

Grignard reaction: Synthesis of triphenylmethanol from benzoic acid.

Sandmeyer reaction: p-Chlorotoluene from p-toluene

Part 3: Physical Chemistry

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

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

Determination of the strength of strong and weak acids in a given mixture conductometrically.

To study the effect of solvent on the conductance of AgNO3/CH3COOH and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel-Onsager theory.

Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate usingDebyeHuckel's limiting law.

Text Books:

TB1. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi
TB2. Inorganic Chemistry: A Laboratory Manual, Mala Nath. Narosa Publishing House

Reference Books:

RB1. Vogel's textbook of Practical Organic Chemistry Vth Edition,Brian S. Furniss, Antony J. Hannaford, Peter W.G Smith. Pearson
RB2. Advanced Practical Physical Chemstry,J B Yadav. Educational Publishers

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Gain knowledge of different types of chromatography and its uses in chemistry.
CO2	Understand the practical aspects of topics related to physical chemistry.
CO3	Perform two and three steps synthesis of organic compounds.

CO-PO Mapping
CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	2	3	1	1	1	3	1	2
CO2	1	3	1	2	2	3	1	1	1	3	1	2
CO3	1	3	1	3	2	3	1	2	1	3	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

MSc Chemistry (IInd Semester)

Course code :MCHC201				
Course Name : Inorganic Chemistry II				
Semester /Year : IInd				
	L	T	P	C
	4	0	0	4

CourseObjective:

The objective of this course is to gain knowledge about electronic spectra &magnetism of coordination compounds, bonding in organometallic compounds, basics of metal clusters and silicates.

Unit I **[No of hours 15]**

Electronic Spectra & Magnetic Properties of Transition Metal Complexes.

Types of absorption spectra.Spectral terms. Russell-Saunders states. Selection rules for electronic transitions in complexes. Width of absorption spectral bands, Terms generated in ligand fields. Orgel and Tanabe-Sugano correlation diagrams for d^1 to d^9 states. Racah parameters. Charge transfer spectra. Magnetic moments, magnetic exchange coupling and spin crossover.

Unit II **[No of hours 15]**

Metal-π-ComplexesandorganometallicCompounds.

Metal carbonyl complexes. Preparation, properties and uses. Nature of bonding in metal carbonyls and carbon monoxide analogs i.e. nitrosyls and dinitrogen complexes. Evidence for back bonding in complexes.Nature of M-C bond Synthesis,bonding and uses of organometallic compounds,twoelectronligands(olefinicandacetyleniccomplexes),three electron ligands (allylic complexes),fourelectron ligand (butadiene and cyclobutadiene complexes),fiveelectronligand(ferrocenecomplexes).

Unit III **[No of hours 15]**

MetalClusters

Polyhedralboranesandboraneanions.Synthesis,reactivity,bondingandtopologyofboranes.. Wade's rules.Carboranes,metalloboranes and metallocarboranes.Metalcarbonyls and halidesasclusters.Metalcarbonylhydrides.

Unit IV **[No of hours 15]**

Silicates

Principles ofsilicates.Structure and classification ofsilicates.Asbestos,Zeolites and Ultramarinesassilicatematerials.Silicatesintechnology

Text Books:

TB1. AdvancedInorganicChemistryVthEd.,F.A.CottonandG.Wilkinson,JohnWiley,(1988).
TB2. AdvancedInorganicChemistryVIthEd.,F.A.Cotton,GWilkinson,C.A.MurilloandM. Bochmann,JohnWiley,(1999).

Reference Books:

RB1. Inorganicchemistry,AUnifiedApproach,IIndEd.,W W.Porterfield,Academic Press,(1993).
RB2. InorganicChemistry,J.E.House,AcademicPress,(2008)

Course outcomes (COs):

Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Gain knowledge about the electronic spectra and magnetism of coordination compounds.
CO2	Understandnature and bonding in organometallic compounds.
CO3	Understand the basics of metal clusters.
CO4	Classification of silicates

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	2	1	3	1	3	1	1	1
CO2	3	1	1	2	1	1	3	2	3	1	2	1
CO3	3	1	1	2	1	1	3	1	3	1	1	1
CO4	3	1	1	2	1	1	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC202**
Course Name	**:Organic Chemistry II**

Semester /Year : IInd				
	L	T	P	C
	4	0	0	4

CourseObjective:

The objective of this course is to gain knowledge about mechanism of varioussubstitution, addition and elimination reactions.

Unit I **[No of hours 5]**

Aromatic Electrophilic Substitution

Orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrate and electrophiles. Diazonium coupling, VilsmeirHaak reaction, Gattermann-Koch reaction.

Unit II **[No of hours 5]**

Aromatic Nuecleophilic Substitution

The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleopile. The von Rictor, Sommelet-Hauser, and Smiles rearrangements.

Unit III **[No of hours 10]**

Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism of an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Unit IV **[No of hours 10]**

Addition to Carbon-Carbon Multiple Bonds

Mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Unit V **[No of hours 10]**

Addition to Carbon-Hetero Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Wittig reaction. Mechanism of condensation reactions involving enolates- Knoevenagel, Claisen, Mannich Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

Unit VI **[No of hours 5]**

Elimination Reactions

The E2, E1 and E1cB mechanisms and their stereochemistry. Orientation of the double bond.Reactivity- effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

Unit VII **[No of hours 15]**

Pericyclic Reactions

Molecular orbital symmetry, Frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann. Correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and suprafacial additions, 4n, and 4n+2 systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1, 3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements- suprafacial and antarafacialshiffs of H, sigmatropic shifts involving carbon moieties, 3,3- and 5,5- sigmatropic rearrangements. Claisen, Cope and aza- Cope rearrangements. Fluxional tautomerism. Ene reaction.

Text Books:

TB1. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
TB2. Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
TB3. Reaction Mechanism in Organic Chemistry, Mukherji and Singh, Macmillan.

Reference Books:

RB1. Advanced Organic Chemistry, Reaction, Mechanism and Structure, Jerry March, 6th Ed., John Wiley.
RB2. Advanced Organic Chemistry, Carey and Sundberg, Springer Verlag, Germany.
RB3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes.

Course outcomes (COs):

Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Identify various types of organic reactions emphasizing their use in various pharmaceutical industries
CO2	Understand the fundamental reactions and mechanism of free radical.
CO3	Analyze the electrocyclic, cycloaddition and sigmatropic reaction.
CO4	Analyze the mechanisms of different types of organic reactions.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	3	1	3	1	3	1	1	3
CO2	3	1	1	2	2	1	3	1	3	1	2	1
CO3	3	1	1	2	2	1	3	1	3	1	1	1
CO4	3	1	1	2	2	1	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC203**			
Course Name	**: Physical Chemistry II**			
Semester /Year	**: IInd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gain knowledge about theories of chemical dynamics&its application in deriving kinetics of various reactions,laws of statistical thermodynamics and use of EMR to measuredifferent aspects of molecular structure.

Unit I **[No of hours 15]**

Chemical Dynamics

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzymes reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of molecular motions, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reactions (Lindemann-

Hinshelwood and Rice-Ramsperger-Kassel-Marcus [RRKM] theories of unimolecular reactions).

Unit II **[No of hours 15]**

Statistical Thermodynamics

Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws- (using Lagrange's method of undetermined multipliers). Partition functions- translational, rotational, vibrational and electronic partition functions. Calculation of thermodynamic properties in terms of partition functions. Applications of partition functions.Heat capacity behaviour of solids- chemical equilibria and chemical equilibrium constant in terms of partition functions, Fermi-Dirac statistics, distribution law and applications to metal. Bose-Einstein statistics – distribution law and application to helium.

Unit III **[No of hours 15]**

Non-Equilibrium Thermodynamics

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non-equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electrokinetic phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

Unit IV **[No of hours 15]**

Electrochemistry

Electrochemistry of solutions, Debye-Huckel, Onsager treatment and its extension, ion solvent interactions.Thermodynamics of electrified interface equations. Structure of electrified interfaces. Guoy Chapman, Stern. Over potentials, exchange current density, derivation of Butler-Volmer equation, Tafel plot. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Electrocatalyis – influence of various parameters. Hydrogen electrode. Bioelctrochemistry, threshold membrane phenomena. Polarography theory, Ilkovic equation, half wave potential and its significance. Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

Text Books:

TB1. Physical Chemistry, P.W. Atkins, ELBS.
TB2. Coulson's Valence, R. McWeeny, ELBS.
TB3. Modern Electrochemistry, Vol. I & II, J.O.M. Bockris and A.K.N. Reddy, Plenum.

Reference Books:

RB1. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.

RB2. Quantum Chemistry, Ira N. Levine, Prentice Hall.

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Understand the theories of chemical dynamics.
CO2	Interpret the basic elements and laws of statistical thermodynamics.
CO3	Apply the knowledge of chemical dynamics in deriving kinetics of various reactions.
CO4	Analyze various regions of the electromagnetic spectrum which can be used to measuredifferent aspects of molecular structure.
CO5	Apply principles of solution electrochemistry in various applications.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	1	1	3	1	3	1	1	1
CO2	3	1	1	2	1	1	3	1	3	1	1	1
CO3	3	1	1	2	1	1	3	1	3	1	1	1
CO4	3	1	1	2	1	1	3	1	3	1	1	1
CO5	3	1	1	3	1	1	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHC204				
Course Name : Spectroscopy and separation methods				
Semester /Year : IInd				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gain knowledge about chromatography, radioactivity and different spectroscopic techniques& its application in structural elucidation of organic compounds.

Unit I **[No of hours 10]**

Molecular Electronic Spectroscopy: Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of excited states, Franck-Condon principle, Dissociation and pre-dissociation, electronic spectra of polyatomic molecules. Emission spectra, radiative and non-radiative decay, internal conversion,

Unit II **[No of hours 15]**

Magnetic Resonance Spectroscopy:

Nuclear Magnetic Resonance Spectroscopy: Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurement, factor influencing chemical shift, deshielding, spin-spin interaction, factors influencing coupling constant 'J'. Classification (ABX, AMX, ABC, A2B2 etc.), spin decoupling, basic ideas about instrument, NMR studies of nuclei other than proton-^{13}C, ^{19}F. FT NMR, advantages of FT NMR, use of NMR in medical diagnostics.

Unit III **[No of hours 15]**

Mass Spectrometry: Introduction, ion production—EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, and ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, Molecular ion peak, Meta-stable peak, McLafferty rearrangement. Nitrogen Rule. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination. Introduction to negative ion Mass spectrometry, TOF-MALDI.

Unit IV **[No of hours 15]**

Chromatographic Methods: Principle, instrumentation and applications of gas liquid chromatography and HPLC. Ion exchange chromatography: cationic and anionic exchanges and their applications. Van-Deemter equation (no derivation), concept about HEPT-plate theory and rate theory. Applications.

Unit V **[No of hours 5]**

Radio Analytical Methods: Basic principles and types of measuring instruments, isotope dilution techniques: principle of operations and uses. Applications.

Text Books:

TB1. Instrumental Methods of Chemical Analysis, Willard, Meritt, Dean & Settle (Wiley Eastern).
TB2. Modern Spectroscopy, J.M. Hollas, John Wiley.
TB3. High Performance Liquid Chromatography, Heinz Engelhardt.

Reference Books:

RB1. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH-Oxford.
RB2. Introduction of Molecular Spectroscopy, G.M. Barrow, McGraw Hill.

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Get Knowledge of Nuclear Magnetic resonance spectroscopy of H^1, C^{13} and Flourine^{19} nuclei, its use in medical sciences and field of chemistry.
CO2	Understand detailed knowledge about molecular electronic spectroscopy and scientific notations related to this topic.
CO3	Understand principle, theory and use of mass spectroscopy, chromatographic and radioactive technique.
CO4	Apply theory in structural elucidation of organic compounds.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	1	1	3	1	3	1	1	3
CO2	3	1	1	2	1	1	3	1	3	1	1	3
CO3	3	1	1	2	1	1	3	1	3	1	1	3
CO4	3	1	1	2	1	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHL205				
Course Name : Laboratory Course I				
Semester /Year : IInd				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

CourseObjective:

The objective of this course is to gain practical knowledge about volumetric and gravimetric analysis, synthesis of organic compounds and spectral techniques.

Part 1: Inorganic Chemistry

Quantitative Analysis of mixtures of two metal ions involving Volumetric (by complexometric titration using masking and demasking agents) and gravimetric analysis.

Part 2: Organic Chemistry

Synthesis of Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.

Cannizzaro reaction: 4-Chlorobenzaldehyde as substrateAromatic electrophilic Substitutions: Synthesis of p-nitroaniline and p-bromoaniline.The products may be characterized by Spectral Techniques where possible.

Part 3: Physical Chemistry

Solutions

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

Text Books:

TB1. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi
TB2. Inorganic Chemistry: A Laboratory Manual, Mala Nath. Narosa Publishing House

Reference Books:

RB1. Vogel's textbook of Practical Organic Chemistry Vth Edition,Brian S. Furniss, Antony J. Hannaford, Peter W.G Smith. Pearson
RB2. Advanced Practical Physical Chemstry,J B Yadav. Educational Publishers

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Get knowledge about the volumetric and gravimetric estimations of mixture of cations.
CO2	Understand the basics of spectral techniques..
CO3	Apply their knowledge in synthesis of various organic compounds.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	1	1	1	3	1	2
CO2	1	3	1	2	1	3	1	1	1	3	1	2
CO3	1	3	1	2	1	3	1	1	1	3	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHL206**			
Course Name	**: Laboratory Course II**			
Semester /Year	**: IInd**			
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

CourseObjective:

The objective of this course is to gain practical knowledge about water and oil analysis, inorganic preparations and quantitative analysis by using potentiometer and pH meter.

Part 1: Inorganic Chemistry

Preparationsof selected inorganic compounds:

VO (acac)2

TiO (C9H8NO)2. 2H2O

cis-K[Cr(C2O4)2 (H2O)2]

Na[Cr(NH3)2(SCN)4]

Mn (acac)3

K3 [Fe (C2O4)3] 3H2O

Prussian Blue, Turnbull's Blue

Co [(NH3)6] Cl3

[Cu (en)2 (H2O)2] I2

Cu2HgI4

[Co (Py)2Cl2]

[Ni (NH3)6] Cl2

Tris-(thiourea) copper (I) sulphate [Cu (tu)3] SO4.2H2O

K3[Cr (C2O4)3]

Part 2: Organic Chemistry

Quantitative Analysis

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

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

Determination of Iodine and Saponification values of an oil sample

Determination of DO, COD and BOD of water sample.

Part 3: Physical Chemistry

Potentiometry/pH-metery

Determination of strengths of halides in a mixtures potentiometrically.

Determination of the valency of mercurous ions potentiometrically.

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

Determination of temperature dependence of EMF of a cell.

Determination of the formation constant of silver-ammonia complex and stiochiometry of the complex potentiometrically.

Acid-base titration in a non-aqueous media using a pH meter.

Determination of activity and activity coefficient of electrolytes.

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

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

Determination of thermodynamic constants ΔG, ΔS and ΔH for the reaction by e.m.f.method.$Zn + H_2SO_4 \longrightarrow ZnSO_4 + 2H$

Text Books:

TB1. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi
TB2. Inorganic Chemistry: A Laboratory Manual, Mala Nath. Narosa Publishing House

Reference Books:

RB1. Vogel's textbook of Practical Organic Chemistry Vth Edition,Brian S. Furniss, Antony J. Hannaford, Peter W.G Smith. Pearson
RB2. Advanced Practical Physical Chemstry,J B Yadav. Educational Publishers

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Get practical knowledge of Quantitative analysis of water, oil and functional groups in organic compounds.
CO2	Understand different inorganic preparations.
CO3	Apply potentiometer and pH meter in quantitative chemistry.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	1	1	1	3	1	2
CO2	1	3	1	2	1	3	1	1	1	3	1	2
CO3	1	3	1	2	1	3	1	1	1	3	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

MSc Chemistry(IIIrd Semester)

Course code	**:MCHC301**			
Course Name	**:ORGANIC SYNTHESIS AND PHOTOCHEMISTRY**			
Semester /Year	**: IIIrd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gain knowledgeabout disconnection approach, reaction mechanismsandphotochemical reactions.

Unit I **[No of hours 5]**

Disconnection Approach

An introduction to synthons and synthetic equivalents disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions and amine synthesis.

Unit II **[No of hours 15]**

Protecting Groups

Principle of protection of alcohols, amine, carbonyl and carboxyl groups

Unit III **[No of hours 15]**

One Group and Two Group C-C Disconnections

Alcohols and carbonyl compounds regioselectivity. Alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis. Diels-Alder reaction, 1,3-difunctional compounds, α,β-unsaturated carbonyl compounds, control in carbonyl condensations. Micheal addition and Robinson annelation.

Unit IV **[No of hours 15]**

Determination of Reaction Mechanism

Classification, rate constants and life times of reactive energy states-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.

Unit V **[No of hours 10]**

Photochemical Reactions

Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4-and 1,5-dienes. Intramolecular reactions of carbonyl compounds-saturated cyclic and acyclic, β,γ-unsaturated and α,β-unsaturated compounds. Cyclohexadienones. Intramolecular cycloaddition reactions-dimerisation and oxetane formation. Isomerisation, additions and substitutions.. Photo-Fries rearrangement, Barton reaction.

Text Books:

TB1. Fundamentals of Photochemistry, K.K. Rohtagi-Mukherji, New Age International
TB2. Essentials of Molecular Photochemistry, A. Gilbert and J. Baggott, Blackwell Scientific Publication

Reference Books:

RB1. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
RB2. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March, John Wiley.
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Course outcomes (COs):

Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Analyze and interpret synthetic route of simple and complex molecules.
CO2	Describe and design synthetic route of given target molecule by disconnection approach.
CO3	Plan and design various synthetic route of modern biologically active compounds.
CO4	Interpret mechanisms of various classical and modern reactions used in organic synthesis.
CO5	Describe the mechanism of photochemical reaction and its application.
CO6	Describe the mechanism of photochemical reaction and its application.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	3	1	3	1	3	1	1	3
CO2	3	1	1	2	3	1	3	1	3	1	1	3
CO3	3	1	1	2	3	1	3	1	3	1	1	3
CO4	3	1	1	2	3	1	3	1	3	1	1	3
CO5	3	1	1	2	3	1	3	1	3	1	1	3
CO6	3	1	1	2	3	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHC302**			
Course Name	**: Heterocyclic Chemistry**			
Semester /Year	**: IIIrd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gain knowledge about nomenclature, classification, chemical and physical properties of various heterocyclic compounds.

Unit I **[No of hours 5]**

Nomenclature of Heterocycles : Replacement and Systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused and bridged heterocycles

Unit II **[No of hours 15]**

Aromatic and Non-aromatic Heterocycles : General chemical behaviour of aromatic heterocycles, classification (structural type), Heteroaromatic reactivity and tautomerism in 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 interactions. Stereo-electronic effects, aromatic and related effects. Attractive interactions - hydrogen bonding and intermolecular nucleophilic, electrophilic interactions.

Unit III **[No of hours 10]**

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

Unit IV **[No of hours 5]**

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes

Unit V **[No of hours 15]**

Six-Membered Heterocycles with One, Two or More Heteroatoms

Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium&thiopyrylium salts. Synthesis and reactions of benzopyrylium salts and coumarins. Synthesis and reacitons of diazines, triazines, tetrezines and thiazines.

Unit VI **[No of hours 10]**

Seven-and Large-Membered Heterocycles

Synthesis and reactions of azepines,oxepine,diazepines,azocines and oxocines.

Text Books:

TB1. Heterocyclic Chemistry Vol. 1 & 2, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag
TB2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.

Reference Books:

RB1. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
RB2. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scietific Technical

Course outcomes (COs):
Uponsuccessfulcompletionofthe course studentwillbeableto

CO1	Get knowledge about nomenclature of heterocyclic compounds, general chemical and physical properties of aromatic and nonaromatic heterocycles.
CO2	Describe synthesis and properties of three & four membered heterocyclic compounds.
CO3	Understand synthesis, reactions and medical applications of Benzo fused five membered heterocycles.
CO4	Distinguish among six, seven and large membered heterocycles.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	2	1	3	1	3	1	1	3
CO2	3	1	1	2	2	1	3	1	3	1	1	3
CO3	3	1	1	2	2	1	3	1	3	1	1	3
CO4	3	1	1	2	2	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHL303				
Course Name : Laboratory Course I				
Semester /Year : IIIrd				
	L	T	P	C
	0	0	3	3

CourseObjective:

The objective of this course is to gain practical knowledge about separation, purification and identification of the components of a mixture.

Qualitative Analysis

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

Text Books:

TB1. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.
TB2. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi.

R**eference Books:**

RB1. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz, Saunders College Publishing, Philadelphia, New York.
RB2. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn& Bacon, Inc. Boston.

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Cite the practical concepts underlying the purification, separation and analysis of organicmixture of a compound
CO2	Paraphrase a range of practical techniques used in science such as the analysis ofsubstances, the separation of substances and the use of instruments/ glassware's.

CO3	Develop the ability of performing accurate quantitative measurements with anunderstanding of the theory and use of contemporary instrumentation.
CO4	Analyze the practical concept qualitatively and quantitatively.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	1	1	1	3	1	2
CO2	1	3	1	2	1	3	1	1	1	3	1	2
CO3	1	3	1	2	1	3	1	1	1	3	1	2
CO4	1	3	1	2	1	3	1	1	1	3	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHL304				
Course Name : Laboratory Course II				
Semester /Year : IIIrd				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

CourseObjective:

The objective of this course is to gain practical knowledge about multistep organic synthesis, photochemical reactions, synthesis of heterocyclic compounds.

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 ⟶ Benzophenone oxime ⟶ 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-phenyl indole from phenylhydrazine.

Text Books:

TB1. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.
TB2. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi.

R**eference Books:**

RB1. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz, Saunders College Publishing, Philadelphia, New York.
RB2. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn& Bacon, Inc. Boston.

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Prepare organic compounds and to identify various functional group transformations.
CO2	Identify the organic compounds in the ternary mixture using separation techniques andconfirmatory tests.
CO3	Analyze various synthetic methodologies involved in organic synthesis.
CO4	Describe various synthetic methodologies involved in organic chemistry.
CO5	Develop their experimental skills for synthesis of various organic compounds.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	1	3	1	1	1	3	1	2
CO2	1	3	1	2	1	3	1	1	1	3	1	2
CO3	1	3	1	2	1	3	1	1	1	3	1	2
CO4	1	3	1	2	1	3	1	1	1	3	1	2
CO5	1	3	1	2	1	3	1	1	1	3	1	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlate

Course code :MCHE313				
Course Name :Bioinorganic, Bioorganic and Biophysical Chemistry				
Semester /Year : IIIrd				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gainknowledge about bioinorganic, bioorganic and biophysical chemistry.

UnitI **[No of hours 20]**

Bioinorganic Chemistry

Metal Ions in Biological Systems, Na+/K+Pump,

Essential and trace metals. role of metal ions in biological processes. Na^+/K^+ Pump.

Bioenergetics and ATP Cycles

DNA polymerization, glucose storage, metal complexes in transmission of energy; chlorophylls,photosystem I and photosystem II in cleavage of water.

Transport and Storage of Dioxygen

Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin.

UnitII **[No of hours 20]**

Bioorganic Chemistry

Enzymes & Mechanism of Enzyme Action

Introduction and historical perspective, chemical and biological catalysis, properties ofenzymes- catalytic power, specificity and regulation. Fischer's lock and Koshland's induced fithypothesis, Enzyme kinetics, Michaelis-Menten and Lineweaver-Burkplots, reversible and irreversible inhibition. Transition-state theory,acid base catalysis, covalent catalysis, strain of distortion.

Kinds of Reactions Catalysed by Enzymes

Nucleophillic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions,-cleavage and

condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

UnitIII **[No of hours 20]**

Biophysical Chemistry

Biological Cell and its Constituents, Cell Membrane and Transport of Ions

Biological cell, structure and functions of proteins, enzymes, DNA and RNA in living systems.Helix coil transition. Structure and functions of cell membrane, ion transport through cellmembrane.

Bioenergetics

Standard free energy change in biological reactions, exergonic, endergonic. Hydrolysis of ATP,Synthesis of ATP from ADP.

Text Books:

TB1. Bioinorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
TB2. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.

Reference Books:

RB1. Enzyme Chemistry: Impact and Applications, Ed. Colliins J Sucking, Chapman and Hall.
RB2. Enzymes Mechanism Ed, M.I. Page and A. Williams, Royal Society of Chemistry.

Course outcomes (COs):
Upon successful completion of the course student will be able to

CO1	Gain Knowledge about bioinorganic chemistry of elements.
CO2	Understand the fundamental concepts of enzymes, their properties and mechanism of action.
CO3	Apply the concept of bioenergetics.
CO4	Understand fundamentals of biological cell, its constituents and the transport of ions across cell membrane.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	2	1	3	1	3	1	1	3
CO2	3	1	1	2	2	1	3	1	3	1	1	3
CO3	3	1	1	2	2	1	3	1	3	1	1	3
CO4	3	1	1	2	2	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHE315**			
Course Name	**: Polymers**			
Semester /Year	**: IIIrd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gainknowledge about classification,properties, thermodynamics, synthesis and applications of polymer.

Unit I **[No of hours 15]**

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain, ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization n homogenous and heterogeneous systems.

Unit II **[No of hours 15]**

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. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

Unit III **[No of hours 15]**

Structure and Properties Morphology and order in crystalline polymers, configurations of polymer chains. Crystal structure of polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties, crystalline melting point Tm, melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and

heat of fusion. The glass transition temperature, Tg. Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization.

Unit IV **[No of hours 15]**

Plastic, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Textbooks:

TB1. Textbook of Polymer Science, F.W. Billmeyer Jr, Wiley.
TB2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.

Reference Books:

RB1. Functional Monomers and Polymers, K. Takemoto, Y. inaki and R.M. Ottanbrite.**RB2.**. Contemporary Polymer Chemistry, H.R. Alcock and F.W. Lambe, Prentice Hall.

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Classify polymers and know about the importance of functionality of polymers.
CO2	Understand about different types of mechanisms in polymerization processes.
CO3	Correlate properties of polymers with their structure.
CO4	Determine molecular weight of polymers by using different methods.
CO5	Understand about thermodynamics of polymer solutions.
CO6	Get Knowledge about synthesis, properties and applications of different polymers.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	3	1	3	1	3	1	1	1
CO2	3	1	1	2	3	1	3	1	3	1	1	1
CO3	3	1	1	2	3	1	3	1	3	1	1	1
CO4	3	1	1	2	3	1	3	1	3	1	1	1
CO5	3	1	1	2	3	1	3	1	3	1	1	1

CO6	3	1	1	2	3	1	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHE317**			
Course Name	**: Medicinal Chemistry**			
Semester /Year	**: IIIrd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gainknowledge about fundamentals of medicinal chemistry,classification and mechanism of actionof drugs and structure of enzymes and their interaction with biomolecules.

Unit I **[No of hours 10]**

Introduction: History of medicinal chemistry, general mechanism of drug action on lipids, carbohydrates, proteins and nuleic acids, drug metabolism and inactivation, receptor structure and sites, drug discovery development, design and delivery systems, gene therapy and drug resistance.

Unit II **[No of hours 15]**

Classification: Drugs based on structure or pharmacological basis with examples, synthesis of important drugs such as α - methyl dopa, chloramphenicol, griseofulvin, cephelosphorins and nystatin. Molecular modelling, conformational analysis, qualitative and quantitative structure activity relationships.

Unit III **[No of hours 15]**

General introduction to antibiotics: Mechanism of action of lactam antibiotics and non lactam anti biotics, antiviral agents, chemistry, stereochemistry, biosynthesis and degradation of penicillins - An account of semisynthetic penicillins - acid resistant, penicillinase resistant and broad spectrum semisynthetic penicillins.

Unit IV **[No of hours 15]**

Elucidation of enzyme structure: Mechanism, kinetic, spectroscopic, isotopic and stereochemical studies. Chemical models and mimics for enzymes, design, synthesis and evaluation of enzyme inhibitors.

Unit V **[No of hours 5]**

Interactions of enzymes: DNA-protein interaction and DNA-drug interaction. Introduction to rational approach to drug design, physical and chemical factors associated with biological activities, mechanism of drug action.

Text Books:

TB1.I. Wilson, Giswald and F. Doerge, Text Book of Organic Medicinal and Pharmaceutical Chemistry, J.B. Lippincott Company, Philadelphia, 1971.
TB2.A. Burger, Medicinal Chemistry, Wiley Interscience, New York, Vol. I and II, 1970.

Reference Books:

RB1. A. Gringauz, Introduction to Medicinal Chemistry, How Drugs Act and Why?, John Wiley and Sons, 1997.
RB2.G. L. Patrick, Introduction to Medicinal Chemistry, Oxford Univeristy Press, 2001.

Course outcomes (COs):

Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Gain the knowledge of fundamentals of medicinal chemistry.
CO2	Understand the classification of drugs.
CO3	Understand an idea of antibiotics and their mechanism of action.
CO4	Analyze the structure of enzymes and their interaction with biomolecules.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	3	2	1	1	3	1	3	1	1	3
CO2	3	1	3	2	1	1	3	1	3	1	1	3
CO3	3	1	3	2	1	1	3	1	3	1	1	3
CO4	3	1	3	2	1	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHE322**			
Course Name	**:Instrumental methods of analysis**			
Semester /Year	**: IIIrd**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gainknowledge about different electroanalytical,microscopic, chromatographic and thermal techniques.

Unit I **[No of hours 5]**

Thermal methods : Theory, instrumentation and applications of thermogravimetric analysis (TGA),Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), thermometric titrations

Unit II **[No of hours 10]**

Electrophoresis : Separation by adsorption-affinity techniques, polyacrylamide gel electrophoresis,isoelectric focussing isotachophoresis, two dimensional gel electrophoresis, applications in clinical andcapillary zone electrophoresis of carbohydrates

Unit III **[No of hours 15]**

High performance liquid chromatography methods : HPLC theory and instrumentation,adsorption chromatography, liquid-liquid partition techniques, affinity techniques, size exclusion,capillary chromatography, ion pair separations, chiral and isotope separations, applications in foodand pesticide analysis

Unit IV **[No of hours 10]**

Gas chromatography : Gas chromatography theory and Instrumentation, column types, solid/liquidstationary phases, basic and specialized detectors, elemental detection, chiral separations, pyrolysisgas chromatography, high temperature techniques, application (clinical, petrochemical etc.) andproblems

Unit V **[No of hours 15]**

Optical and diffraction methods : Atomic fluorescence spectrometry-theory, instrumentation andapplications, basic principles of electron and neutron diffraction, X-ray methods: x-ray absorptionspectroscopy (XAS), x-ray diffraction (XRD), x-ray photoelectron spectroscopy (XPS), energydispersivex-ray spectroscopy (EDX), scanning electron microscopy (SEM), transmission electronmicroscopy (TEM), atomic-force microscopy (AFM)

Unit VI **[No of hours 5]**

Electroanalytical methods : Basic theory, instrumentation and applications of electrogravimetry,coulometry, polarography, cyclic voltametry, amperometry

Text Books:

TB1. Principles of instrumental analysis by douglas a. skoog, f. james holler, stanley r. crouch, cengage learning.
TB2.. Vogel's quantitative chemical analysis by j. mendham, r.c.denney, m.j.kthomas, david j. barnes, pearson

Reference Books:

RB1. Instrumental methods of analysis by h.h.willard, l.l.merritt, j.a. dean, cbs publishers & distributors pvt. ltd.

Course outcomes (COs): Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Gain Knowledge about theory, instrumentation and applications of different electroanalytical methods.
CO2	Differentiate between various electroanalytical techniques including cyclic voltametry,coulometry, polarography etc.
CO3	Determine morphology of materials using scanning electron microscopy and transmissionelectron microscopy
CO4	Illustrate the theories, instrumentation and applications of high performance liquidchromatography and gas chromatography.

CO5	Apply various thermal methods for characterization of different types of compounds.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	2	1	3	1	3	1	1	3
CO2	3	1	1	2	2	1	3	1	3	1	1	3
CO3	3	1	1	2	2	1	3	1	3	1	1	3
CO4	3	1	1	2	2	1	3	1	3	1	1	3
CO5	3	1	1	2	2	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHS320				
Course Name : Pesticide Chemistry				
Semester /Year : IIIrd				
	L	**T**	**P**	**C**
	0	**0**	**0**	**3**

CourseObjective:

The objective of this course is to gainknowledge about classification, synthesis and properties of various pesticides.

General introduction to pesticides (natural and synthetic), benefits and adverse effects, changing concepts of pesticides, structure activity relationship, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Text Books:

TB1: Chemistry of Pesticides, N.K Roy. CBS Publishers and Distributors
TB2: Principles of Pesticide Chemistry, S.K.Handa. AgrobiosIndia

Course outcomes (COs):

Upon successful completionofthecoursestudentwillbeableto

CO1	Gain the knowledge of fundamentals of pesticide chemistry.
CO2	Understand the classification of pesticides.
CO3	Apply and use self study for teaching practice.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	3	3	3	1	3	1	3	1	1	3
CO2	3	1	3	3	3	1	3	1	3	1	1	3
CO3	3	1	3	3	3	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

MSc Chemistry (IVth Semester)

Course code	**:MCHC401**			
Course Name	**:Chemistry of natural products**			
Semester /Year	**: IVth**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gainknowledge about isolation, structural features, biosynthetic pathways forvarious classes of natural products**.**

Unit I **[No of hours 15]**

Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule Structures of abietic acid and β-carotene.

Unit II **[No of hours 10]**

Alkaloids

Classification,Nomenclature,Isolation and structure of ephedrine, quinine.

Unit III **[No of hours 15]**

Steroids

Structural features of cholesterol and bile acids (without synthesis). Chemistry of testosterone, estrone and progestrone.

Unit IV **[No of hours 15]**

Pigments

(a) Plant Pigments: Occurrence, nomenclature and general methods of structure determination.Isolation and synthesis of cyanidin, and quercetin.

(b) Porphyrins
General Introduction of haemoglobin and chlorophyll. Chemistry of chlorophyll (without synthesis).

Structure and synthesis of haem.

Unit V **[No of hours 5]**

Prostaglandins

Occurrence, nomenclature, classification, biogenesis and physiological effectsSynthesis of Key intermediate, PGE2 and PGF2

Text Books:

TB1. Natural Products: Chemistry and Biological Significance, J.Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
TB2. Organic Chemistry, Vol 2, I.L. Finar, ELBS.
TB3. Stereoselective Synthesis: A Practical Approach, M. Nogradi, VCH.

Reference Books:

RB1. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
RB2. New Trends in Natural product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Get knowledge regarding procedures of isolation of natural products

	form plant extract.
CO2	Understandthe basic chemical and structural features of biomolecules,including terpenoids, alkaloids, steroids and plant pigments.
CO3	Apply the mechanistic aspects of the chemical reagents used in studying thechemistry of natural products
CO4	Compare the biosynthetic pathways for various classes of natural products.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	3	1	1	2	3	1	3	1	3	1	1	3
CO2	3	1	1	2	3	1	3	1	3	1	1	3
CO3	3	1	1	2	3	1	3	1	3	1	1	3
CO4	3	1	1	2	3	1	3	1	3	1	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHL402				
Course Name : Laboratory Course I				
Semester /Year : IVth				
	L	**T**	**P**	**C**
	0	**0**	**3**	**3**

CourseObjective:

The objective of this course is to gain practicalknowledge about isolations and purification of natural products by chromatography and their structural elucidation.

I. 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 TLC and PC and Rf value reported).
4. Isolation of nicotine dipicrate from tobacco.
5. Isolation of cinchonine from cinchona bark.
6. Isolation of piperine from black pepper.
7. Isolation of lycopene from tomatoes.
8. Isolation of -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 cloves.
11. Isolation of limonene from citrus fruits.

II. 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.

III. Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR & MS)

IV. Spectrophotometric (UV/VIS) Estimations

1. Amino acids
2. Proteins
3. Carbohydrates
4. Cholesterol
5. Ascorbic acid
6. Aspirin
7. Caffeine

Text Books:

TB1. Laboratory Manual of Organic Chemistry, RK Bansal, New Age International, Delhi.
TB2. Introduction to Organic Laboratory Techniques (Third Edition), DL Pavia, GM Lampman and GS Kriz, Saunders College Publishing, Philadelphia, New York.

Reference Books:

RB1. Operational Organic Chemistry, A Laboratory Course, Second Edition, JW Lehman, Allyn& Bacon, Inc. Boston.
RB2. Microscale Organic Experiments KL Willianson, DC Health & Co. Le Xington.

Course outcomes (COs):

Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Understand the use of spectroscopic techniques in structural determination of natural product
CO2	Paraphrase about the isolations and purification of natural products and check their purity by Chromatography.
CO3	Analyze and comprehend the practical concepts in the identification of

	components forgiven organic mixtures.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO 2	PSO 3	PSO4
CO1	1	3	1	2	3	3	1	1	1	3	1	3
CO2	1	3	1	2	3	3	1	1	1	3	1	3
CO3	1	3	1	2	3	3	1	1	1	3	1	3

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code :MCHC403				
Course Name :Dissertation				
Semester /Year : IVth				
	L	**T**	**P**	**C**
	0	**0**	**0**	**9**

CourseObjective:

The objective of this course is toinculcate the research aptitude in students.

Project from parent institute/industry /Research Organizations. Project should be completed under the guidance of a faculty member in the same Department or Industry or research organization. In case of Industry / research organization one member of that body can also be included as project guide.

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Learn basics to identify research problem.
CO2	Develop ability in writing the research publication.
CO3	Apply knowledge to evaluate and present research results.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	3	3	1	1	3	1	1	3	2
CO2	1	1	3	3	3	1	1	3	1	1	3	2
CO3	1	1	3	3	3	1	1	3	1	1	3	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHE410**			
Course Name	**:Computer and Biostatistics**			
Semester /Year	**: IVth**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is togain knowledge about use of computers and biostatistics in different fieldof biological and chemical sciences.

Computers

Unit I **[No of hours 10]**

History of computer Simple model of computer and its working, input-output devices, computer languages and their hierarchy(low level and high level),Introduction of microcomputers, concept of operating system, computer networking, concept of OSI layers, Introduction of software(MS-Word, MS-Excel & Power point etc.)

Unit II **[No of hours 10]**

Introduction of C++ Programming Difference between C and C++, concept of OOP'S, basic data types and operators, sample programs, conditional statements(IF-ELSE ,NESTED IF),concept of looping(for, while and dowhile),Introduction to arrays(single and double), classs and objects, function & function overloading, constructor and destructor, file handling.

Unit III **[No of hours 10]**

Internet and its working,Uniform resource locator(URL),World wide web,HTTP,Internet explorer,PDB,NRL-3D,BLAST &FASTA,Special software to align sequences,general DNA sequence data base,protein structure data base,genome project database,human mapping data base.

Biostatistics

Unit IV **[No of hours 15]**

Introduction and scope of Biostatistics Presentation of data: classification of data, Methods of collection of data, frequency distribution, graphical representation of data by histogram, frequency polygon, frequency curve and cumulative frequency curve. Central tendency and

measures of dispersion, mean, median, mode and their properties, partition value, standard deviation and coefficient of variation, simple correlation coefficient and regression coefficient, regression lines, tests of significance :t-test, z-test, chi-square tests, F-test, heterogeneity and independence of attributes.

Unit V **[No of hours 15]**

Testing of hypothesis Types of errors, power of test, test of significance based on normal distribution T-test for mean of population, difference of means of two normal population, chi-square test of goodness of fit, independent test ,test of variance of normal population F-test for variance ration, correlation and regression ,latest square methods and its application, significance of coefficient of correlation, rank correlation curve fitting and sign test.

Text books:

TB1. Information technology-D.P.Curtin,Tata McGraw Hill,New Delhi.

TB2. Guide to Medical Informatics,The Internet & Telemedicine-E Coiera,AmoldPublishers,USA

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Understand basics of computer and its working
CO2	Identify the use of biostatistics in science.
CO3	Apply computer programming in chemistry
CO4	Apply knowledge in different field of biological and chemical sciences..

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2	2	1	3	2	3	1	3	1
CO2	3	1	1	2	2	1	3	2	3	1	3	1
CO3	3	1	1	2	2	1	3	2	3	1	3	1
CO4	3	1	1	2	2	1	3	2	3	1	3	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**:MCHE411**			
Course Name	**:Environmental Chemistry**			
Semester /Year	**: IVth**			
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

CourseObjective:

The objective of this course is to gain knowledge about different segmentsof environment. It also gives an idea about composition, pollution, quality parameters, toxic elements of these segments

Unit I **[No of hours 15]**

Environment

Introduction, composition of atmosphere, vertical temperature, heat budget of the earth atmospheric system, vertical stability atmosphere. Biogeochemical cycles of C, N, P, S and O. Bio distribution of elements.

Unit II **[No of hours 15]**

Atmosphere

Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals chlorofluorohydrocarbons. Analytical methods for measuring air pollutants. Continuous monitoring instruments.

Unit III **[No of hours 5]**

Soils

Composition, micro and macro nutrients, Pollution of fertilizers, pesticides and metals.

Unit IV **[No of hours 15]**

Hydrosphere

Aquatic pollution- inorganic, organic, pesticides, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters-dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms. Water quality standards. Analytical methods for measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.) residual chloride and chlorine demand. Purification and treatment of water

Unit V **[No of hours 10]**

Environmental Toxicology

Introduction; threshold limiting value (TLV); Toxicity and control of toxicants-- Nonmetallic compounds, asbestos, organic compounds, endocrine disrupters, persistent organic pollutants (POP's), polychlorinated biphenyls (PCB's), dioxins, pesticides, phthalates, heavy metals- As, Hg, Cd, Pb..

Text Books:

TB1. Environmental Chemistry, S.E. Manahan, Lewis Publishers.
TB2. Environmental Chemistry, Sharma and Kaur, Krishna Publishers.
TB3. Environmental Chemistry, A.K. De, Wiley Eastern.

Reference Books:

RB1. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern.
RB2. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co.

Course outcomes (COs):
Uponsuccessfulcompletionofthecoursestudentwillbeableto

CO1	Get knowledge about environment, its heat budget, biogeochemical cycles and biodistribution of elements.
CO2	Explain composition of atmosphere, pollutants present in it and their estimation.
CO3	Understand composition of soil and its pollution by fertilizers, pesticides and metals.
CO4	Classify aquatic pollutants and learn water quality standards, analytical techniques to measure water quality parameters, treatment and purification of water.

CO5	Understand about threshold limit of environmental toxicants, their toxicity and control.

CO- PSO-PO Mapping:

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO 1	PSO2	PSO3	PSO4
CO1	3	1	3	2	3	3	3	1	3	1	1	1
CO2	3	1	3	2	3	3	3	1	3	1	1	1
CO3	3	1	3	2	3	3	3	1	3	1	1	1
CO4	3	1	3	2	3	3	3	1	3	1	1	1
CO5	3	1	3	2	3	3	3	1	3	1	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated