

As per NEP 2020
M.Sc. Chemistry
(Effective from Academic Year 2024-2025 onwards)



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Sikar (Rajasthan)

Curriculum Structure									
Session 2024-2025 onwards									
Name of the Program: Master of Chemistry									
Year: First							Semester: I (Pawas)		
Course Code	Course Title	Contact Hrs per Week	Credits			Weightage (%)			
			L	T	P	CWS	MTE	ETE	
Discipline Specific Core (DSC):									
24MCH9101T	Inorganic Chemistry-I	4	0	0	0	4	10	20	70
24MCH9102T	Organic Chemistry-I	4	0	0	0	4	10	20	70
24MCH9103T	Physical Chemistry-I	4	0	0	0	4	10	20	70
24MCH9104P	Chemistry Core Laboratory-I	0	0	8	4	4	-	-	100
Discipline Specific Elective(DSE): (Select any one)									
24MCH9105T	Spectroscopy-I	4	0	0	0	4	10	20	70
24MCH9106T	Analytical Techniques	4	0	0	0	4	10	20	70
Value Added Course(VAC):									
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Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):									
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		Total				22			

Summary: I Semester (Pawas)			Credits
S.N.	Particulars		
1.	Discipline Specific Core(DSC):	16	
2.	Discipline Specific Elective (DSE):	04	
3.	Value Added Course (VAC):	02	
4.	Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):	00	
Total		22	
\$CW (Class work): It would include attendance, class test/quiz test/assignments, ppt, play, learn by fun activities etc.			

Note: VAC to be selected from the list of VAC courses for PG, given on University website.

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Srikrishna University,
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Curriculum Structure									
Session 2024-2025 onwards									
Name of the Program: Master of Chemistry									
Year: First			Semester: II (Vasant)						
Course Code	Course Title	Contact Hrs per Week	Credits			Weightage (%)			ETE
			L	T	P	CWS	MTE		
Vasant Semester II									
Discipline Specific Core (DSC):									
24MCH9201T	Research Methodology	4	0	0	4	10	20	70	
24MCH9202T	Inorganic Chemistry-II	4	0	0	4	10	20	70	
24MCH9203T	Organic Chemistry-II	4	0	0	4	10	20	70	
24MCH9204P	Chemistry Core Laboratory-II	0	0	8	4	30	-	70	
Discipline Specific Elective(DSE):									
24MCH9205T	Spectroscopy-II	4	0	0	4	10	20	70	
24MCH9206T	Environmental Chemistry	4	0	0	4	10	20	70	
Value Added Course(VAC):									
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Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):									
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	Total				22				

Summary: II Semester (Vasant)			Credits
S.N.	Particulars		
1.	Discipline Specific Core(DSC):		16
2.	Discipline Specific Elective (DSE):		04
3.	Value Added Course (VAC):		02
4.	Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):		00
Total			22
\$CW (Class work): It would include attendance, class test/quiz test/assignments, ppt, play, learn by fun activities etc.			

Note: VAC to be selected from the list of VAC courses for PG, given on University website.


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Curriculum Structure									
For Session 2024-2025 onwards									
Name of the Program: Master of Chemistry					Semester: III (Pawas)				
Year: Second									
Course Code	Course Title	Contact Hrs per Week	Credits			Weightage (%)			
			L	T	P	CW	MT	ET	
Discipline Specific Core (DSC):									
24MCH9301T	Thermodynamics and Chemical Kinetics	4	0	0	4	10	20	20	70
24MCH9301P	Chemistry Core Laboratory-III	0	0	8	4	-	-	-	100
Discipline Specific Elective(DSE): Select any one group									
Group A Inorganic Chemistry									
24MCH9302T	Organotransition Metal Chemistry	4	0	0	4	10	20	20	70
24MCH9303T	Bioinorganic and Supramolecular Chemistry	4	0	0	4	10	20	20	70
24MCH9304T	Polymers	4	0	0	4	10	20	20	70
24MCH9302P	Elective Lab-I (Inorganic Chemistry)	0	0	8	4	-	-	-	100
Group B Organic Chemistry									
24MCH9305T	Organic Synthesis-I	4	0	0	4	10	20	20	70
24MCH9306T	Organic Synthesis-II	4	0	0	4	10	20	20	70
24MCH9307T	Natural Products	4	0	0	4	10	20	20	70
24MCH9303P	Elective Lab-I (Organic Chemistry)	0	0	8	4	-	-	-	100
Group C Physical Chemistry									
24MCH9308T	Chemical Dynamics	4	0	0	4	10	20	20	70
24MCH9309T	Electrochemistry	4	0	0	4	10	20	20	70
24MCH9310T	Nuclear Chemistry	4	0	0	4	10	20	20	70
24MCH9304P	Elective Lab-I (Physical Chemistry)	0	0	8	4	-	-	-	100
Value Added Course(VAC):									
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Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):									
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	Total				26				

Summary: III Semester (Pawas)			Credits
S.N.	Particulars		
1.	Discipline Specific Core (DSC):		08
2.	Discipline Specific Elective (DSE):		16
3.	Value Added Course (VAC):		02
4.	Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/P/C):		00
Total			26
§CW (Class work): It would include attendance, class tests /quizzes /assignments, PPT, play, learn by fun activities, etc.			

Note: 1. Number of Discipline specific Elective (DSE) offered will be finalized by the HoD, as per the available resources, Group will remain same in for semester IV.
2. VAC to be selected from the list of VAC courses for PG, given on the University website.

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Curriculum Structure									
For Session 2024-2025 onwards									
Name of the Program: Master of Chemistry					Semester: IV (Vasant)				
Year: Second									
Course Code	Course Title	Contact Hrs per Week			Credits	Weightage (%)			
		L	T	P		CW	MTE	ETE	
Discipline Specific Core (DSC):									
24MCH9401T	Solid State and Photochemistry	4	0	0	4	10	20	70	
Discipline Specific Elective(DSE): Select a group as per semester III									
Group A Inorganic Chemistry									
24MCH9402T	Photo-Inorganic Chemistry	4	0	0	4	10	20	70	
24MCH9401P	Elective Lab-II (Inorganic Chemistry)	0	0	8	4	-	-	100	
Group B Organic Chemistry									
24MCH9403T	Heterocyclic Chemistry	4	0	0	4	10	20	70	
24MCH9402P	Elective Lab-II (Organic Chemistry)	0	0	8	4	-	-	100	
Group C Physical Chemistry									
24MCH9404T	Physical Organic Chemistry	4	0	0	4	10	20	70	
24MCH9403P	Elective Lab-II (Physical Chemistry)	0	0	8	4	-	-	100	
Value Added Course(VAC):									
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Seminar/Internship/Apprenticeship/Project/Community Outreach (S/I/A/D/C):									
24MCH9401S	Seminar	--	--	--	8	--	--	100	
OR									
24MCH9401D	Dissertation	--	--	--	8	--	--	100	
	Total				20				

Summary: IV Semester (Vasant)			Credits
S.N.	Particulars		
1.	Discipline Specific Core (DSC):		04
2.	Discipline Specific Elective (DSE):		08
3.	Value Added Course (VAC):		00
4.	Seminar/Internship/Apprenticeship/Dissertation/Community Outreach (S/I/A/P/C):		08
Total			20
CW ^s (Class work): It would include attendance, class tests /quizzes /assignments, PPT, play, learn by fun activities, etc.			


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Semester I

Learning Objectives

The objective of the course is to provide students with a comprehensive understanding of Inorganic Chemistry. The course aims to develop their knowledge and skills in analyzing and solving problems related to these topics, using appropriate theoretical concepts and practical applications in Inorganic Chemistry.

Learning Outcomes

Comprehensive Knowledge: Students will gain a thorough understanding of the structure, bonding, and reactivity of inorganic compounds, including coordination and organometallic chemistry.

Practical Application: Students will be able to apply theoretical concepts to solve complex problems in inorganic chemistry, including the synthesis, characterization, and analysis of inorganic materials and their roles in various applications.

Course Title:	Inorganic Chemistry-I	Course Code: 24MCH9101T
Total Lecture hour 60		
Unit I	Stereochemistry and Bonding in Main Group Compounds: VSEPR theory and its limitations, Walsh diagrams (tri and penta-atomic molecules), $d\pi$ - $p\pi$ bonds, Bent rule and energetics of hybridization. Metal-Ligand Bonding in Metal Complexes: Crystal field theory for octahedral, tetrahedral and square planar complexes. Jahn-Teller distortion, limitations of crystal field theory. Molecular orbital theory applied to octahedral, tetrahedral and square planar complexes, π -bonding and molecular orbital theory.	15
Unit II	Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation (d_2 and d_3 in octahedral and tetrahedral symmetry), Orgel and Tanabe-Sugano diagrams for transition metal complexes ($d1$ - $d9$ states), calculations of Dq , B and β parameters using simplified T-S diagrams, charge transfer spectra, introduction about circular dichroism and optical rotatory dispersion, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.	15
Unit III	Metal π-Complexes: Metal carbonyls of Fe, Co & Ni, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls. Metal Clusters: Higher boranes: Wade's rule, styx numbers & structures, carboranes, metallocboranes, metallocarboranes.	15
Unit IV	Nuclear and Radiochemistry: Laws of radioactive decay; Detection of radiations; Geiger-Nuttall rule; GM tubes and their characteristics, Ionization chamber, Proportional counters, Scintillation counters; Solid state detectors; Calibration of counting equipments; Determination of absolute disintegration rates. Activation analysis: Principles; Various methods of activation; Methodology: Advantages, limitations and applications.	15
Reference Books:		
1	Inorganic Chemistry, Principles of structure and Reactivity, 4 th Edition; James E. Huheey, Ellen A Keiter, Richard L. Keiter. Pearson	

2	Advanced Inorganic Chemistry; F.A.Cotton and G.Wilkinson, Concise Inorganic Chemistry; J.D.Lee, Wiley.
3	Concepts and Models in Inorganic Chemistry; Douglas McDaniel
4	Physical Methods in Inorganic Chemistry, R.S.Drago
5	Chemistry of the Elements; N.N.Greenwood and A. Earushow, Pergamon, 1984.
6	Inorganic Electronic Spectroscopy; A.B.P. Lever, Elsevier, 1968.
7	Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillas and J.A. Me Clevert, regamon, 1987; Vol. 2.
8	Inorganic chemistry; W.U. Malik, 4th Eds. , New Age International: N Delhi, India, 2011
9	Essentials of Nuclear Chemistry, H. J. Amikar, 4th Eds. , New Age International: N Delhi, India, 2011
10	Nuclear and Radiochemistry: Fundamental and Applications, 2 Vols., Jens Volke Kratz and K Heinrich Lieser, 3rd Edn., John Wiley & Sons: UK, 2013.

Learning Objectives

The objective of the course is to provide students with a comprehensive understanding of Organic Chemistry. The course aims to develop their knowledge and skills in analyzing the structure, properties, and reactions of organic molecules, using appropriate theoretical concepts and practical techniques in organic synthesis and analysis.

Learning Outcomes

Comprehensive Knowledge: Students will gain a thorough understanding of the structure, mechanisms, and reactions of organic compounds, including functional groups, stereochemistry, and reaction mechanisms.

Practical Application: Students will be able to apply their knowledge to solve complex problems in organic synthesis, analysis, and reactivity, including the design and execution of organic reactions and the interpretation of spectroscopic data.

Course Title:		Organic Chemistry-I	Course Code: 24MCH9102T
Total Lecture hour 60			Hours
Unit I	Reaction Mechanism: Structure and Reactivity A review of types of mechanisms and reactions, methods of determining reaction mechanism, thermodynamic and kinetic requirements for reaction, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett Principle, Isotope effects. Effects of structure on reactivity, resonance and field effects, steric effects. Quantitative treatment of the effect of structure on reactivity. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation. Aromaticity: Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π -molecular orbitals, annulenes, anti-aromaticity, homo- aromaticity, PMO approach.	15	
Unit II	Stereochemistry: Optical activity and chirality, elements of symmetry, specification of configuration molecules with more than one chiral centre. D/L, R/S and Threo/Erythro nomenclature. E-Z Nomenclature. Interconversion of Fischer, Newman and Sawhorse projections. Prochirality, Homotopic and Heterotopic ligands and faces, Enantotopic and diastereotopic atoms, groups and faces, R/S Nomenclature. Stereospecific and stereoselective reactions. Racemic mixture and racemization. Resolution of racemic mixture. Optical activity in the absence of chiral carbon (biphenyls, allenes, spiranes). Chirality due to helicity. Chirality in the compounds containing N, S and P. Geometrical isomerism in cyclic and condensed systems, Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity. Cram's, Prelog's and Horeau's rules. Circular birefringence, CD, ORD, Octant rule, Cotton effect. The axial haloketone rule. Determination of configuration (absolute and	15	

Unit III	relative) and conformation.	
	Aliphatic Nucleophilic Substitution: The S_N1, S_N2, mixed S_N1-S_N2 and SET mechanisms. The S_Ni mechanism. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system. Application of NMR spectroscopy in the detection of carbocations. Nucleophilic substitution at the allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. Ambident nucleophile. Regioselectivity. Aromatic Nucleophilic Substitution: The S_NAr, S_N1, benzyne and S_{RN}1 mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet - Hauser and Smiles rearrangements.	15
Unit IV	Aliphatic Electrophilic Substitution Bimolecular mechanisms - S_E2 and S_Ei. The S_E1 mechanism- electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on reactivity. Aromatic Electrophilic Substitution The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, Ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeier reaction, Gattermann-Koch reaction.	15
Reference Books:		
1	Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, McGraw Hill.	
2	Mechanism and Structure in Organic Chemistry E. S. Gould (Holt, R nehart and Winston Advanced Organic Chemistry Part-A. F.A. Carey and R.J. Sundberg, 1th Ed. Springer (2007).	
3	Physical Organic Chemistry - J. Hine. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes. Longman	
4	Organic Chemistry - J. Clayden, N. Greeves, S. Warren and P. Wothers. Oxford University Press (2001)	
5	Structure and Mechanism in Organic Chemistry. C.K. Ingold. Cornell University Press. Organic Chemistry. R.T. Morrison and R.N. Boyd. Prentice-Hall.	
6	Modern Organic Reactions. HO House, Benjamin Principles of Organic Synthesis, ROC Norman and I.M. Coxon. Blackie Academic & Professional.	
7	Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.	

Learning Objectives

The objective of the course is to provide students with a comprehensive understanding of Physical Chemistry. The course aims to develop their knowledge and skills in analyzing the physical principles underlying chemical systems, using appropriate mathematical and theoretical frameworks in thermodynamics, kinetics, quantum chemistry, and statistical mechanics.

Learning Outcomes

Comprehensive Knowledge: Students will understand the fundamental principles of physical chemistry, including thermodynamics, kinetics, quantum mechanics, and statistical mechanics, and their application to chemical systems.

Practical Application: Students will be able to apply mathematical models and theoretical concepts to analyze and predict the behavior of chemical systems, solve problems in thermodynamics and kinetics, and interpret experimental data.

Course Title:	Physical Chemistry-I	Course Code: 24MCH9103T
Total Lecture hour 60		
Unit I	Quantum Chemistry -I Introduction: Postulates of Quantum Mechanics, Operators-Linear, Commutator, Hamiltonian, Hermitian and Angular Momentum Operators, Eigen Value and Eigen Functions, Schrodinger's equation, wave function, physical significance of ψ^2. Application of Schrodinger's Equation to (i) particle in one dimensional box, (ii) particle in three dimensional box, (iii) Simple Harmonic Oscillator, (iv) Rigid Rotor and (v) Hydrogenatom; Radial and angular wave functions, quantum numbers and their significance.	Hours 15
Unit II	Quantum Chemistry -II Angular Momentum: Ordinary angular momentum, Eigen functions and Eigen values of angular momentum, Ladder Operator, Addition of Angular Momentum, Spin, antisymmetry and Pauli's exclusion principle. Approximation Method: The Variation theorem, linear variation principle, perturbation method (First order and nondegenerate). Application of variation method and perturbation method to Helium atom. Molecular Orbital Theory: Basic ideas, criteria of forming MO's, LCAO Concept. Huckel's Molecular Orbital (HMO) theory for conjugated organic systems. Application of HMO to ethylene, allylic, cyclopropenyl radical, butadiene and cyclobutadiene system.	15
Unit III	Surface Chemistry Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation). Langmuir adsorption isotherm, B.E.T. adsorption isotherm (BET equation), estimation of surface area (BET method), Gibbs adsorption isotherm, surface films on liquids (Electro-kinetic phenomenon) Micelles: Surface active agents, classification of surface-active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization -phase separation and mass action models, solubilization, micro emulsion, reverse micelles.	15
Unit IV	Electrochemistry: Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces, Guoy-Chapman, Stern, Graham Devanathan -Mottwatts, Tobin, Bockris, Devanathan models, Over potentials, exchange, current density derivation of Butler Volmer equation, Tafel plot. Polarography theory, Ilkovic equation; half wave potential and its significance.	15
Reference Books:		
1	Physical Chemistry by P.W. Atkins, ELBS.	
2	Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.	
3	Quantum Chemistry. Ira N. Levine, Prentice Hall.	
4	Quantum Chemistry; R.K. Prasad, New Age International	
5	Micelles, Theoretical and Applied aspects; V. Morai, Plenum Press.	
6	Modern Electrochemistry Vol. I & II; J.O. M. Bockris and A.K.N. Reddy, Plenum Press, New York.	

Course Title:	Chemistry Core Laboratory-I	Course Code: 24MCH9104P
1	Qualitative analysis of mixture consisting of eight cationic / anionic radicals including: - Interfering anionic radical - Insolubles: oxides, sulphates and halides - Less common metal ions: Ti, W, Mo, Se, Te, V, Th, Ti, Zr, Ce, Li	
2	Purification techniques and Qualitative analysis - Demonstrations of purification, drying and storage of solvents using various techniques-distillation, steam distillation, vacuum distillation, etc. - Separation of Organic binary mixtures [(one liquid and one solid) or (two solids)] using H₂O, HCl, NaOH, NaHCO₃, Ether or other reagent and identification of components using chemical tests, IR spectra for functional group identification and preparation of derivatives.	
3	Experiments based on surface tension - To study surface tension concentration relationship for solution (Gibbs equation). - To determine the critical micelle concentration (CMC) of DS and CTAB by surface tension techniques.	
4	Adsorption - Adsorption of Oxalic acid - Acetic acid on charcoal	
5	Viscosity, Solubility and Molecular weight determination - Experiments based on determination of viscosity of given liquid using Ostwald's viscometer. - Study the variation of viscosity of pure liquid with temperature and determination of temperature coefficient of viscosity of the liquid. - Determination of Solubility of various salts like NaCl, KCl, KNO₃ and NaNO₃ at different temperature and draw the solubility Curve. - Determination of molecular weight of given polymer (Polyvinyl alcohol, polystyrene, methyl acrylate, etc.) using viscometer. - Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.	

Course Title:	Spectroscopy-I	Course Code: 24MCH9105T
Total Lecture hour 60		
Unit I	Introduction: Interaction of light with matter, mechanism of absorption' and emission of radiation. Microwave Spectroscopy: Classification of molecules, rigid rotor model. effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor; stark effect, nuclear and electron spin interaction and effect of external field. Applications. Vibrational Spectroscopy: Vibrational energies of diatomic molecules, zero-point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy. P.Q.R. branches, breakdown of Oppenheimer approximation; vibrations of polyatomic molecules; selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region, metal ligand vibration.	15
Unit II	Raman Spectroscopy: Origin, rotational and vibrational Raman Spectra of diatomic molecules. Electronic Spectroscopy Atomic Spectroscopy: Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms. Molecular Spectroscopy: Energy levels, molecular orbitals, vibronic transitions, vibrational	15

Unit III	progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, spectra of transition metal complexes, charge-transfer spectra. Photoelectron Spectroscopy: Photo-electric effect, ionization process, Koopman's theorem, photoelectron spectra of simple molecules, ESCA, chemical information from ESCA; Auger electron spectroscopy-basic idea Magnetic Resonance Spectroscopy Nuclear Magnetic Resonance: Basic Principle, Spin quantum number, interaction between Spin and a Magnetic Field, Larmor Precession, Relaxation Times; Continuous Wave NMR Spectroscopy, Fourier Transform NMR Spectroscopy; Introduction to Chemical Shift, Spin - spin coupling, Coupling constant. Nuclei other than hydrogen: Nuclei with spin $\frac{1}{2}$ (^{13}C, ^{19}F, ^{31}P etc.), Nuclei with spin greater than $\frac{1}{2}$ (^{14}N, ^{11}B). Quadrupole effects; factors effecting chemical shift in inorganic compounds - geometry, electronegativity, charge, oxidation state, coordination number. Coupling between two or more than two types of NMR active nucleus in a compound (e.g., CH_2Cl_2, HPFCL OP(O)FH, HP(O)F_2, BH_4). Electron Spin Resonance: Basic principles, zero field splitting and Kramer's degeneracy, Isotropic and anisotropic Hyperfine coupling, spin-orbit coupling and significance of g - tensors, factors affecting the 'g' value, its applications to the study of free radicals & fast reactions and application in transition metal complexes.	15
Unit IV	Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum, display, applications of the techniques to the studies of (i) bonding and structures of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin; (ii) Sn^{2+} and Sn^{4+} compounds, nature of M-L bond, coordination number, structure; and (iii) detection of oxidation state and in equivalent MB atoms. Electron Microscopy: Basic principles of Electron Microscopy SEM. TEM, AFM; and their applications in structural analysis.	15
Reference Books:		
1	Fundamentals of Molecular Spectroscopy, Banewell land McCash	
2	Modern Spectroscopy, J.M. Hollas, John Wiley.	
3	Applied Electron Spectroscopy for Chemical Analysis D. H. Windawi and F.L. Ho, Wiley Interscience.	
4	Physical Methods in Chemistry, R.S. Drago, Saunders College.	
5	Chemical Applications of Group Theory, F. A.Cotton.	
6	Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.	
7	Electronic Absorption Spectroscopy and related Techniques, DNS athyanarayana	
8	Basic Principles of Spectroscopy, R. Chang, McGraw Hill.	
9	Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orelin, IBH-Oxford.	
10	Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.	
11	Introduction to Magnetic Resonance. A Carrington and A.D. MacLachalan, Harper & Row.	
12	NMR Spectroscopy in Inorganic Chemistry, J.A. Iggo, Oxford University Press: Oxford, 1999, pp1- 21; 31-35.	
13	NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.	

Course Title:	Analytical Techniques		Course Code: 24MCH9106T
Total Lecture hour 60			Hours
Unit I	Statistics-Introduction to Chemometrics		15
	Limitations of analytical methods, Errors and classification, Determinant, constant and indeterminate. accuracy, precision, minimization of errors, significant figures and computation rules, mean and standard deviation, distribution of random errors, variance and confidence		

Unit II	interval, paired t-test, least square method, correlation and regression, linear regression. Sampling in analysis: Definition, theory, basis and techniques of sampling, sampling statistic, sampling and physical state, crushing and grinding, hazards in sampling, techniques of sampling of gases, fluid, solids, and particulates, minimization of variables, transmission and storage of samples, high pressure ashing techniques (HPAT), particulate matter, its separation in gas stream, filtering and gravity separation, analysis of particulate matter like asbestos, mica, dust and aerosols etc. Solvent extraction method in analysis: Principle, classification, theory, instrumentation and applications.	15
Unit III	Conductometry: Important laws, definitions, relations, effect of dilution on conductivity, measurement of conductivity, types of conductometric titrations, its applications and limitations. Potentiometry Principle, instrumentation, types of potentiometric titrations and its applications, pH, measurements, determination of pH, ion selective electrodes, instrumentation and applications. Coulometry: Introductions, principle, experimental details of coulometry at constant current and constant potential, titrational applications. Atomic Absorption Spectroscopy: Introduction, principle, Grotrian diagram, instrumentation, applications, detection limit, sensitivity and disadvantages.	15
Unit IV		15
Reference Books:		
1	MendhamJ., Denney R.C., Barnes J. D., Thomas M. J. K., Vogels' text book of quantitative chemical analysis, 6th edition, Prentice Hall, 2000.	
2	Skoog Douglas A., Holler F. James, Nieman Timothy A., Principles of instrumental analysis, Saunders College Pub., 1998.	
3	Day R. A and A. L. Underwood, Quantitative analysis, Prentice Hall, 1999.	
4	Drago R. S., Physical methods in Chemistry, Saunders, 1999.	
5	Peters D. G, J. M. Hayes and G. M. Hefige, A brief introduction to Modern chemical analysis, Philadelphia: Saunders, 1976.	
6	Elan JAD Butter Worth, Photo electron spectroscopy.	
7	D. C. Das, Analytical Chemistry, Prentice Hall India.	

Semester – II**Learning Objectives**

- A basic understanding of how to pursue research.
- A basic understanding of how to learn mathematics.
- A basic understanding of set theory.
- A basic understanding of the software that supports the mathematical research.

Learning Outcomes

After completion of this course, students will be able to

- Understand mathematics more efficiently and clearly.
- Understand how to write a basic mathematics article.
- Make students analyze a given fact or concept and how to reach a concept.
- Make students curious enough to read the most recent trends in mathematics.


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 Sikar (Rajasthan)

- Understand the basic ideas of how to write an algorithm and related ideas.
- Understand the effective use of open-source software to write mathematical articles.

Course Title:	Research Methodology	Course Code: 24MCH9201T
Total Lecture hour 60		Hours
Unit I	Nature of Scientific Inquiry- Scientific Methods- Induction- Deduction Hypothesis and Theory and their Interpretation-Nature and Scope of Social Research for Multi-Disciplinary Inter-Disciplinary Approach in Commerce. Planning of Research-Selection of a Problem for Research-Sample design-Census and Sample Surveys- Sampling Techniques- Sample size.	15
Unit II	Research Design- Important Aspects of Research Design. Methods of Data Collection- Sources of data Use of secondary data- Methods of collecting primary data- Observation- Interviews- Questionnaires and Schedules.	15
Unit III	Processing and Analysis of Data: Processing Operations-Types of Analysis- Presentation and Interpretation of Data-Editing, Classification and Tabulation- Interpretation. Preparation of a Report- Types of Report- Research Report- Format- Principles of Writing Reports- Documentation- Footnotes and Bibliography	15
Unit IV	Quantitative Tools- Measures of Central Tendency- Dispersion- Measures of Correlation- Simple and Multiple Correlation-testing of Hypothesis-Tests based on t-P, Z, and Chi-square-Time Series Analysis-Trend Measurement-Moving Averages	15
Reference Books:		
1	Srivastava, S.C.: Foundation of Social Research and Economics Techniques, Himalaya Publishing House, 1990.	
2	Sharma H.D. and Mukherji S.P.: Research Methods in Economics and Business, New York: The Macmillan Company, 1992.	
3	Gerber R. and Verdoorn, P.J. :Research Methods in Economics and Business, NewYork, The Macmillan Company, 1992.	
4	Krishna swami O.R.: Methodology of Research in Social Sciences, Himalaya Publishing House, 1993.	
5	Menden HYall and Varacity: Reinmuth J.E.: Statistics for Management and Economics (2 nd Edition), 1982.	
6	Courtis J.K.(ed.) Research and Methodology in Accounting & Financial Management, 1980.	

Course Title:	Inorganic Chemistry-II	Course Code: 24MCH9202T
Total Lecture hour 60		Hours
Unit I	Symmetry and Group Theory in Chemistry Symmetry elements and symmetry operation, definition of group, subgroup, conjugacy relation and classes. Point symmetry group. Schonflies symbols, representations of groups by matrices (Representation for the C_n , C_{nv} , D_{nh} etc, groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses; spectroscopy derivation of character table for C_{2v} and C_{3v} point group. Symmetry aspects of molecular vibrations of H_2O molecule.	15
Unit II	Molecular Rearrangement Processes Electron transfer reactions (outer and inner sphere), HOMO and LUMO of oxidant and reductant, chemical activation. Precursor complex formation and rearrangement, nature of bridge ligands, fission of successor complexes, Two-electron transfers, Synthesis of coordination compounds using electron transfer reactions, mixed valence complexes and internal electron transfer.	15

Unit III	Inorganic Reaction Mechanism-I Basic principles; lability, inertness, stability and instability of coordination compounds, general principles and mechanisms of substitution reactions of tetrahedral, square planar, trigonalbipyramidal, square pyramidal and octahedral complexes; potential energy diagrams, transitionstates and intermediates, isotope effects, Berry's pseudo rotation mechanism, Swain -Scott equation.	15
Unit IV	Inorganic Reaction Mechanism- II Substitution reactions of octahedral complexes; nature of substitution reactions; Theoretical approach to substitution mechanisms; mechanism of substitution reaction of complexes of cobalt; acid hydrolysis and base hydrolysis of Co (III) complexes. Substitution reactions of square planar complexes; reaction of Pt (II) complexes; trans effect and its applications to synthesis of complexes; theories of trans effect; mechanism of substitution - kinetics of substitution of Pt(II) complexes; factors affecting the reactivity of square planar complexes.	15
Reference Books:		
1	Inorganic Chemistry, Principles of Structure and Reactivity, 4 th Edition, James E. Huheey: EA. Keiter, Richard L. Keiter.	
2	Advanced Inorganic Chemistry. F.A. Cottonand G. Wilkinson.	
3	Theoretical Inorganic Chemistry, Dayand Selbin.	
4	Concepts and Models in Inorganic Chemistry, Douglas McDaniel.	
5	Introductory Quantum Chemistry, A.K. Chandra (Tata McGraw Hill)	
6	Chemical Applications of Group Theory, F. A. Cotton.	

Course Title:	Organic Chemistry-II	Course Code: 24MCH9203T
Total Lecture hour 60		Hours
Unit I	Addition to Carbon-Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophile and free radicals. Regio- and chemo selectivity. Orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, Sharpless asymmetric epoxidation. Addition to Carbon-Heteroatom Multiple Bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, mesters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates - Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions.	15
Unit II	Free Radical Reactions: Types of free radical reactions, free radical substitution mechanisms, neighbouring group assistance, reactivity for aliphatic and aromatic substrates at a bridgeheadcarbon, reactivity in the attacking radicals, 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, Hunsdiecker reaction, free radical rearrangements. Elimination Reactions: E2, E1 and E1cB mechanisms and their spectrum, orientation of the double bond, reactivity effects of substrate structures, attacking base, leaving group and medium; mechanism and orientation in pyrolytic elimination.	15

Unit III	Rearrangements General mechanistic considerations - nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction, Wolff rearrangement, Wittig rearrangement, Fritsch-Buttenberg-Wiechell rearrangement, Stevens rearrangement, Chapman rearrangement, Wallach rearrangement.	15
Unit IV	Pericyclic Reactions Characteristics and Classification of pericyclic reactions, thermal and photochemical reactions, Molecular orbital symmetry. Woodward-Hoffmann selection rules, Fukui's FMO approach, Woodward-Hoffmann's Conservation of orbital symmetry and correlation diagrams and PMO method. Electrocyclic reactions: conrotatory and disrotatory motions, $4n$, $4n+2$ π electron and allyl systems. Cycloadditions: Antarafacial and suprafacial additions, $4n$ and $4n+2$ π electron systems. Diels-Alder reaction-stereoselectivity (endo, exo), and regioselectivity; normal and inverse electron demand Diels-Alder reactions; asymmetric Diels-Alder reactions; retro-Diels-Alder reactions; $2+2$ addition of ketenes, 1,3-dipolar cycloadditions. Chelotropic reactions. Sigmatropic rearrangements: suprafacial and antarafacial shifts of C-H and C-C bonds. $3,3$ and $5,5$ - sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Fluxional tautomerism. Ene reaction.	15
Reference Books:		
1	Advanced Organic Chemistry: Reactions, Mechanisms, and Structure by Jerry March, McGraw Hill.	
2	Mechanism and Structure in Organic Chemistry by E.S. Gould, Holt, Rinehart, and Winston.	
3	Advanced Organic Chemistry Part-A by F.A. Carey and R.J. Sundberg, Springer (2007).	
4	Physical Organic Chemistry by J. Hine.	
5	A Guide Book to Mechanism in Organic Chemistry by Peter Sykes, Longman.	
6	Organic Chemistry by J. Clayden, N. Greeves, S. Warren, and P. Wothers, Oxford University Press (2001).	
7	Structure and Mechanism in Organic Chemistry by C.K. Ingold, Cornell University Press.	
8	Organic Chemistry by R.T. Morrison and R.N. Boyd, Prentice-Hall.	
9	Modern Organic Reactions by H.O. House, Benjamin.	
10	Principles of Organic Synthesis by R.O.C. Norman and I.M. Coxon, Blackie Academic & Professional.	
11	Reaction Mechanism in Organic Chemistry by S.M. Mukherji and S.P. Singh, Macmillan.	
12	Pericyclic Reactions: A Mechanistic Study by S.M. Mukherji, Macmillan.	
13	Pericyclic Reactions by Ian Fleming, Oxford Chemistry.	
14	Pericyclic Reactions: A Textbook by S. Sankararaman, Wiley-VCH.	

Course Title:	Chemistry Core Laboratory-II	Course Code: 24MCH9204P
1	A. Inorganic Preparations: Following selected inorganic compounds and their studies by IR spectra, Mössbauer, ESR and Magnetic susceptibility measurements. Handling of air and moisture sensitive compounds under vacuum. i. Sodium thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ ii. $\text{CuCl}_2 \cdot 2\text{DMSO}$ iii. Tetraamine cupric sulphate $[\text{Cu}(\text{NH}_3)_4\text{SO}_4] \cdot \text{H}_2\text{O}$ iv. N,N-bis(salicylaldehyde)ethylenediamine, Salen H_2, Co(Salen.) v. Copper glycine complex cis- and trans-bis(glycinato) Coppe. (II) vi. Cis- and trans-dichlorobis(ethylenediamine)cobalt(III) chloride, $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$ vii. $\text{Na}[\text{Cr}(\text{NH}_3)_2(\text{SCN})_4]$	

	viii. $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$
2	B. Two Step Organic Synthesis i. Aniline $\rightarrow$ 2,4,6-Tribromoaniline $\rightarrow$ 1,3,5-Tribromobenzene ii. Aniline $\rightarrow$ Diazoaminobenzene $\rightarrow$ p-Anilinoazobenzene iii. Phthalic anhydride $\rightarrow$ Fluorescein $\rightarrow$ Eosin iv. Phthalic anhydride $\rightarrow$ Phthalimide $\rightarrow$ Anthranilic acid v. Acetanilide $\rightarrow$ p-Nitroacetanilide $\rightarrow$ p-Nitroaniline vi. More two step organic preparations involving general organic reactions may be carried out. The products to be characterized by m.pt/spectral techniques.
3	C. Experiments based on -Chemical Kinetics i. 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). ii. Determination of the effect of (a) Change of temperature (b) Change of concentration of 11 reactant and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reactions. iii. Determination of the velocity constant of hydrolysis of an ester/ionic reaction in micellar media iv. Determination of the rate constant for the oxidation of iodide ions by peroxide studying the kinetics as an iodine clock reaction.
4	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 intramolecular interactions (benzoic acid in water and in DMSO- water mixture) and calculate the partial molar heat of solution.

Course Title:	Spectroscopy-II	Course Code: 24MCH9205T
Total Lecture hour 60	Hours	
Unit I 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. Woodward-Fieser rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. Infrared Spectroscopy Characteristic vibrational frequencies of 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.	15	
Unit II Mass spectrometry Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds common functional groups, molecular ion peak, metastable peak. McLafferty rearrangement. Ring rule, Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination	15	
Unit III Proton Magnetic Resonance Spectroscopy Chemically nonequivalent protons, 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 and mercapto). Chemical exchange, effect	15	

	of deuteration. Complex spin-spin interaction between two, three, four and five nuclei (first order spectra). Stereochemistry, hindered rotation. Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra- nuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE).	
Unit IV	Carbon-13 NMR Spectroscopy General consideration, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two-dimension NMR spectroscopy COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques. Applications of Spectroscopy - Problems based on UV, IR, NMR spectroscopy and. Mass spectrometry for structural elucidation of organic compounds.	15
Reference Books:		
1	Spectrometric Identification of Organic Compounds by R.M. Silverstein, G.C. Hassler, and T.C. Morbi, John Wiley.	
2	Fundamentals of Spectroscopy by Banwell and McCash.	
3	Introduction to NMR Spectroscopy by R.J. Abraham, J. Fisher, and P. Loftus, Wiley.	
4	Application of Spectroscopy of Organic Compounds by J.R. Dyer, Prentice Hall.	
5	Spectroscopic Methods in Organic Chemistry by D.H. Williams and I. Fleming, Tata McGraw-Hill.	

Course Title:	Environmental Chemistry	Course Code: 24MCH9206T
Total Lecture hour 60		Hours
Unit I	Atmospheric Chemistry Atmospheric layers. Vertical temperature profile, heat radiation, budget of the earth atmosphere systems. Properties of troposphere, thermodynamic derivation of lapse rate. Temperature inversion. Calculations of Global mean temperature of the atmosphere. Pressure variation in atmosphere and scale height. Biogeochemical cycles of carbon, nitrogen, sulphur, phosphorus and oxygen. Residence times. Sources of trace atmospheric constituents: nitrogen oxides, sulphur dioxide and other sulphur compounds, carbon oxides, chlorofluorocarbons and other halogen compounds, methane and other hydrocarbons. Tropospheric Photochemistry: Mechanism of photochemical decomposition of NO ₂ and formation of ozone. Formation of oxygen atoms, hydroxyl, hydroperoxy and organic radicals and hydrogen peroxide. Reactions of hydroxyl radicals with methane and other organic compounds. Reactions of OH radicals with SO ₂ and NO ₂ . Formation of nitrate radical and its reactions. Photochemical smog, meteorological conditions and chemistry of its formation.	15
Unit II	Air Pollution: Air pollutants and their classification. 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 SO ₂ and NO ₂ , acid rain control strategies. 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. Dissolved oxygen, biological oxygen demand, chemical oxygen demand, determination of DO, BOD and COD. Aerobic and anaerobic reactions of organic sulphur and nitrogen compounds in water, acid-base chemistry of	15

	fresh water and sea water. Aluminium, nitrate and fluoride in water. Eutrophication. Sources of water pollution. Treatment of waste water and sewage. Purification of drinking water, techniques of purification and disinfection.	
Unit IV	Environmental Toxicology Toxic Heavy Metals - Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As and Cd. Biochemical and damaging effects. Toxic Organic Compounds - Pesticides, classification, properties and uses of organochlorine and organophosphorus pesticides, detection and damaging effects. Polychlorinated Biphenyls - Properties, uses and environmental contamination and effects. Polynuclear Aromatic Hydrocarbons - Sources, structures and as pollutants. Soil and Environmental Disasters Soil composition, micro and macronutrients. soil pollution by fertilizers, plastic and metals. Methods of remediation of soil. Bhopal gas tragedy, Chernobyl, Three-mile Island, Minamata Disease, Seveso (Italy), London smog.	15
Reference Books:		
1	Environmental Chemistry. Colin Baird, W.H. Freeman Co. New York, 1098.	
2	Chemistry of Atmospheres. R.P. Wayne, Oxford.	
3	Environment Chemistry, A.K. De, Wiley Eastern, 2004.	
4	Environmental Chemistry, S.E. Manahan, Lewis Publishers.	
5	Introduction to Atmospheric Chemistry, P.V. Hobbs, Cambridge.	

Dr. Registrar
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Thermodynamics and Chemical Kinetics

Learning Objectives:

1. To learn the advanced concepts in thermodynamics and chemical kinetics.
2. To learn the basic principles of Classical Thermodynamics and Statistical Thermodynamics.
3. To understand the thermodynamic properties and postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws and calculation of thermodynamic properties in terms of partition functions.
4. To develop knowledge and skills in analyzing and solving problems related to thermodynamics and chemical kinetics.
5. To study dynamic chain reactions, Dynamics of unimolecular reactions and theories.

Learning Outcomes:

On completion of the course the student shall be able to:

1. Gain knowledge on advanced concepts in thermodynamics and chemical kinetics.
2. Apply basics of chemical chain reactions, fast reactions and theories of chemical dynamics.
3. Understand the thermodynamic properties of real gases and to apply phase rule to three component systems.
4. Understand in detail about Statistical thermodynamics, partition functions and chemical kinetics.
5. Acquire knowledge on classical thermodynamics and chemical dynamics.

Course Title:	Thermodynamics and Chemical Kinetics	Course Code: 24MCH9301T
Total Lecture hours: 60		Hours
Unit I	Classical Thermodynamics Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and Methods of 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. Application of phase rule to three component systems; second order phase transitions.	15
Unit II	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-translation, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behavior of solids-chemical equilibria and 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.	15
Unit III	Chemical Dynamics/Kinetics-I 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 reactions (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical reactions (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions.	15

Unit IV	Chemical Dynamics/Kinetics-II General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Collision theory of reaction rates, Arrhenius equation and the effect of temperature on reaction rate. Activated complex theory, modified collision theory (steric effect) Dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions).	15
Reference and Reading Books:		
• P.W. Atkins; Physical Chemistry, ELBS. • K.J. Laidler; Chemical Kinetics, McGraw-Hill. • J.Rajaraman and J. Kuriacose; Kinetics and Mechanism of Chemical Transformation, Mc Millan. • Samuel Glasstone; Thermodynamics for Chemist, East West Press. • R.P. Rastogi and R.R. Mishra; Introduction to Chemical Thermodynamics, Vikash Publication House. • B.R. Puri, L.R. Sharma and M.S. Pathaniya; Principals of Physical Chemistry, Vishal Publication.		

Chemistry Core Laboratory-III

Course Title:	Chemistry Core Laboratory-III	Course Code: 24MCH9301P
	A. Laboratory Estimations: • Spectrophotometric determination of Iron-phenanthroline complex: Job's method of continuous variations. • Spectrophotometric determination of nickel as nickel dimethyl glyoximate complex. • Find out the stability constant of metal complexes by Bjerrum's Method. • Analyse the given sample of Copper Ferrite (CuFe_2O_4) and determine the volumetric amount and percentage of Copper and Iron. • Determination of ferrous (Fe^{2+}) and ferric (Fe^{3+}) ions in the given solution. • Determination of Ca^{2+} and Mg^{2+} ions in a given solution and estimation of total hardness of water. • Estimation of H_2O_2 by iodometric method. • Estimation of Zinc involving Potassium ferrocyanide. • Estimation of sulphate as barium sulphate gravimetrically. • Estimate Ni in a given sample complexometrically using murexide as an indicator. • Analysis of the given sample of iron ore & determination of Silica - Gravimetrically, Iron- Volumetrically to find out their percentages in the given sample. • Estimation of Iron in Portland Cement. B. Separation & Purification Techniques: • Extraction of organic compound using separating funnel, Soxhlet extraction. • Purification of organic compounds using Chromatographic methods. • Isolation of caffeine from tea leaves, casein from milk, chlorophyll from green leaves. C. Quantitative estimations • Estimation of number of Functional groups (phenol, amino, methoxy groups) in given organic compounds. • Estimation of amino acids and sugar in given samples. • Estimation of citric acid / vitamin C in citrus juice. D. Chemical Analysis • Determine the dissolved oxygen (DO) of the given water sample. • Determine the biological oxygen demand (BOD) of the given water sample. • Determine the Chemical Oxygen Demand (COD) of the given water sample • Determine the Nitrate (NO_3^-) in drinking water sample. • Determine the phenolic substance in the waste water sample. • Determine the amount of free Chlorine in given water sample. • Determine the amount of Fluoride in given water sample. • Determine the dissolved CO_2 in the given water sample.	

Dr. P. R. Registrar
 Sreekrishna University
 Bangalore

Organotransition Metal Chemistry

Learning Objectives:

1. To learn the advanced concepts of alkyls, and aryls of transition metal complexes.
2. To learn the basic principles of Transition Metal π -Complexes and their properties.
3. To understand the Compounds of Transition Metal-Carbon Multiple Bonds.
4. To learn the concept of Transition metal π -complexes with unsaturated organic molecules, nature of bonding and structural features.
5. To study Compounds of Transition Metal-Carbon Multiple Bonds and catalysis.

Learning Outcomes:

On completion of the course the student shall be able to:

1. Understand alkyls and aryls of Transition Metals and chemical reactions of transition metal hydrocarbyls, Organocopper in organic synthesis.
2. Apply their knowledge and skills in transition metal π -complexes with unsaturated organic molecules, nature of bonding and structural features.
3. Create reliable methodologies for optimizing performance and improving design of various transition metal complexes.
4. Acquire knowledge on homogeneous Catalysis and Transition Metal-Carbon Multiple Bonds.

Course Title:	Organotransition Metal Chemistry	Course Code: 24MCH9302T
Total Lecture hours: 60		Hours
Unit I	Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability, decomposition pathways and chemical reactions of transition metal hydrocarbyls, Organocopper in organic synthesis.	15
Unit II	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 III	Compounds of Transition Metal-Carbon Multiple Bonds: Alkylidenes, alkylidyne, low valent carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions on the ligands, role in organic synthesis. Fluxional Organometallic Compounds: Fluxionality and dynamic equilibrium in compounds such as η^2 -olefine, η^3 -allyl and dienyl complexes.	15
Unit IV	Homogeneous Catalysis Stoichiometric reactions for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), oxopalladation reactions, activation of C-H bond.	15
Reference and Reading Books:		
1. B. D. Gupta and A. J. Elias; Basic Organometallic Chemistry: Concepts, Syntheses and Applications; Universities Press. 2. R. H. Crabtree; The Organometallic Chemistry of the Transition Metals, Wiley. 3. Anthony F. Hill; Organotransition Metal Chemistry, Royal Society of Chemistry. 4. J. Hartwig; Organotransition Metal Chemistry: From Bonding to Catalysis, University Science Books. 5. J. P. Collman, L. S. Hegsdus, J.R. Norton and R.G. Finke; Principles and Application of Organotransition Metal Chemistry, University Science Books. 6. R. C. Mehrotra and A. Singh; Organometallic Chemistry, New Age International. 7. G. R. Chatwal and M. Arora; Organotransition Metal Chemistry, Himalaya Publishing House. 8. A. J. Pearson; Metallo-organic, Chemistry/Wiley.		

Bioinorganic and Supramolecular Chemistry

Learning Objectives:

1. To understand basic principles of supramolecular chemistry.
2. To get knowledge about calcium in biology and metalloenzymes.
3. To learn the concepts of Metal-Nucleic Acid Interactions and their applications.
4. To study the concepts involved in transport processes, carrier designs and nanomolecular devices.


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Learning Outcomes:

On completion of the course the student shall be able to:

1. Investigate the theoretical background and applications of supramolecular and bioinorganic chemistry.
2. Examine the structure of bioinorganic molecules in chemistry.
3. Reveal the structure of supramolecular compounds and complex compounds.
4. Understand the principles and uses of supramolecular reactivity, catalysis, transport processes and carrier design.
5. Convey knowledge of Metal-Nucleic Acid Interactions and Metals in Medicine.

Course Title:	Bioinorganic and Supramolecular Chemistry	Course Code: 24MCH9303T
Total Lecture hours: 60		Hours
Unit I	Metal Storage and Transport: Ferritin, transferrin, and siderophores. Calcium in Biology: Calcium in living cells, transport and regulation, molecular aspects of intramolecular processes, extracellular binding proteins.	15
Unit II	Metalloenzymes: Zinc enzymes-carboxypeptidase and carbonic anhydrase. Iron enzymes-catalase, peroxidase and cytochrome P-450. Copper enzymes-superoxide dismutase. Molybdenum oxotransferase enzymes-xanthine oxidase. Coenzyme vitamin B ₁₂ .	15
Unit III	Metal-Nucleic Acid Interactions: Metal ions and metal complexes interactions. Metal complexes-nucleic acids. Metals in Medicine: Metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference the anticancer drugs.	15
Unit IV	Supramolecular Chemistry (a) Molecular recognition: Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of co receptor molecules and multiple recognition. (b) Supramolecular reactivity and catalysis. (c) Transport processes and carrier design: Cation, anion and coupled transport process. (d) Supramolecular devices: Supramolecular photochemistry, electronic, ionic and switching devices.	15
Reference and Reading Books:		
1. S. J. Lippard and J. M. Berg; Principles of Bioinorganic Chemistry, University Science Books. 2. A. Das, M. Das and A. Das; Bioinorganic Chemistry, Books & Allied Pvt. Ltd., Kolkata. 3. I. Bertini, H. B. Gray, S. J. Lippard and J. S. Valentine; Bioinorganic Chemistry, University Science Books. 4. G. L. Eichhorn; Inorganic Biochemistry Vol.-I and II., Elsevier. 5. Bioinorganic and Supramolecular Chemistry; A. Bhagi and G.R. Chatwal; Himalaya Publishing House, New Delhi. 6. P. S. Kalsi and J. P. Kalsi; Bioorganic, Bioinorganic and Supramolecular Chemistry, New Age International Pvt. Ltd., New Delhi. 7. A. Das and M. Das; An Introduction to Supramolecular Chemistry, CBS Publishers and Distributors Pvt. Ltd., New Delhi. 8. J. W. Steed, J. L. Atwood; Supramolecular Chemistry, Wiley. 9. J. M. Lehn; Supramolecular Chemistry: Concepts and Perspective,, Wiley VCH.		

Polymers

Learning Objectives:

1. To provide students with a strong theoretical foundation in the core areas of polymer chemistry.
2. To develop students' ability to understand, analyze, and predict polymer reactions and their mechanisms.
3. To enhance students' practical skills through laboratory experiments and analytical techniques.
4. To prepare students for careers in research, academia, and various chemical industries.

5. To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

- Students will be able to explain the principles of various chemical reactions and their mechanisms.
- Students will be able to apply their knowledge to solve complex polymer reactions.
- Students will be proficient in using various analytical instruments and techniques to solve polymer reactions.
- Students will be able to design and synthesize new molecules and materials.

Students will be able to communicate their scientific findings effectively.

Course Title:	Polymers	Course Code: 24MCH9304T
Total Lecture hours: 60		Hours
Unit I	Basic Concepts of Polymer: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition/radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogeneous and heterogeneous systems. Importance of polymers.	15
Unit II	Polymer Characterization: Poly dispersion-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.	15
Unit III	Structure, Properties and Applications of (a) Polymers based on boron: Borazines, Boranes and Carboranes. (b) Polymers based on Sulphur: Tetrasulphurtetranitride and related compounds. (c) Polymers based on Phosphorous: Phosphazenes, Polyphosphates	15
Unit IV	Structure, Properties and Applications of (a) Polymers based on Silicon: Silazanes, Silicones, Polymetalloxanes and Polymetallosiloxanes. (b) Metal clusters. (c) Co-ordination and metal chelate polymers.	15
Reference and Reading Books:		
J. E. Huheey; Inorganic Chemistry: principles of structure and reactivity, Harper & Row. M. F. Lappert; Developments in Inorganic Polymer Chemistry, Elsevier. A. Bhagi; A Text Book of Inorganic Polymer, Himalaya Publishing House Pvt. Ltd., New Delhi. - Inorganic Polymers; Oxford University Press. J. E. Mark, H. R. Allcock and R. West; Inorganic and Organometallic Polymers; Oxford University Press. R. D. Archer; Inorganic and Organometallic Polymers, John Wiley & Sons. V. Chandrasekhar; Inorganic and organometallic polymers, Springer. - N.H. Ray; Inorganic polymers, Academic Press. F. W. Billmeyer; Textbook of Polymer Science, John Wiley & Sons.		

Elective Lab-I (Inorganic Chemistry)

Course Title:	Elective Lab-I (Inorganic Chemistry)	Course Code: 24MCH9302P
	Quantitative Analysis: Analysis of a three-component mixture of metal ions by gravimetrically and volumetrically: Cu^{2+}, Ni^{2+}, Zn^{2+} Cu^{2+}, Ni^{2+}, Ag^+ Cu^{2+}, Ni^{2+}, Mg^{2+}	

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	• Cu^{2+}, Ag^{+}, Fe^{2+} • Ni^{2+}, Zn^{2+}, Fe^{2+} Inorganic Preparations: Preparation of selected inorganic compounds and their study by IR, electronic, and magnetic susceptibility measurements. Handling of air and moisture sensitive compounds involving vacuum lines. Selection can be made from the following: • $\text{Na}_3[\text{Co}(\text{ONO})_6]$ • $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_3$ • $[\text{Co}(\text{NH}_3)_6] [\text{Co}(\text{NO}_2)_6]$ • cis-$[\text{Co}(\text{trien}) (\text{NO}_2)_2] \text{Cl} \cdot \text{H}_2\text{O}$ • $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$ • Sodium tetrathionate $\text{Na}_2\text{S}_4\text{O}_6$. • Sodium amide. • Preparation of Tin(IV) iodide, Tin(IV) chloride and Tin(II) iodide. Chromatographic separation and identification by paper chromatography and determination of R_f values: • Cadmium and Copper. • Zinc and Manganese. • Arsenic, Antimony and Tin. • Lithium, Sodium and Potassium. • Fe^{3+}, Al^{3+} and Cr^{3+} • Ca^{2+}, Sr^{2+} and Ba^{2+}
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Organic Synthesis-I

Learning Objectives:

1. To provide students with a strong theoretical foundation in the organometallic reagents, principles, preparations, properties and applications core areas of organometallic chemistry.
2. To develop students' ability to understand, analyse, and predict oxidation, reduction chemical reactions and their mechanisms.
3. To enhance students' practical skills through laboratory experiments and analytical techniques.
4. To prepare students for careers in research, academia, and various chemical industries.
5. To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

1. Students will be able to explain the principles of various chemical reactions and their mechanisms.
2. Students will be able to apply their knowledge to solve Non-benzenoid Aromatics and Polycyclic Aromatic Compounds.
3. Students will be proficient in using various analytical instruments and techniques.
4. Students will be able to design and synthesize new molecules and materials. Metalloenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds
5. Students will be able to communicate their scientific findings effectively.

Course Title:	Organic Synthesis-I	Course Code: 24MCH9305T
Total Lecture hours: 60		Hours
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.	15

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Unit II	Oxidation Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) Nitrate.	15
Unit III	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 IV	Metalloenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone).	15
Reference and Reading Books:		
1. H. O. House; Modern Synthetic Reactions, W.A. Benjamin. 2. W. Carruthers; Some Modern Methods of Organic Synthesis, Cambridge Univ. Press. 3. J. March; Advanced Organic Chemistry, Reactions Mechanisms and Structure, John Wiley. 4. R. O. C. Norman and J. M. Coxon; Principles of Organic synthesis, Blackie Academic & Professional. 5. F. A. Carey and R. J. Sundberg; Advanced Organic Chemistry Part-B, Plenum Press. 6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier.		

Organic Synthesis-II

Learning Objectives:

1. To provide students with a strong theoretical principle in the disconnection approach and protecting groups.
2. To develop students' ability to understand, analyze, and predict chemical reactions to protect the functional groups.
3. To enhance students' practical skills through laboratory experiments.
4. To prepare students for careers in research, academia, and various chemical industries.
5. To foster critical thinking, problem-solving, ring synthesis, and communication skills.

Learning Outcomes:

1. Students will be able to explain the principles of disconnection approach and their chemical reactions.
2. Students will be able to apply their knowledge to protecting functional groups and their chemical reactions.
3. Students will be proficient in using various analytical instruments and techniques in ring synthesis.
4. Students will be able to design and synthesize new molecules and materials.
5. Students will be able to communicate their scientific findings effectively.

Course Title:	Organic Synthesis-II	Course Code: 24MCH9306T
Total Lecture hours: 60		Hours
Unit I	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.	15
Unit II	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.	15

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Unit III	Two Group C-C Disconnections Diels-Alder Reaction, 1,3-difunctionalised compounds, α,β - unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Michael addition and Robinson annelation. Use of 1,2-; 1,4- and 1,6- difunctionalised compounds in ring synthesis	15
Unit IV	Ring Synthesis Saturated heterocycles; synthesis of 3,4,5 and 6 membered rings. aromatic heterocycles in organic synthesis.	15
Reference and Reading Books:		
1. S. Warren; Designing Organic Synthesis, Wiley. 2. J. Fuhrhop and G. Penzlin; Organic Synthesis-Concept, Methods and Starting Materials, Wiley VCH. 3. H. O. House; Modern Synthetic Reactions, W.A. Benjamin. 4. W. Carruthers; Some Modern Methods of Organic Synthesis, Cambridge Univ. Press. 5. J. March; Advanced Organic Chemistry, Reactions Mechanisms and Structure, John Wiley. 6. F. A. Carey and R. J. Sundberg; Advanced Organic Chemistry Part-B, Plenum Press.		

Natural Products

Learning Objectives:

1. To learn the advanced concepts of natural products.
2. To develop students' ability to understand, analyze, and predict chemical reactions and their mechanisms of natural products.
3. To enhance students' practical skills through laboratory experiments and analytical techniques.
4. To prepare students for careers in research, academia, and various chemical industries.
5. To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

1. Students will be able to explain the principles of various alkaloids, steroids, and pigments, and their properties.
2. Students will be able to apply their knowledge to solve complex chemical problems of alkaloids, steroids and pigments.
3. Students will be able to design and synthesize new molecules and materials.
4. Students will be able to communicate their scientific findings effectively.

Course Title:	Natural Products	Course Code: 24MCH9307T
Total Lecture hours: 60		
Unit I	Terpenoids and Carotenoids Callsification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol a-Terpeneol, Mentohl, Farnesol, Zingiberence, Santonin, Phytol, Abietic acid and b-Carotene.	15
Unit II	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, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine. Steroids Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolatrin, Structure determination and synthesis of Cholesterol ^{cholesterol} .	15

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	Bile acids, Androstosterone, Testosterone, Estrone, Progesterone, Aldosterone, Biosynthesis of Steroids	
Unit III	Plant Pigments Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Pelargonidin, Flavone, Flavonol, Quercetin, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway. Prophyrins Structure and synthesis of Haemoglobin and Chlorophyll.	15
Unit IV	Prostaglandins Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2a. Pyrethroids and Rotenones Synthesis and reactions of Pyrethroids and Rotenones. (For structure education, emphasis is to be placed on the use of spectral parameters wherever possible).	15
Reference and Reading Books:		
1. J. Mann, R. S. Davidson, J.B. Hobbs, D.V. Banthroppe and J.B. Harbome; Natural Products: Chemistry and Biological Significance, Longman, Esses. 2. I. L. Finar; Organic Chemistry: Vol. 2, ELBS 3. M. Norgadi; Stereoselective Synthesis: A Practical Approach, VCH. 4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier. 5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas; Eds. Kurt Hostettmann, M. P. Gupta and A. Marston, Harwood Academic Publishers. 6. Ata-ur-Rahman and M. L. Choudhary; New Trends in Natural Product chemistry, Harwood Academic Publishers. 7. Sukh Dev; Insecticides of Natural Origin, Harwood Academic Publishers.		

Elective Lab-I (Organic Chemistry)

Course Title:	Elective Lab-I (Organic Chemistry)	Course Code: 24MCH9303P																					
	A. Multi-step Organic synthesis based on Name Reactions The exercise should illustrate the use of organic reagents and mechanism. Purification of products by chromatographic techniques. • Photochemical reaction: Benzpinacolone from Benzophenone (Benzophenone → Benzpinacol → Benzpinacolone) • Bockman Rearrangement: Benzamide from Benzene (Benzene → Benzophenone → Benzophenone oxime → Benzanilide) • Benzilic acid rearrangement: Benzilic acid from Benzoin (Benzoin → Benzil → Benzilic acid) • Synthesis of heterocyclic compounds a Skraup Synthesis: Preparation of Quinoline from Aniline b. Fisher Indole synthesis: Preparation of 2-phenylindole from Phenylhydrazine. • Diazocoupling: Phthalic anhydride → Phthalimide → anthranilic acid → methyl red. B. Separation of three component organic mixture and identification of the components, Preparation of their derivatives and verification with the help of IR and NMR spectral data provided. C. Interpretation of some following organic compounds using UV, IR, NMR and MS spectra: <table border="1"> <tbody> <tr> <td>Acetone</td><td>Phthalic acid</td><td>Acetamide</td></tr> <tr> <td>Phenylacetone</td><td>Ethyl bromide</td><td>Benzamide</td></tr> <tr> <td>Acetaldehyde</td><td>Propyl chloride</td><td>Acetonitrile</td></tr> <tr> <td>Crotonaldehyde</td><td>Benzyl bromide</td><td>Benzonitrile</td></tr> <tr> <td>Cinnamaldehyde</td><td>n-Propylamine</td><td>Anisole</td></tr> <tr> <td>Furfuraldehyde</td><td>Triethylamine</td><td>Cresols</td></tr> <tr> <td>Glycerol</td><td>Aniline</td><td>Toluidines</td></tr> </tbody> </table>	Acetone	Phthalic acid	Acetamide	Phenylacetone	Ethyl bromide	Benzamide	Acetaldehyde	Propyl chloride	Acetonitrile	Crotonaldehyde	Benzyl bromide	Benzonitrile	Cinnamaldehyde	n-Propylamine	Anisole	Furfuraldehyde	Triethylamine	Cresols	Glycerol	Aniline	Toluidines	
Acetone	Phthalic acid	Acetamide																					
Phenylacetone	Ethyl bromide	Benzamide																					
Acetaldehyde	Propyl chloride	Acetonitrile																					
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Cinnamaldehyde	n-Propylamine	Anisole																					
Furfuraldehyde	Triethylamine	Cresols																					
Glycerol	Aniline	Toluidines																					

Ethyl alcohol	Nitrobenzene	Anisidines
Isopropyl alcohol	Acetylene	Pyridine
t-Butyl alcohol	Styrene	4-Picoline
p-aminophenol	Cyclohexane	s-Triazine
p-Bromophenol	Toluene	Vinyl acetate
p-Methoxybenzyl alcohol	Xylenes	Diethyl phthalate
Acetic acid	1,3,5-trimethylbenzene	Phthalic anhydride
Benzoic acid	p-Dichlorobenzene	2-Methoxyethyl acetate
Cinnamic acid	Urea	

Chemical Dynamics

Learning Objectives:

1. To appreciate the concept of kinetics of enzymes, and atmospheric reactions.
2. To study substitution and elimination reactions and their mechanisms.
3. To understand the path, feasibility and mechanism of chemical dynamics.
4. To understand the techniques involved in the determination of mechanism of reactions and applications of various molecular rearrangements.
5. To enable the student to understand and appreciate the importance of chemical reactions.

Learning Outcomes:

1. Students will be able to learn the techniques of studying the mechanisms of reactions and to understand the metal ion catalysis and induced phenomena.
2. Students will be able to learn the kinetics of enzymes and dynamics of gas-surface reactions.
3. Students will have sufficient knowledge on the mechanisms of substitution reactions and their name reactions.
4. Students will be able to know the classifications, mechanisms and applications of various chemical reactions.

Course Title:	Chemical Dynamics	Course Code: 24MCH9308T
Total Lecture hours: 60		Hours
Unit I Atmospheric Reactions The physical structure and chemical composition of the atmosphere, the kinetics and mechanisms of NO _x and ClO _x cycles, the H ₂ + O ₂ reaction, the mechanisms of general methane oxidation, the kinetics and mechanisms of low-temperature methane oxidation, and the concept of global warming. Transition State A brief aspect of statistical mechanics and transition state theory. Application in the calculation of the second-order rate constant for reactions with collision for (1) atom + atom, (2) atom + molecule, and (3) molecule + molecule reactions. Static solvent effects and thermodynamics formulations. Adiabatic electron transfer reactions, energy surfaces.	15	
Unit II Kinetics of Enzymes Kinetics of one enzyme-two substrate systems and their experimental characteristics. Enzyme inhibitors and their experimental characteristics. Kinetics of enzyme-inhibited reactions. Micellar catalysis and inhibition Kinetics and mechanism of micelle-catalysed reactions (First order and second order). Various types of micelle-catalysed reactions. Micelle inhibited reactions. (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.	15	
Unit III Substitution Reactions Substitution reactions. Classification of ligand substitution mechanism. Anation and base-catalyzed kinetics of anation reactions. Aquation and acid-catalysed kinetics of aquation reactions (octahedral complexes). Inner-sphere electron transfer reactions and mechanism. Various types of inner sphere bridges.	15	

	adjustments, and remote attacks. Linkage isomerism. Chemical and resonance mechanisms. Marcus-Cross relation in outer sphere reactions (no mathematical derivation). Its application in reactions: $\text{Ce(IV)} + \text{Mo(CN)}_5^{4-} \rightarrow \text{Ce(III)} + \text{Mo(CN)}_6^{3-}$ $\text{Fe(CN)}_6^{3-} + \text{Fe(CN)}_6^{4-} \rightarrow \text{Fe(CN)}_6^{4-} + \text{Fe(CN)}_6^{3-}$ Bridged outer-sphere electron transfer mechanism. Kinetics of reactions in the presence of cyclodextrins. Considering one full case study, Nucleophilic and electrophilic catalyst and their mode of action.	
Unit IV	Metal ion catalysis and induced Phenomena Metal ion catalyzed reactions, their kinetics and reaction mechanism in solutions. Induced reactions and 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). Kinetics of hydroformylation reaction. Oscillatory Reactions Autocatalysis and oscillatory reactions, Kinetics and mechanism of Belousov-Zhabotinski (B-Z) reactions.	15
Reference and Reading Books:		
- Progress in Inorganic Chemistry, Vol. 30, Wiley-Interscience. R. W. Lumry and W. L. Raymond, Electron Transfer Reactions, Wiley-Interscience. - M.L. Bender, Mechanism of Homogeneous Catalysis from protein to protein, Wiley-Interscience. - A.G. Sykes, Kinetics of Inorganic reactions, Pergamon. D. Benson, Mechanism of Inorganic Reactions in Solution: An Introduction, McGraw-Hill Inc. US. F. Basolo and R.G. Pearson, Inorganic Reaction Mechanism, J. Wiley. - Electron Transfer Reactions, H. Taube, Oxford Press.		

Electrochemistry

Learning Objectives:

- To provide students with a strong theoretical foundation in the electrochemistry.
- To develop students' ability to understand, analysing, and conversion of electrochemical energy.
- To enhance students' practical skills through laboratory experiments and analytical techniques.
- The course aims to develop knowledge and skills in electrochemistry.
- To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

- Students will be able to explain the principles of electrochemical reactions and their mechanisms.
- Students will be able to apply their knowledge about corrosion and stability of metals.
- Students will be proficient in using various analytical instruments and techniques.
- Students will be able to design and synthesize new molecules and materials.
- Students will be able to communicate their scientific findings effectively.
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Course Title:	Electrochemistry	Course Code: 24MCH9309T
Total Lecture hours: 60		Hours
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): History of fuel cells, Hydrogen oxygen cells, Hydrogen Air cells, Hydrocarbon air cells, Alkaline fuel cells, Phosphoric acid fuel cells, Direct NaOH fuel cells, and applications of fuel cells.	15

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	Electrochemical Energy Storage: Properties of Electrochemical energy stores : Measure battery performance, Charging and discharging of a battery, Storage Density, Energy Density. 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 storage: Storage in (i) Hydrogen, (ii) Alkali Metals, (iii) Non-aqueous solutions.
Unit II	Corrosion and Stability of Metals Civilisation 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 an 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 III	Kinetics of Electrode Process Essentials of Electrode Reaction. Current Density, Overpotential, Tafel Equation, Butler-Volmer equation. Standard rate constant (k_0) and Transfer coefficient (α), 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. 15
Unit IV	Potential Sweep Method: 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 potential coulometry, Controlled Coulometry, Electro-organic synthesis and its important applications. Stripping analysis: anodic and Cathodic modes, pre-electrolysis and stripping steps, applications of Stripping Analysis. 15
Reference and Reading Books: 1. J'O.M. Bockris and A.K.N. Reddy, Modern Electrochemistry Vol. I, IIA, and IIB, Plenum Pub. NY. 2. L. Meites, Polarographic Techniques, Wiley-Interscience. 3. J'O.M. Bockris and S. Srinivasan, Fuel Cells: Their Electrochemistry, McGraw-Hill, NY. 4. A.M. Bond, Modern Polarographic Methods, CRC Press. 5. K. Zutshi, Polarography and Allied techniques by New Age International, New Delhi. 6. Basil H. Vessor & Galen W.; Electroanalytical Chemistry, Wiley-Interscience.	

Nuclear Chemistry

Learning Objectives:

1. To provide students with a strong theoretical foundation about nuclear chemistry.
2. To develop students' ability to understand, analyse, radioactive decay processes, detection and measurement of radioactivity.
3. To enhance students' practical skills through laboratory experiments and analytical techniques.
4. To prepare students for careers in research, academia, and various chemical industries.
5. To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

1. Students will be able to explain the principles of nuclear reactions and their mechanisms.
2. Students will be able to apply their knowledge in nuclear reactors and industries.
3. Students will be proficient in using various analytical instruments and techniques.
4. Students will be able to design and synthesize new molecules and materials.
5. Students will be able to communicate their scientific findings effectively.


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Course Title:	Nuclear Chemistry	Course Code: 24MCH9310T
Total Lecture hours: 60	Hours	
Unit I	Introduction of Radioactivity: Nuclear models, mass defect, binding energy, mean binding energy of stable nuclei, disintegration theory: nuclear stability and group displacement law; synthesis of radioisotopes: ^{14}C , ^3H , ^{32}P , ^{35}S , ^{36}Cl , ^{82}Br , ^{131}I ; contribution of the discovery of artificial radioactivity in the field of heavy element chemistry.	15
Unit II	Radioactive Decay Processes: Alpha decay-penetration of potential barriers hindered alpha decay, alpha decay energies; beta decay-Fermi theory, Curie plots, comparative half-lives, electron capture, selection rules, forbidden transitions, non-conservation of parity, neutrinos; gamma decay- life-time of excited states, multipole radiation and selection rules, isomeric transition, internal conversion and Auger effect. Detection and Measurement of Radioactivity: Ionization chamber, Geiger-Muller, proportional, scintillation counters, Wilson cloud chamber, health physics, Instrumentation: Film badges, pocket ion chambers, portable counters and survey meters, accelerators: Van de Graff and cyclotron.	15
Unit III	Isotope Effects and Isotopic Exchange Reactions: Isotope effect: Definition, physical and chemical isotope effects, generalities of isotope effects; Isotopic exchange: basic concept, characteristics of isotopic exchange, mechanism of isotopic exchange, kinetics of homogenous and heterogeneous isotopic exchange reactions, self-diffusion, and surface measurements. Tracers: Selection of radioisotopes as tracer, application of radioisotopes as tracers-analytical, physico-chemical, medical, agriculture and industrial applications, neutron activation analysis, radiometric titrations and isotope dilution techniques, radiopharmaceutical, radioimmunoassay and radiation sterilization.	15
Unit IV	Nuclear Reactors: Basic principles of chain-reacting systems, characteristics of nuclear reactors and their applications, classification of reactors, breeder reactor, reactor-associated problems, nuclear reactors in India, the four-factor formula: The reproduction factor, reactor power, life and critical size of reactor, reactor safety, fuel cycle, re-processing of spent fuel, nuclear waste management.	15
Reference and Reading Books:		
1. Nuclear Chemistry and its applications – By. Haisionsky – Addison Wesley 2. Nuclear and Radio Chemistry – By. G. Friedlander, J. W. Kennedy, E. S. Macias and J. M. Miller – A Wiley – Interscience Publication, John Wiley and Sons – III Edition. 3. Radio Chemistry – By An. N. Nesmeyanov, Mir Publishers. 4. Artificial Radioactivity by K. Narayana Rao and H. J. Arnikar Tata McGraw Hill, New Delhi		

Elective Lab-I (Physical Chemistry)

Course Title:	Elective Lab-I (Physical Chemistry)	Course Code: 24MCH9304P
	A. Chemical Kinetics - Determining the energy of activation and entropy of activation in the KMnO_4-benzyl alcohol reaction, measuring the rate constant at least at three temperatures. - Determining the Formation Constant for the $[\text{Ce}^{4+}\text{-H}_3\text{PO}_4]$ intermediate complex and its decomposition rate constant. - Determine the rate constant in the bleaching of malachite green in the basic medium. - Determine the order with respect to Ag (I) in the oxidation of $\text{Mn (ID by } \text{S}_2\text{O}_8^{2-}$ and the rate constant for the un-analysed reaction. - Investigate the auto-catalysed reaction between KMnO_4 and Oxalic Acid. - Kinetics of enzyme-catalysed reactions. B. Spectrophotometry / Colorimetry - Verify Beer's Law for the solution of potassium permanganate (KMnO_4) and determine the concentration of the given aqueous solution of unknown concentration of this salt.	

	• Determine the pH of the solution employing methyl red indicator spectrophotometrically. • Determine the indicator constant (pK_a) of methyl red, spectrophotometrically. • Determine the stability constant of the FeSCN+2 complex ion spectrophotometrically, keeping the strength constant. C. Electrochemistry • Identification and Estimation of metal ions such as Cu⁺², Cd⁺², Ni⁺², Voltametrically. • To plot a cyclic voltammogram of a reversible system and calculate the number of electrons in the redox process. • To plot a voltammogram of an organic compound (such as nitroaniline, picric acid, m-dinitrobenzene) and verification of the Randles-Sevcik equation (a current vs scan rate and current vs concentration) • Determining the strength of strong and weak acids in a given mixture using a potentiometer / pH meter. • Determination of the formation constant of silver-ammonia complex and the stoichiometry of the complex potentiometrically.
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	Isomerisations, additions and substitutions. Miscellaneous Photochemical Reactions Photo-Fries reactions of annelid's, Photo-Fries rearrangement. Barton reaction. Singlet molecular Oxygen reaction. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.
Reference and Reading Books:	
1. A. R. West; Solid state chemistry and its applications, Plenum. 2. H. V. Keer; Principles of the Solid State, Wiley Eastern. 3. N. B. Hannay; Solid State Chemistry. 4. D. K. Chakrabarty; Solid State Chemistry, New Wiley Eastern. 5. K. K. Rothagi-Mukheriji; Fundamentals of photochemistry, Wiley-Eastern. 6. A. Gilbert and J. Baggott; Essentials of Molecular Photochemistry, Blackwell Scientific Publications. 7. N. J. Turro; Molecular Photochemistry, W. A. Benjamin. 8. A. Cox and T. Camp; Introductory Photochemistry, McGraw-Hill. 9. R. P. Kundall and A. Gilbert; Photochemistry, Thomson Nelson. 10. J. Coxon and B. Halton; Organic Photochemistry, Cambridge University Press.	

Photo-Inorganic Chemistry

Learning Objectives:

1. To provide students with a strong theoretical foundation in photo-inorganic chemistry.
2. To develop students' ability to understand, analyze, basics of photochemistry, excited states of metal complexes.
3. To enhance students' practical skills through laboratory experiments and analytical techniques.
4. To prepare students for careers in research, academia, and various field of photochemical Reaction Mechanisms.
5. To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

1. Students will be able to explain the principles of photo-inorganic reactions and their mechanisms.
2. Students will be able to apply their knowledge in solid state chemistry.
3. Students will be proficient in using various analytical instruments and techniques.
4. Students will be able to design and synthesize new concepts of photochemistry and materials.
5. Students will be able to communicate their scientific findings effectively.

Course Title:	Photo-Inorganic Chemistry	Course Code: 24MCH9402T
Total Lecture hours: 60		Hours
Unit I Basics of Photochemistry Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, Energy dissipation by radiative an non-radiative processes, absorption spectra, Frank-Condon principle, photochemical stages-primary and secondary processes.		15
Unit II Properties of Excited States Structure, dipole moment, acid-base strengths, reactivity. Photochemical kinetics-calculation of rates of radiative processes. Bimolecular deactivation-quenching.		15
Unit III 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. 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.		15
Unit IV Redox Reactions by Excited Metal Complexes Energy transfer under conditions of weak interaction and strong interaction-examples formation; condition of the excited states to be useful as redox reactants.		15

	excited electron transfer, metal complexes as attractive candidates, (2,2-bipyridine and 1,10-phenanthroline complexes), illustration of reducing and oxidising character of $[\text{Ru}(\text{bpy})_3]^{2+}$ complex, comparison with $[\text{Fe}(\text{bpy})_3]^{3+}$; 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 energy products, chemical energy into light. 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.
Reference and Reading Books:	
1. A. W. Adamson and P. D. Fleischauer; Concepts of Inorganic Photochemistry, Wiley. 2. Inorganic Photochemistry, <i>J. Chem. Educ.</i> vol. 60 No. 10, 1983. 3. Progress in Inorganic Chemistry, Vol. 30, ed. S. J. Lippard. Wiley. 4. <i>Coordination Chem. Revs.</i> 1981, vol. 39, 121, 1231, 1975, 14, 321, & 1990, 97, 313. 5. V. Balzari and V. Carassiti; Photochemistry of Coordination Compounds, Academic Press. 6. G. J. Ferraudi; Elements in Inorganic Photochemistry, Wiley.	

Elective Lab-II (Inorganic Chemistry)

Course Title:	Elective Lab-II (Inorganic Chemistry)	Course Code: 24MCH9401P
	Spectrophotometry: • Determination of the equilibrium constant of the reaction $\text{KI} + \text{I}_2 \rightarrow \text{KI}_3$ spectrophotometrically. • Determination of stoichiometry and stability constant of Ferric isothiocyanate complex ion in solution. • Determination of the rate constant of alkaline bleaching of Malachite green and the effect of ionic strength on the rate of reaction. • Determination of the amount of each copper and bismuth or copper and iron (III) from the given mixture at 745nm by spectrophotometric titration using a solution of EDTA. • Determination of Al^{3+}, Ti^{3+}, Fe^{3+} using 8-Hydroxyquinoline. • Determination of Fe^{2+} using the 1,10-phenanthroline method. • Determination of Cr^{3+} by the diphenyl carbazide method. • Determination of Ni^{2+} by DMG method. Cerimetric titration • Standardization of ceric sulphate solution using ferrous ammonium sulphate intermediate solution. • Determination of the percentage of $\text{H}_2\text{C}_2\text{O}_4$ in oxalic acid crystals. • Determination of the percentage purity of a sample of sodium nitrate. Oxidation-Reduction Titrations • Standardization with sodium oxalate of KMnO_4 and determination of Ca^{2+} ion. • Standardization of ceric sulphate with Mohr's salt and determination of Cu^{2+}, NO_3^- and $\text{C}_2\text{O}_4^{2-}$ ions. • Standardization of $\text{K}_2\text{Cr}_2\text{O}_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum) • Standardization of hypo solution with potassium iodate / $\text{K}_2\text{Cr}_2\text{O}_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} and Cu^{2+}. • Determination of hydrazine with KIO_3 titration. Precipitation Titrations • AgNO_3 standardization by Mohr's method by using adsorption indicator. • Volhard's method for Cl^- determination. • Determination of ammonium / potassium thiocyanate. • Estimating magnesium or cadmium as oxinate by titration with standard bromate solution. • Estimation of KBr in the given solution by titrating against std. AgNO_3 solution using eosin as indicator. Complexometric Titrations • Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.	

Dr. J. Registrar

Shri D. Deendayal Rupnarayan Institute of Technology
Sundernagar, Coimbatore-641 004

	- Determination of Ni^{2+} (back titration). - Determination of Ca^{2+} (by substitution method). - Estimation of the purity of oxalic acid employing standard Ce(IV) solution.
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Heterocyclic Chemistry

Learning Objectives:

- To provide students with a strong theoretical foundation in heterocyclic chemistry.
- To develop students' ability to understand, analyze, aromatic and nonaromatic heterocyclic compounds and their synthesis.
- To enhance students' practical skills through laboratory experiments and analytical techniques.
- To prepare students for careers in research, academia, and various of photochemical Reaction Mechanisms.
- To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

- Students will be able to explain the principles of heterocyclic reactions and their mechanisms.
- Students will be able to apply their knowledge about heterocyclic chemistry.
- Students will be proficient in using various analytical instruments and techniques.
- Students will be able to design and synthesize new molecules and materials.
- Students will be able to communicate their scientific findings effectively.

Course Title:	Heterocyclic Chemistry	Course Code: 24MCH9403T
Total Lecture hours: 60		Hours
Unit I	Nomenclature of Heterocycles Replacement and systematic nomenclature (Hantzsch-Widman system) 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 exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.	15
Unit II	Non-aromatic Heterocycles Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction. Stereo-electronic effects anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. Small Ring Heterocycles Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.	15
Unit III	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 meso-ionic heterocycles of type-A and B and their applications.	15
Unit IV	Six-Membered Heterocycles with one Heteroatom Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and phridones. Synthesis and reactions of quionlizinium and benzopyrylium salts, coumarins and chromones. Six Membered Heterocycles with Two or More Heteroatoms	15

	Synthesis and reactions of diazotones, triazines, tetrazines and thiazines.
Reference and Reading Books:	
1.	R. R. Gupta, M. Kumar and V. Gupta; Heterocyclic Chemistry Vol. 1-3, Springer Verlag.
2.	T. Eicher and S. Hauptmann; The Chemistry of Heterocycles, Thieme.
3.	J. A. Joule, K. Mills and G.F. Smith; Heterocyclic chemistry, Chapman and Hall.
4.	T. L. Gilchrist; Heterocyclic Chemistry, Longman Scientific Technol.
5.	Contemporary Heterocyclic Chemistry, Wiley-Inter Science.
6.	G. R. Newkome and W. W. Paudler; An Introduction to the Heterocyclic Compounds, Ed. R. M. Acheson, John-Wiley.
7.	A. R. Katritzky and C. W. Rees; Comprehensive Heterocyclic Chemistry, Pergamon Press.

Elective Lab-II (Organic Chemistry)

Course Title:	Elective Lab-II (Organic Chemistry)	Course Code: 24MCH9402P
	Extraction of Organic Compounds from Natural Sources: - Isolation of nicotine from tobacco. - Isolation of lycopene from tomatoes. - Isolation of β-carotene from carrots. - Isolation of limonene from citrus fruits - Isolation of lactose from milk. - Isolation of eugenol from clove. - Isolation of piperine from black pepper. Organic Synthesis The exercises should illustrate the use of organic reagents, eco-friendly synthetic techniques and may involve purification of the products by chromatographic techniques and characterization by UV, IR, NMR, MS, particle size analyzer, etc.: - Bischler-Napieralski Synthesis: Preparation of isoquinoline from β-phenylethylamine. - Fries' rearrangement: Preparation of acetophenones. - Vilsmeier-Haack reaction: Preparation of aromatic aldehydes. - Wittig reaction: Preparation of alkenes. Drug Synthesis: Synthesis, separation and characterization of some of the following drugs: - Antipyretic Analgesic: Paracetamol, Aspirin, Cinchophen, Mefenamic acid. - Anti-inflammatory: Ibuprofen, Diclofenac. - Sulphonamides : Sulphanilamide, Sulphapyridine, Sulphadiazine. - Local Anesthetics : Benzocaine, Procaine. - Anti-malarial : Chloroquine, Primaquine, Pyrimethamine. - Sedative and Hypnotic: Barbitol, diazepam, alprazolam, zolpidem. - Anti-psychotic : Chlorpromazine, clozapine.	

Physical Organic Chemistry

Learning Objectives:

- To provide students with a strong theoretical foundation in physical organic chemistry.
- To develop students' ability to understand, analyze, concepts in molecular orbital (MO) and valence bond (VB) theory.
- To enhance students' practical skills through laboratory experiments and analytical techniques.
- The course aims to develop their knowledge and skills in analyzing structure, properties, and reactions.
- To foster critical thinking, problem-solving, and communication skills.

Learning Outcomes:

- Students will be able to explain the principles of physical organic reactions and their mechanisms.
- Students will be able to apply their knowledge to solve complex problems in organic synthesis, analysis and reactivity.
- Students will be proficient in using various analytical instruments and techniques.
- Students will be able to design and synthesize new molecules and materials.

5. Students will be able to communicate their scientific findings effectively.

Course Title:	Physical Organic Chemistry	Course Code: 24MCH9404T
Total Lecture hours: 60		Hours
Unit I	Concepts in Molecular Orbital (MO) and Valence Bond (VB) Theory Introduction to Huckel molecular orbital (HMO) method as a means to explain modern theoretical methods. Advanced techniques in PMO and FMO theory. Molecular mechanics, semi-empirical methods and ab initio and density functional methods. Quantitative MO Theory: HMO method as applied to ethene, allyl and butadiene. Qualitative MO theory ionisation potential. Electron affinities. MO energy levels. Orbital symmetry. Orbital interaction diagrams. Valence bond (VB) configuration mixing diagrams. Relationship between VB configuration mixing and resonance theory. Valence bond (B) configuration mixing diagrams, the relationship between VB configuration mixing and resonance theory, reaction profiles, potential energy diagrams, and the curve-crossing model—the nature of the activation barrier in chemical reactions.	15
Unit II	Principles of Reactivity Mechanistic significance of entropy, enthalpy and Gibbs' free energy. Arrhenius equation. Transition state theory. Uses of activation parameters, Hammond's postulate, Bell-Evans-Polanyi Principle. Potential energy surface model. Marcus's theory of electron transfer. Reactivity and selectivity principles. Solvation and Solvent Effects Qualitative understanding of solvent-solute effects on reactivity. Thermodynamic measure of solvation. Effects of solvation on reaction rates and equilibria. Various empirical indexes of solvation based on physical properties, solvent-sensitive reaction rates, spectroscopic properties and scales for specific solvation. Use of solvation scales in mechanistic studies. Solvent effects from the curve-crossing model.	15
Unit III	Structural Effects on Reactivity Linear free energy relationships (LFER). The Hammett equation, substituent constants, theories of substituent effects. Interpretation of values. Reaction constant. Concepts in Deviations from Hammett equation. Dual parameter correlation, inductive substituent constant. The Taft model, σ_I and σ_R scales. Acids, Bases, Electrophiles, Nucleophiles and Catalysis: Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity functions and their application. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The α-effect. Ambivalent nucleophiles. Acid-base catalysis-specific and general catalysis. Brønsted catalysis, Nucleophilic and electrophilic catalysis. Catalysis by noncovalent binding-micellar catalysis. Steric and Conformation Properties: Various type of steric strain and their influence on reactivity. Steric acceleration. Rotation around partial double bonds. Winstein-Holness and Curtin-Hammett principle.	15
Unit IV	Nucleophilic and Electrophilic Reactivity Structural and electronic effects on S_N1 and S_N2 reactivity. Solvent effect. Kinetic isotope effects. Intra-molecular assistance. Electron transfer nature of S_N2 reaction. Nucleophilicity and S_N2 reactivity based on curve crossing mode. Relationship between polar and electron transfer reactions $S_{RN}1$ mechanism. Electrophilic reactivity, general mechanism. Kinetic of S_E2 Ar reaction. Structural effects on rates and selectivity. Curve-crossing approach to electrophilic reactivity. Radical Reactivity Radical stability, polar influences, solvent and steric effects. A curve crossing approach to radical addition, factors affecting barrier heights in addition, regioselectivity in radical reactions. Molecular Orbital (MO) and Valence Bond	15

	(VB) Theory.	
Reference and Reading Books:		
1.	U. Burket and N. L. Allinger; Molecular Mechanics, ACS Monograph 177, 1982.	
2.	L. Salem and W. L. Jorgensen; Organic Chemists, Book of Orbitals, Academic Press.	
3.	T. H. Lowry and K. C. Richadson; Mechanism and Theory in Organic chemistry, Harper and Row.	
4.	N. S. Isaacs; Physical Organic Chemistry, ELBS/Longman.	

Elective Lab-II (Physical Chemistry)

Course Title:	Elective Lab-II (Physical Chemistry)	Course Code: 24MCH9403P
	Chemical Kinetics - Determination of the primary salt effect on the kinetics of ionic reaction and testing of the Bronsted relationship (iodide ion is oxidised by persulphate ion). - Determination of energy and enthalpy of activation in the reaction of KMnO_4 and benzyl alcohol in acid medium. - Determination of the energy of activation and the entropy of activation from a single kinetic run. - Kinetics of decomposition of benzene diazonium chloride. - Kinetics of decomposition of acidified hydrogen peroxide with potassium iodide and determination of activation energy. Conductometry - Determination of the relative strength of acetic acid, chloroacetic acid, and trichloroacetic acid through measuring their K_a-value by the conductivity measurement method. - Conductometric titration of (i) strong acid, monobasic weak acid, or polybasic weak acid with strong base, (ii) zinc with EDTA, and (iii) KCl v/s AgNO_3. - Conductometric titration of triple mixture ($\text{HCl} + \text{NH}_4\text{Cl} + \text{KCl}$) with (i) NaOH and (ii) AgNO_3. - Determination of the strength of the $\text{HCl} + \text{CH}_3\text{COOH}$ mixture against the standard NaOH solution. Potentiometry / pH metry - Determination of the EMF of the Daniel cell. - Determination of the standard electrode potential (E_o) value of the ferrous-ferric system by titrating ferrous ammonium sulphate against potassium dichromate potentiometrically. - Determination of pK_a of dibasic acid (oxalic acid, succinic acid, etc). - Determination of the formation constant of Ag-ammonia complex and the stoichiometry of the complex potentiometrically. - Determination of hydrolysis constant and degree of hydrolysis of aniline hydrochloride pH metrically. 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. Network of resistors. Thevenin's theorem, superposition theorem, loop analysis, RC circuits, LR Circuits, LCR circuits. Illustration of the use of circuits in NQR spectroscopy, Mossbauer spectroscopy, cyclic voltammetry, and in power supply as filter circuits.	

Dr. Registrar
Shekhawati University,
Sikar(Rajasthan)

Course Title: Seminar
Course Code: 24MCH9401S

Max. Marks: 200

Guideline for Seminar

- Select a latest topic relevant to the stream of study with content suitable for a master's in Chemistry.
- The topic of the presentation should be approved by the head of the department/seminar coordinator well in advance.
- Know the topic very well, and the message of the presentation should be clear.
- Presentation (PPT) should consist of a minimum of 15 slides and a maximum of 25 slides.
- In slides, mention the key point only and fonts should be readable.
- For presentation, select simple themes and avoid unnecessary animations.
- Give a title and slide number for each slide.
- Duration of the seminar should be 20 to 25 minutes, and another 5 minutes for question answers.
- The organization of slides should be as follows
 1. The first slide will be the title page showing the title of the seminar, the student's name, roll number, and class.
 2. The second page will contain an overview of seminar
 3. The seminar body includes principles, methodology, graphs, charts, block diagrams, applications, case studies, and advantages and disadvantages arranged in logical sequence depending on the topic.
 4. Conclusion
 5. The last slide should contain references and bibliography.
- The seminar must be evaluated by at least two faculty members of the science stream.
- Submit the handout of the presentation to the Coordinator of the seminar.

Distribution of marks

Relevance of title	Content of the seminar	Presentation in slides	Knowledge of the topic	Message of presentation	Maximum marks
12	12	13	50	13	100


Dy. Registrar
Pandit Deendayal Upadhyaya
University
Silketa (Rajshahi)

Course Title: Dissertation
Course Code: 24MCH9401D

Max. Marks: 200

Course Outcomes:

After completion of course, students will have hand on experience of

1. Literature survey on advanced research topics in novel areas of chemistry.
2. Planning and designing the experiment and theoretical modelling of the research problem
3. Analysis and evaluation of the experimental data/ theoretical & computational modeling
4. Deduction and systematic presentation of the results
5. Compilation of the results / information to produce written document
6. Defending the results of the project in an open viva-voice through power point Presentation

Guidelines

Project will be a supervised collaborative work in Theoretical Chemistry, Experimental Chemistry, Computational Chemistry. The project will aim to introduce student to the basics and methodology of research in Chemistry, which is done via theory, computation and experiments either all together or separately by one of these approaches.

Following will be the modalities:

- (i) Since lot of ground work including purchase of components/ equipment's may be involved depending on the choice of the project, a strict schedule will be drawn and followed, to meet the deadline for submitting the project.
- (ii) Students are required to consult and discuss with the potential supervisor and/or co-supervisor on the proposed project and apply to take on the project till mid of third Semester i.e. 30th September. The application is to be approved by the Head of Department/Principal.
- (iii) The students will be allotted M.Sc. IV Semester project in consultation with their supervisors well in advance till 31st October, to give students ample time to work on the allotted topics in consultation with their supervisors.
- (iv) To develop team spirit and group learning, students will be allotted projects in groups of three to four students but not more than four students in any case.
- (v) Groups will be formed by inviting applications from the students who want to work together as a group in the office of Chemistry Department, after due recommendation from the supervisor under whose supervision they wish to work along with a tentative title/topic by 30th September.
- (vi) Students can choose topics from the following major fields or any other field decided from time to time for which department has the faculty and facilities
 1. Theoretical and Computational Chemistry
 2. Synthetic schemes for Organic and Inorganic Compounds
 3. Computational Chemistry
 4. Novel Analytical Techniques
 5. Nanochemistry


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Registrar
Shrikrishna University,
Sikar (Rajasthan)

- (vii) Students will discuss the topic with the supervisors and submit a one-page typed abstract giving the plan of the project by 31st November along with the list of components etc.

The plan of work should include information about.

- a) Gathering resource material
- b) Setting up of the experiment if any
- c) Understanding of the theoretical frame work.
- d) Writing of the program for computation if any

e) References

- (viii) Group of students working on a particular topic will be required to give a presentation in the beginning of the IV semester i.e. February/ March about the progress made during vacations. The presentation should be preferably in the forms of a power point presentation.

- (ix) 2nd presentation of the progress of the work will be held in April.

- (x) A complete seminar on the project will be held in the month of June before submission of the project report.

- (xi) Three copies of the project will be required to be submitted in the office of the Chemistry department for final evaluation.

- (xii) Final evaluation will be done by at least two examiners including one examiner outside department/Institute.

- (xiii) The project dissertation should consist of minimum 50 pages (up to 80 pages) including text and figures. Other extended data sheets and programs can be placed under Appendix.

- (xiv) Project report must include following

- a) Title Page
- b) Certificate from supervisor
- c) Acknowledgement
- d) Preface
- e) Contents
- f) List of abbreviations
- g) List of tables
- h) List of graphs and figures
- i) Introduction
- j) Chapter 1
- k) Chapter 2
- l)
- m) Concluding remarks
- n) Appendices
- o) Bibliography/references

(xv) **General Formatting:**

- **Title Page:** The title page should indicate i) M.Sc. Coursework Project Title, ii) Student Name & Student Roll Number and iii) Project Supervisor(s) Name

- **Page Size:** A4 size page (8.27" x 11.69") paper with white background and black colour font for the text

- **Margins:** The left and right margins should be 1½ inches. The top & bottom margins should be one inch each side.

- **Font:** The font size for the main text should be 12. The same font type and size should be used for the entire dissertation
- **Line Spacing:** The text should be in 1.5 spacing
- **Page Numbering:** All pages except the title page must be paginated. The page numbers should appear at the bottom center of the page.

A format of the Title page and certificate from the supervisor is given below:

Title Page

A project report submitted in partial satisfaction of the requirements for the degree of Master of Science in Chemistry
On
“Title of the Project”

Supervised by:

“(Name of the Supervisor)”

Submitted by:

“Name 1”

“Name 2”

“Name 3”

“Name of Department”

“Name of Institution”

Session

Page 2

Certificate

This is to certify that the project entitled “Title of Project” aimed at “Project purpose” was worked upon by the following students under my supervision at the Chemistry Laboratory in the Department of Chemistry “Name of Institution/ College”,

Name 1 with signatures

Name 2 with signatures

Name 3 with signatures

It is certified that the work done by the team in this project is original and has not been submitted for any degree.

Head of the Department

Name of Supervisor with Signature

Last Date for Submission of Project Report: Final project report shall be submitted within 15 days after the last theory paper examination of Semester IV.


Dr. Registrar
Shriharwati University,
(Sriharwati)