CENTRAL UNIVERSITY OF GUJARAT

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Master of Science (M. Sc.)

Chemical Sciences

CENTRAL UNIVERSITY OF GUJARAT

GANDHINAGAR, SECTOR-30

GUJARAT-382030

INDIA

	Code	Course	Hours /week	Total hours	Credit
Semester I	CHE401	Inorganic Chemistry-I	3		3
	CHE402	Quantum Mechanics and Chemical Dynamics-I	3		3
	CHE403	Basics of Organic Chemistry-I	3		3
	CHE404	Basics in Chemical Analysis-I	3		3
	CHE441	Laboratory Techniques in Physical Chemistry – I	6		3
	CHE442	Laboratory Techniques in Organic Chemistry –I	6		3
Semester II	CHE451	Group Theory and Advanced Inorganic Chemistry-II	3		3
	CHE452	Thermodynamics and Electrochemistry-II	3		3
	CHE453	Organic Reaction Mechanisms-II	3		3
	CHE454	Spectroscopic Methods-II	3		3
	CHE491	Laboratory Techniques in Inorganic Chemistry –II	6		3
	CHE492	Laboratory Techniques in Organic Chemistry –II	6		3
Semester III	CHE501	Advanced Inorganic Chemistry-III	3		3
	CHE502	Applied Physical Chemistry-III	3		3
	CHE503	Photochemistry and Pericyclic Reactions-III	3		3
	CHE504	Separation Techniques-III	3		3
	CHE541	Laboratory Techniques in Physical Chemistry –III	6		3
	CHE542	Laboratory Techniques in Inorganic Chemistry –III	6		3
Semester IV	CHE551	Advanced Inorganic and Nanochemistry /Inorganic Spectral Techniques Elective-IV	3		3

	CHE552	Polymer Chemistry/ Molecular Bio-physical Chemistry, Elective-IV	3		3
	CHE553	Advanced Organic Chemistry/ Organic Synthesis, Elective-IV	3		3
	CHE554	Advanced Analytical Methods/ Medicinal Chemistry, Elective-IV	3		3
	CHE591	Project			6
	Total Credits				**72**

Subject Code	**M. Sc. Chemical Sciences** **First Semester**	No. of Credits
CHE401	**Inorganic Chemistry-I**	**3**
	Unit-I: **Molecular Symmetry** Symmetry elements and operations, symmetry groups and molecular point groups. **Molecular Geometry** VSEPR, ligand close packing model, Walsh diagrams, dπ-pπ bonds, Bent's rule. **Coordination Chemistry** Bonding theories, stereochemistry and structure of coordination compounds, Jahn–Teller theorem. **Unit-II:** **Electronic Spectra of Transition Metal Complexes** Spectroscopic ground states; Orgel energy level and Tanabe-Sugano diagrams; calculation of calculation of ligand-field parameters, charge transfer spectra; symmetry based concepts of Orgel energy level diagrams, Spectroscopic method for assignment of absolute configuration of optically active metal chelates. **Magnetic Properties of Transition Metal Complexes** Microstates, multiplet, multiplet width, hole formalism, zero-field splitting, spin-orbit coupling, quenching of orbital contribution, high spin/low spin equilibrium, anomalous magnetic moments, magnetic exchange coupling and spin cross over. **Unit-III:** **Inorganic Polymers** Classification, types of inorganic polymerization, comparison with organic polymers, boron-oxygen, boron-nitrogen, phosphorus-nitrogen, sulfur-nitrogen, sulfur-nitrogen-fluorine compounds, silicones.	

	Structure of solids Structure of compounds of AX, AX_2, AmX_2, ABX_3, spinels and inverse spinel structures. **Nuclear Chemistry** Nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis. **SUGGESTED BOOKS:** 1. Inorganic Chemistry Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter, R. A. Keiter, 4th ed., Pearson Education India, 2006. 2. Inorganic Chemistry, Gary L. Miessler, Paul J. Fischer, Donald A. Tarr**,** 5th ed., Upper Saddle River, N.J: Pearson Education, 2014. 3. Molecular Symmetry and Group Theory, Robert L. Carter, Wiley, 2008. 4. Modern Nuclear Chemistry, Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg, Wiley, 2017.	
CHE402	**Quantum Mechanics and Chemical Dynamics-I**	**3**
	Unit-I: **Quantum Mechanics** Failures of classical mechanics, Introduction to quantum mechanics, Schrödinger wave equation: time-independent and time dependent, Application to exactly solvable problems: translational motion, vibrational motion, rotatory motion, tunnelling, wave functions and energies of hydrogen-like systems orbital-radial functions, radial distribution functions, angular functions and their plots, Stern-Gerlach experiment. **Unit-II:** **Chemical Dynamics** Review of theories of reaction rate-collision theory and transition state theory, Significance of energy of activation, temperature	

	coefficient and its evaluation. Thermodynamical formulation of reaction rates, reaction between ions in solutions –Concept of steady state kinetics, chain reactions –photochemical and thermal reactions and examples **Unit-III:** **Surface chemistry** Types of adsorption isotherms, estimation of surface area, surface tension and surface energy, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), surface film on liquids (electro-kinetic phenomena), catalytic activity of surfaces. **Kinetics of homogeneous catalysis** Concepts of catalysis, acid-base, enzyme catalysed, and autocatalyzed reactions and examples **SUGGESTED BOOKS:** 1. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 9th ed., 2011. 2. Physical Chemistry: A Molecular Approach, Donald A. McQuarrie and John D. Simon, Viva, New Delhi, 2001. 3. Quantum Chemistry, I. N. Levine, Prentice Hall, New Jersey, 6th ed., 2008. 4. Quantum Chemistry, R. K. Prasad, New Age International, 4th rev. ed., 2010. 5. Kinetics and Mechanism – A. A. Frost and R. G. Pearson, John-Wiley, New York, 1961. 6. Kinetics and Mechanism of Chemical Transformations- J. Rajaram and J. C. Kuriakose, Mc Millan, 2011. 7. Physical chemistry of surfaces A. W. Adamson and A. P. Gast. 6th ed. 1997	
CHE403	**Basics of Organic Chemistry-I**	**3**
	Unit-I:	

	Basic concepts of organic chemistry Review of basic concepts in organic chemistry: bonding, hybridization, inductive effect, resonance effect, hyperconjugation, tautomerism and steric effect. The concept of aromaticity: delocalized chemical bonding, conjugation, cross conjugation, aromaticity, Huckel's rule, examples of neutral and charged aromatic systems (including annulenes, azulene, tropone and tropolone, benzenoids, mesoionic compounds). Anti and homo-aromatic systems. Alternant and non-alternant hydrocarbons, energy levels in odd and even-alternant hydrocarbons, benzyl cation, benzyl free-radical and benzyl carbanion. **Unit-II:** **Reaction Mechanisms** Generation, structure, stability, and reactivity of reaction intermediates: carbocations, carbanions, carbon free radicals, carbenes, and nitrenes. Classification of reactions and mechanisms; thermodynamic and kinetic controlled reactions, Hammond postulate, Curtin-Hammett principle. Potential energy diagrams, transition states, and intermediates. Methods of determining mechanisms: based on the structure of products, determination of the presence of intermediates, isotopic labeling, isotope effects, stereochemical evidence. Acids and bases: hard and soft acids and bases, effect of structure on the strengths of acids and bases. **Heterocyclic compounds** Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyrimidine, purine and indole. **Unit-III:** **Stereochemistry** Projection formula and interconversion of projection formulas. Elements of symmetry, concepts of chirality and molecular	

	asymmetry, chirality in compounds without stereogenic center. Optical isomerism: D-L conventions. CIP rules, R-S and M-P conventions, threo and erythro nomenclature. Geometrical isomers: E and Z nomenclature. Homotopic, enantiotopic and diastereotopic atoms, groups and faces. Conformational analysis of 5, and 6 membered cycloalkanes Nomenclature and conformations of fused rings and bridged ring systems. ORD, CD, and cotton effect **SUGGESTED BOOKS:** 1. Advanced Organic Chemistry-Reactions, Mechanism, and Structure, Jerry March, ed.John Wiley 2008. 2. Stereochemistry of Organic Compounds, D. Nasipuri, 3rd ed., New-Age International, 2011. 3. Organic chemistry, J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford University Press, 2004. 4. Stereochemistry of Organic Compounds, S. H Wilen and E. L Eliel, Wiley, 2008. 5. Basic stereochemistry of organic molecules, S. S. Gupta, Oxford University Press, 2014. 6. Stereochemistry of Organic Compounds, D. Nasipuri, 3rd ed., New-Age International, 2011.	
CHE404	**Basics in Chemical Analysis-I**	**3**
	Unit-I: **Data handling and statistical methods** Accuracy and precision, error and types of error, significant figures, rounding off, standard deviation, confidence limits, tests of significance, rejection of results, least squares, correlation coefficient. **Acid – Base Titrations** Basic principles, titration curves for mono functional acids and	

bases, pH calculations, titration curve for diprotic system, theory of indicators.

Redox Titrations

Equilibrium constants for redox reactions- electrode potentials in equilibrium systems; calculation of equilibrium constants; redox titration curves- formal redox potentials; derivation of titration curves; redox indicators; structural aspect of redox indicators; specific and nonspecific indicators; choice of indicator. Sample preparation- pre-reduction and pre-oxidation.

Unit-II:

Complexometric titrations

Organic complexing agents; amino carboxylic acid titration; EDTA; acidic properties of EDTA; EDTA complexes with metal ions; equilibrium calculations involving EDTA in solution; condition of formation constants; EDTA titration curves; effect of other complexing agents on EDTA; indicators for EDTA titrations; theory of common indicators; titration methods using EDTA- direct titration, back titration and displacement titration; indirect determinations; titration of mixtures; selectivity, masking and damasking agents; applications of EDTA titrations- hardness of water.

Precipitation titrations

Solubility product. Theoretical principles: titration curves, End point detection: Volhard and Fajans titration.

Unit III

Karl-Fischer titrations

Titration method and application

Gravimetric analysis

Introduction; properties of precipitates and precipitating reagents; completeness of precipitates; super saturation and precipitate formation; particle size and filterability of precipitates; colloidal

	precipitates; crystalline precipitates; purity of the precipitate; co-precipitation, post precipitation; conditions for precipitation; fractional precipitation; precipitation from homogenous solution; washing of precipitates; drying and ignition of precipitates; calculation of results from gravimetric data; applications. **SUGGESTED BOOKS:** 1. Vogel's Text Book of Quantitative Chemical Analysis; J. Mendham, J.R. C Denney, J.D. Barnes M. Thomas, B. Sivasankar, B . 6th Edn.; 2009 2. Analytical Chemistry; G. D. Christian, 5th Edn, John Wiley and Sons, NY. 3. Fundamentals of analytical chemistry 9th Edn.; Douglas A. Skoog, Donald M. West, F. James Holler, Stanley R. Crouch, publisher Mary Finch.	
CHE441	**Laboratory Techniques in Physical Chemistry – I**	**3**
	I. Adsorption 1. Verification of Freundlich and Langmuir adsorption isotherm: charcoal-acetic acid or charcoal-oxalic acid system. 2. Determination of the concentration of the given acid using the isotherms. **II. Phase diagrams** 1. Construction of phase diagrams of simple eutectics. 2. Construction of phase diagram of compounds with congruent melting point: diphenyl amine-benzophenone system. 3. Effect of (KCl/succinic acid) on miscibility temperature. 4. Construction of phase diagrams of three component systems with one pair of partially miscible liquids. **III Viscosity** 1. Determination of viscosity of pure liquids using Survismeter. 2. Determination of the composition of binary liquid mixtures using	

	viscosity data. 3. Determination of the molecular weight of a polymer. **IV. Surface tension** 1. Determination of the surface tension of a liquid by Survismeter. 2. Determination of Parachor values. 3. Determination of the composition of two liquids by surface tension measurements using Survismeter. 4. Determination of interfacial tension of two immiscible liquids with Survismeter. **V. Chemical Kinetics** 1. Kinetics of Ester Hydrolysis (acid catalyzed)-Determination of the rate constant. 2. Kinetics of Ester Hydrolysis (base catalyzed)-Determination of order of the reaction 3. Kinetics of reaction between $K_2S_2O_8$ and KI. Influence of ionic strength on the rate constant of the reaction between $K_2S_2O_8$ and KI **SUGGESTED BOOKS:** 1. Practical Physical Chemistry A. Finlay and J. A. Kitchener, Longman. 2. Experimental Physical Chemistry, F. Daniels and J. H. Mathews, Longman. 3. Practical Physical Chemistry A. M. James, Churchil. 1967 4. Experimental Physical Chemistry D. P. Shoemaker and C. W. Garland, McGraw-Hill.	
CHE442	**Laboratory Techniques in Organic Chemistry –I**	**3**
	1. Organic synthetic techniques (purification) a. Simple distillation: Ethanol-water mixture using water condenser, nitrobenzene and aniline using air condenser. b. Steam distillation: Naphthalene from its suspension in water or Clove oil from cloves or separation of o-and p- nitrophenols. c. Crystallisation: Concept of induction of crystallization	

i. Crystallisation of phthalic acid from hot water using fluted filter paper and stemless funnel.
ii. Acetanilide from boiling water or naphthalene from ethanol (any one).
iii. Decolorisation and crystallization of brown sugar (sucrose) with animal charcoal using gravity filtration.

d. Sublimation: camphor and succinic acid

2. Organic Synthesis

a. Aliphatic electrophilic substitution : Preparation of iodoform from ethanol & acetone.
b. Oxidation: i) Benzoic acid from toluene ii) Cyclohexanone from cyclohexanol iii) Borneol to camphor using jones reagent (any one)
c. Reduction : p-nitrophenyl methylcarbinol from p-nitro acetophenone by $NaBH_4$ and purification of the product through distillation under reduced pressure.
d. Bromination of an alcohol using CBr_4/ triphenylphosphine.
e. Grignard reaction : Triphenylmethanol from benzoic acid ester or benzophenone.
f. Aldol condensation: Dibenzal acetone from Benzaldehyde
g. Acetoacetic ester condensation: Preparation of ethyl-n-butyl acetoacetate.
h. Cannizzaro reaction using 4-chlorobenzaldehyde as substrate.
i. Friedel Crafts reaction: using toluene and succinic anhydride.
j. Solventfree preparation of coumarin by the Knoevenagel condensation under MW irradiation.

SUGGESTED BOOKS:

1. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Organic Experiments, K.L.Williamson, D. C. Heath.
Experimental Organic Chemistry, Vol I & II,

	3. Vogel's Textbook of Practical Organic Chemistry, A. R. Tatchell,5th Ed., John Wiley. 1989	
	M. Sc. Chemical Sciences **Second Semester**	
CHE451	**Group Theory and Advance Inorganic Chemistry-II**	3
	Unit-I: **Group Theory** Classification of Groups; Matrix representation of symmetry elements and point groups, matrices of C_2v, C_3v point groups, transformation matrices; structure of character tables, Reducible representations, determination of symmetry species for translations and rotations. **Applications of Group Theory** Vibrational Spectroscopy, Crystal Field Theory, MOT and formation of hybrid orbitals in different covalent molecules. **Unit-II:** **Chemistry of inorganic rings, cages and metal clusters** Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds, metal carbonyls, and halide clusters. **Inner transition elements** Spectral and magnetic properties, redox chemistry, analytical applications. **Unit III:** **Synthesis, Structure and Bonding in Organometallic Compounds** Introduction, classification, nomenclature, valence electron count, Ligands in organometallic chemistry; carbonyls, nitrosyls, hydride and dihydrogen, phosphine, ethylene and related ligands, cyclopentadiene and related ligands, alkyl, aryl, carbenes, carbynes, carbidos. **SUGGESTED BOOKS:**	

	1. Inorganic Chemistry Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter, R. A. Keiter, 4th ed., Pearson Education India, 2006. 2. Inorganic Chemistry, 6th Ed., Weller, Overton , Rourke, Armstrong, Oxford University Press, New York, 2015. 3. Chemical Applications of Group Theory, F. A. Cotton, 3rd ed. Reprint, John Wiley and Sons, New York, 1999. 4. Inorganic Chemistry, Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, 5th ed., Upper Saddle River, N. J: Pearson Education, 2014. 5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins and C. H. Langford, Oxford University Press, New York, 2006. 6. The Organometallic Chemistry of the Transition Metals, Robert H. Crabtree, 6th Ed., Wiley, 2014.	
CHE452	**Thermodynamics and Electrochemistry-II**	**3**
	Unit-I: **Thermodynamics** Thermodynamic functions, Concepts of partial molar properties –Gibbs-Duhem equation, Gibbs-Duhem-Margulus equation. Determination of partial molar volume: Graphical method, intercept method and Apparent molar volume method. Fugacity and determination by graphical method and compressibility factor method. Activity and activity coefficient: Determination of activity coefficient by EMF and solubility method. Thermodynamics of non-ideal system-Excess thermodynamic functions. **Unit-II:** **Phase Rule** Derivation of phase rule from the concept of chemical potential. Application of Phase Rule to three components system: Principle of triangular diagram: Plots for a mixture of three liquids consisting of one, two and three pairs of partially miscible liquids; colligative properties.	

	Unit-III: **Electrochemistry** Conductance, electrolytic, specific, equivalent and molar conductance. Ionic mobility; determination and calculation, Transport number and determination, Kohlrausch's law and application, molar ionic conductance and ionic mobility, applications of conductance measurements. **SUGGESTED BOOKS:** 1. Thermodynamics J. Rajaram and J. C. Kuriacose, East-West Press, 3rd ed., 2. Modern Electrochemistry Vol-1 and 2 J. O. M Bockris and A. K. N. Reddy, Plenum, New York 1978. 3. Text book of Physical Chemistry, Samuel Glastone, 2nd ed., Mac Millan India Ltd. (1991)	
CHE453	**Organic Reaction Mechanisms-II**	3
	Unit-I: **Nucleophilic substitution reactions** Revision of different nucleophilic substitution reaction S_N1, S_N2, S_Ni etc. Neighbouring group participation with reference to classical and non-classical carbocation. **Electrophilic substitution reactions** S_E2, S_E1 and S_Ei reactions. **Unit-II:** **Aromatic Substitution Reactions** Electrophilic substitution reactions: The arenium ion mechanism; Nucleophilic substitution reactions: The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. **Reactivity** Effect of substrate structure, leaving group and attacking	

nucleophile. Goldberg reaction, Bucherer reaction, Schiemann reaction, Von Richter reaction, Sommelet-Hauser and Smiles rearrangements.

Addition Reactions

Addition to carbon-carbon multiple bonds: mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals. Regio, stereo and chemoselectivities. Orientation and reactivity. Mechanism of metal hydride reduction (NaH, LiH, $LiAlH_4$, $NaBH_4$) of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds.

Unit-III:

Elimination Reactions

The E^2, E^1 and E^1cB mechanisms and their spectrum. E^2C and E^2H mechanisms. Orientation of the double bond.

Rearrangements

Hoffmann, Curtius, Lossen and Schmidt, Beckmann,

Wagner-Meerwein, Pinacol-Pinacolone, Fries, Wolff, Benzil-benzilic acid, Arndt-Eistert reaction, Tiffeneau-Demjanov reaction, Firtsch-Buttenberg-Wiechell. Stevens, Wittig and Favorskii, Dienone-phenol, Baker-Venkatraman rearrangement. Baeyer-Villiger oxidation. Neber Benzidine rearrangement.

SUGGESTED BOOK:

1. Advanced Organic Chemistry–Reactions, Mechanism and Structure, Jerry March 7th Ed., John Wiley (2013).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).

CHE454	Spectroscopic Methods-II	3
	Unit-I: **Ultraviolet and Visible Spectroscopy** Classification of electronic transitions, Terminology, substituent and solvent effects, UV spectral study of alkenes, polyenes, enones and aromatic compounds. Empirical rules for calculating λ_{max}. **IR Spectroscopy** Sampling techniques, Group frequencies, factors affecting group frequencies, bond order, mass effect, conjugation, inductive, resonance, steric effects, intramolecular interactions. application of IR in the study of H-bonding and tautomerism. Complementarity of IR and Raman. Problems using UV and IR. **Unit-II:** **Nuclear Magnetic Resonance Spectroscopy** Introduction, Magnetic properties of nuclei-Resonance condition, Nuclear spin, population of nuclear spin levels and NMR isotopes, relaxation methods, Instrumentation handling; classical approach and FT-NMR. chemical shift, factors influencing chemical shifts, Pascals triangle-low and high resolution, reference compounds Karplus Curve, diamagnetic and paramagnetic effects and magnetic anisotropy. equivalence of protons-chemical and magnetic equivalence; Spin systems: first order and second order coupling of AB systems, simplification of complex spectra. CIDNP, Nuclear Over Hauser effect (NOE), Factors influencing coupling constants and Relative intensities. **^{13}C NMR Spectroscopy** Types of CMR spectra-undecoupled, proton decoupled, Off-resonance decoupled (SFORD); Selectively decoupled and gated decoupled spectra. ^{13}C chemical shifts of aliphatic and aromatic compounds; Factors affecting the chemical shifts. Applications of ^{13}C NMR spectroscopy. NMR problems	

	Unit-III: **Mass Spectrometry** Basic principles- instrumentation; Ion production: Soft ionization methods: Low energy electron ejection; Chemical ionization; Fast-atom bombardment (FAB), Plasma desorption (PD) and Matrix Assisted Laser Desorption/ionization (MALDI); Electrospray ionization (ESI); Mass spectrum: Unit mass molecular ion and isotope peaks; High resolution molecular ion; recognition of the molecular ion peak; Use of molecular formula; Fragmentation of pattern for common organic compounds; Composite problems; Use of HRMS to determine exact molecular weight of compounds; Application of UV, IR, NMR and mass methods in the structural elucidation of organic compounds **SUGGESTED BOOKS:** 1. Organic spectroscopy, W. Kemp, ELBS London, 2000. 2. Spectrometric identification of organic compounds, 6th ed., R. M. Silverstien, and F. X. Webster, 2004. 3. Mass spectroscopy a foundation course. K. Downard, RSC, Cambridge, 2004.	
CHE491	**Laboratory Techniques in Inorganic Chemistry –I**	3
	Qualitative and Quantitative Analysis: 1. Qualitative analysis of mixture of salts (soluble and insoluble) containing six radicals including one less common metal ions-Tl, Mo, W, Se, Ti, Zr, Th, Ce, V, and U. 2. Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe involving volumetric and gravimetric methods. 3. Preparation, purification and structural studies (magnetic, electronic and IR) of inorganic complex compounds (any 5 only):	

	a. trans-potassium diaquabis(oxalato)chromate(III) trans-$K[Cr(ox)_2(H_2O)_2]$. b. vanadyl bis(acetylacetonate) $[VO(acac)_2]$. c. sodiumdiamminetetrathiocyanatochromate(III), $Na[Cr(NH_3)_2(SCN)_4]$. d. bis(acetate)chromate(II), $[Cr(OAc)_2].2H_2O$. e. cis-potassium diaquabis(oxalato)chromate(III) cis-$K[Cr(ox)_2(H_2O)_2]$. f. tris(acetylacetonato)manganese(III), $[Mn(acac)_3]$ g. potassium trioxalatoferrate(III) trihydrate $K_3[Fe(C_2O_4)_3]. 3H_2O$. h. Prussian blue, $Fe_3[Fe(CN)_6]_3$. i. sodium hexanitritocobaltate(III), $Na_3[Co(ONO)_6]$. j. Schiff base complexes of cobalt and nickel. **SUGGESTED BOOKS:** 1. Advanced Practical Inorganic Chemistry, Gurdeep Raj, 23rd Ed, Krishna Prakashan Media, Goel Publishing House, Agara, U.P., India, 2013. 2. Vogel's Qualitative Inorganic Analysis, G. Svehla, 7th Ed., Prentice Hall, 2013. 3. Advanced Experimental Inorganic Chemistry, Ayodhya Singh, Ayushaman Publication House, 2012. 4. Applied Analytical Chemistry, Vermani O P., New Age International Publisher, New Delhi, (2005)	
CHE492	**Laboratory Techniques in Organic Chemistry -II**	**3**
	1. Organic mixture separation Separation of ternary mixtures by detection of extra elements in organic compounds by non-breakable sodium ignition apparatus (NOSIA) **2. Multistep organic synthesis**	

	a) Preparation of oxidizing agent and its use b) Preparation nitro compound and its derivative c) Preparation of organic compounds by Mannich reaction and Doebner modification of Knoevengel reaction. **3. Chromatographic Techniques** Paper, thin layer and column chromatography 4. Draw structures using ChemDraw 5. Prediction of structure using IR, NMR and Mass. **SUGGESTED BOOKS** 1. Experiments and Techniques in Organic Chemiatry, D. Pasto, C. Johnson and M. Miller, Prentice Hall. 2. Organic Experiments, K.L.Williamson, D. C. Heath. Experimental Organic Chemistry, Vol I & II, 3. Experimental Organic Chemistry, Vol. I, P. R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGraw Hill.	
	M. Sc. Chemical Sciences **Third Semester**	
CHE501	**Advanced Inorganic Chemistry-III**	**3**
	Unit I: **Redox Reactions by Excited Metal Complexes** Charge transfer spectra; Intra ligand and charge transfer to solvent state, metal complexes as redox reactants, reducing and oxidizing properties of $Ru(bipy)_3$, comparison with $Fe(bipy)_3$, role of spin-orbit coupling, applications of redox processes of low energy reactants into high-energy products and chemical energy into light, water photolysis, metal colloids, dye sensitized solar cell. **Unit-II:** **Inorganic Reactions Mechanisms** Metal ligand equilibrium in solution, kinetically indistinguishable schemes, rate scale, mechanistic simulation; associative, dissociative,	

	interchange, nucleophilic, electrophilic pathways; cross reactions and Marcus-Hush theory, Hammett relation. **Substitution Reactions** Square planar and octahedral complexes, inorganic nucleophilicity scales, proton ambiguity, kinetics of chelate formation. **Redox reactions** Electron transfer reactions, mechanism of one-electron transfer reactions, outer sphere type reactions, inner sphere type reactions. **Photochemical Reactions** **Unit III:** **Organometallics Reactions and Catalysis** Reactions involving gain and loss of ligands, reactions involving modification of ligands, Metathesis reactions; σ-bond meta thesis, π-bond metathesis and Ziegler-Natta polymerization, Commercial Catalytic process; homogeneous, heterogenous and hybrid catalysts, Isolobal analogy. **SUGGESTED BOOKS**: 1. Topics in Current Chemistry, Ed. Vincenzo Balzani, Sebastiano Campagna, Springer, 2007. 2. Inorganic Chemistry, Gary L. Miessler, Paul J. Fischer, Donald A. Tarr, 5th ed., Upper Saddle River, N. J: Pearson Education, 2014. 3. Inorganic and Organometallic Reaction Mechanisms, J. D. Atwood, 2nd Ed., VCH, New York, 1997.	
CHE502	**Applied Physical Chemistry-III**	**3**
	Unit-I: **Electronic structure of solids** Free electron theory of solids, results of free electron theory; limitations and success of free electron theory, Fermi distribution, Fermi sphere, volume of Fermi sphere, expression for energy levels in a solid, density of states, expression for the number of energy	

	levels in a Fermi sphere. **Electrical properties of Solids** Electronic conductivity: Ohm's law, derivation of Ohm's law, Hall Effect, Band theory, Zone theory, Brillion zones, K-space, k-vector, Significance of k-vector, semiconductors, energy bands in a semiconductor, temperature dependence of conductivity in metals and semiconductors, intrinsic and extrinsic semiconductors, Insulators, Piezo and inverse Piezo electric effect. ferro, and pyroelectricity, magnetic properties **Unit-II: Crystal Defects** Point defects; Schottky, Frenkel and interstitial, line defects and plane defects. Non-stoichiometric defects. **Heat Capacity of Solids** Definition, Theories of heat capacity of solids: Dulong-petit, Einstein's theory, Debye Theory. Problems and their solution**.** **Superconductivity** Features of Superconductors, BCS theory, Meisner effect, Type I and Type II superconductors, Frolich diagram, Cooper pairs. **Unit-III:** **Concepts in Electrochemistry** Electrochemical cell; conduction, reactions; Faradic and non-Faradic currents; reversible and irreversible cells; EMF series; standard electrode potential; Nernst equation; calculation of cell potential; effect of current; ohmic potential; polarization; decomposition potential; over voltage; concentration polarization; reference electrodes hydrogen electrode, calomel, and silver/silver chloride; metallic electrodes- electrodes of first, second and third kind; membrane electrodes- classifications and properties; principle, design; theory of ion selective electrodes; glass electrode. Polarographic, amperometry and voltammetry. **SUGGESTED BOOKS:**	

	1. Physical Chemistry, P. W. Atkins, Julio de Paula, ELBS, 9th ed., 2011. 2. Introduction to solids, L.V. Azoroff, McGraw Hill Book Co., New York, 1960. 3. Introduction to solids, L.V. Azoroff, McGraw Hill Book Co., New York, 1960. 4. Solids State Physics, N.W. Ashcroft and N. D. Mermin, Holt Saunders International Ltd., New York 1976. 5. Analytical Chemistry; G. D. Christian, 5th ed., John Wiley and Sons, NY. 6. Modern Electrochemistry Vol-1 and 2 J. O. M Bockris and A. K. N. Reddy, Plenum, New York 1978.	
CHE503	**Photochemistry and Pericyclic Reactions-III**	**3**
	Unit-I: **Radical and carbene chemistry** Generation and reactions of free-radicals: radical abstraction reactions; nitrogen and oxygen centred cleavage; radical reactions involving nitroso and oximes; hydrogen abstraction reactions; radical addition reactions. Carbenes; generation and reactions of diazo compounds, cyclopropanation reactions. **Unit-II:** **Photochemistry** Photochemistry of functional groups: i) Olefins: Cis-trans isomerism, [2 + 2]-cycloaddition, rearrangements. Reaction of conjugated olefins; di-π-methane rearrangements (including oxa- and aza- di-π-methane rearrangements). ii) Ketones: excited state of C=O. Norrish type-I and type-II cleavages. Paterno-Buchi reaction. α,β-unsaturated ketones. [2+2] addition. Rearrangement of cyclohexadienones Cycloaddition of singlet molecular oxygen {[2+2], [4+2]-additions}. Oxidative coupling of aromatic	

	compounds, photoreduction by hydrogen abstraction. **Unit-III:** **Pericyclic reactions** Molecular orbital symmetry, Woodward-Hoffmann correlation diagrams. FMO and PMO approaches (any one); Electrocyclic reactions: Cycloadditions: selectivities in Diels-Alder reactions, Hetero Diels-Alder reaction. cheletropic reactions. Sigmatropic rearrangements: including Walk, Ene, Claisen, Cope, oxy and aza-Cope rearrangements. **SUGGESTED BOOKS:** 1. Advanced Organic Chemistry–Reactions, Mechanism and Structure, Jerry March 7th Ed., John Wiley (2013). 2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990). 3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).	
CHE504	**Separation Techniques-III**	**3**
	Unit-I: **Partition Chromatography** Introduction; theory; technique of partition chromatography; Liquid-liquid partition chromatography; reversed phase partition chromatography; stationary support materials Paper Chromatography- introduction; principle; theory; types; technique; choice of solvent; two-dimensional paper chromatography; applications; **Thin Layer Chromatography (TLC)** Definition; mechanism; efficiency of thin layer plates; methodology (technique); **Unit-II:**	

	Column Chromatography Definition; types; principle; elution in column chromatography experimental requirements; theory of development; Van Deemeter equation and its modern version; qualitative and quantitative analysis; applications. **Gel permeation chromatography** Gel chromatography; mechanism of gel permeation chromatography (GPC); instrumentation and applications. **Unit III:** **Gas Chromatography** Introduction; definition; instrumentation; technique; applications; HPLC: Theory, principles, instrumentation, applications. **Hyphenated Techniques** Coupled techniques; GC-FTIR, GC-MS, LC-MS, MS-MS. **SUGGESTED BOOKS:** 1. Analytical Chemistry; G. D. Christian, 5th Edn., John Wiley and Sons, NY 2. Instrumental Methods of Inorganic Analysis; A. I. Vogel, ELBS 3. Fundamentals of Analytical Chemistry; D. A. Skoog; D. M. West, F. J. Holler, 7th Edn 4. Vogel's Text Book of Quantitative Chemical Analysis; J. Mendham, J RC Denney, J. D. Barnes M. Thomas, B. Sivasankar, B . 6th Edn.; 2009	
	M. Sc. Chemical Sciences **Third Semester**	
CHE541	**Laboratory Techniques in Physical Chemistry -III**	**3**
	I. **Polarimetry** 1. Kinetics of the inversion of sucrose in presence of HCl. 2. Determination of the concentration of a sugar solution. 3. Determination of the concentration of HCl.	

4. Determination of the relative strength of acids.

II. **Refractometry**

1. Identification of pure organic liquids and oils.
2. Determination of molar refractions of pure liquids.
3. Determination of concentration of solutions (KCl-water, glycerol-water).
4. Determination of molar refraction of solids.
5. Study of complex formation between potassium iodide and mercuric iodide system.

III. Distribution law

1. Distribution coefficient of iodine between an organic solvent and water.
2. Distribution coefficient of benzoic acid between benzene and water.
3. Determination of the equilibrium constant of the reaction $KI + I_2 \leftrightarrow KI_3$

IV. Conductivity Measurements

1. Verification of Onsager equation.
2. Determination of the degree of ionization of weak electrolytes.
3. Determination of pKa values of organic acids.
4. Determination of solubility of sparingly soluble salts.
5. Titration of a mixture of acids against a strong base.
6. Titration of a dibasic acid against a strong base.

V. Potentiometry

1. Determination of single electrode potentials (Cu and Zn).
2. Application of Henderson equation.
3. Titration of a mixture of acids against a strong base.
4. Determination of end point of a titration using Gran Plot.
5. Determination of the concentration of a mixture of Cland Iions.

SUGGESTED BOOKS:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel

	Publishing House, 2001. 2. Experiments in Physical Chemistry, G. W. Garland, J.W. Nibler, D. P. Shoemaker, 8 th Edn., McGraw Hill, 2009. 3. Practical Physical Chemistry, B. Viswanathan, Viva Pub., 2005.	
CHE542	**Laboratory Techniques in Inorganic Chemistry -III**	**3**
	I. Estimation and Separation (Any five): 1. Estimation of nitrogen by Kjeldahl's method. 2. Estimation of sulphur/halogen by fusion method. 3. Separation of Cu, Co, and Zn on paper strips. 4. Separation of Cu and Ni on cellulose column. 5. Separation and determination of Zn and Cd using Ion exchanger. 6. Separation and determination of Co and Ni using Ion exchanger. 7. Separation and determination of chloride and bromide using Ion exchanger. 8. Evparation and determination of chloride and iodide using Ion exchanger. 9. Separation and spectrophotometric determination of Cu, Fe, and Ni using Ion Exchanger. 10. Separation and determination of Cl^- and I^- (aqueous-acetone medium). **II. Solvent Extraction (Any five):** 1. Determination of Fe(III) by chloride extraction in ether. 2. Determination of Fe(III) as the 8-hydroxy quinolate (oxinate) by extraction in chloroform. 3. Quantitative analysis of tri-component mixture of metal ions by gravimetrically, volumetrically and spectrophotometrically. a. Mixed solution of Cu^{2+}- Ni^{2+}- Zn^{2+} b. Mixed solution of Cu^{2+}- Ni^{2+}- Fe^{3+} 4. Spectrophotometric determination: a. Manganese / Chromium / Vanadium in steel sample.	

	b. Iron-phenanthroline complex: Job's method of continuous variation. c. Zirconium-Alizarin red complex: slope ratio method. d. Phosphate, nitrate, fluoride and sulphate 5. Analysis of dolomite. 6. Analysis of brass. 7. Colorimetric determination of chromium (VI) (in ppm) using 1,5 diphenyl carbazide as a reagent for color development. **Suggested Books:** 1. Experiments in Inorganic Chemistry, Satya Prakash Mohanty , Sushil Chauhan, Campus Books International (2010). 2. Text Book of Quantitative Chemical Analysis, Bassett et al, 5th Edition, ELBS, Longmann, U.K., 1989. 3. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, 6th Edn, 2009. 4. Advanced Practical Inorganic Chemistry, G. Raj, 23rd Edition, Krishna Prakashan Media, Goel Publishing House, Agra, U.P., India, 2013.	
	M. Sc. Chemical Sciences **Fourth Semester**	
CHE551	**Advanced Inorganic and Nanochemistry** **/ Inorganic Spectral Techniques Elective-IV**	**3**
	Advanced Inorganic and Nanochemistry **Unit I:** **Principles and concepts of Green Chemistry** Introduction, definition, principles, atom economy, atom economic and atom uneconomic reaction, reducing toxicity, waste minimization techniques, on-site waste treatment, design for degradation, polymer recycling. **Catalysis and Green Chemistry** Introduction to catalysis, heterogeneous catalysis-basics, zeolites, sulfonated resins, clays, oxidation, catalytic converters;	

	homogeneous catalysis-transition metal catalysis, asymmetric catalysis; phase transfer catalysis, biocatalysis, photocatalysis. **Unit II:** **Nanochemistry** Introduction to nanomaterials, role of size in nanomaterials, nanoparticles, stability of nanoparticles, structures and classification of nanomaterials, properties of materials & nanomaterials. **Fabrication of Nanomaterials** Chemical, physical and biological methods. **Nanocomposites** Introduction, types of nanocomposite, core-shell structured nanocomposites. **Unit III:** **Supramolecular Chemistry** Molecular recognition, molecular receptors for different types of molecules including arisonic substrates, design, and synthesis of co-receptor molecules and multiple recognition, supramolecular reactivity and catalysis, transport processes and carrier design, supramolecular devices: electronic, ionic and switching devices, supramolecular photochemistry, some example of self-assembly in supramolecular chemistry. **Books Suggested:** 1. Green Chemistry: Frontiers in Benign Chemical Synthesis and Processes, Edited by Paul T. Anastas & Tracy C. Williamson, Oxford University Press, 1998. 2. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press, 2008. 3. Supramolecular Chemistry, J.M. Lehn, VCH, 2006.	
	Inorganic Spectral Techniques	

Unit I:

Nuclear Magnetic Resonance (NMR) spectroscopy

Signal intensities and spin-spin coupling to structure determination of inorganic compounds carrying NMR active nuclei like ^{11}B, ^{15}N, ^{19}F, ^{29}Bi, ^{31}P, coupling to quadrupolar nuclei, NMR of paramagnetic substances in solution.

Unit II:

Mossbauer Spectroscopy

Doppler shift and recoil energy, isomer shift and its interpretation, quadrupole interactions, effect of magnetic field on Mossbauer spectra, applications to metal complexes, metal carbonyls, Fe-S clusters and tin compounds.

Vibrational Spectroscopy

Applications of vibrational spectroscopy in investigating the stretching and bending modes of molecules (AB_3 and AB_4 types).

Unit III:

Electronic Paramagnetic Resonance (EPR) spectroscopy

Electronic Zeeman effect and EPR transition energy, EPR spectrometers, presentation of spectra. effects of electron Zeeman, Hyperfine splitting in isotropic systems, spin polarization mechanism and McConnell's relations Anisotropy in g-value, EPR of triplet states, zero field splitting, Kramer's rule, survey of EPR spectra of first-row transition metal ion complexes.

Nuclear Quadrupolar Resonance (NQR) spectroscopy*:* Quadrupolar moment, energy levels of a quadrupolar nuclease and effect of asymmetry parameters and energy levels, Effect of an external magnetic field, selected examples for elucidation of structural aspects of inorganic compounds using NQR spectroscopy.

Books Suggested:

	1. Ebsworth, E. A. O. Structural Methods in Inorganic Chemistry Blackwell Scientific Publications, 1991. 2. Physical Methods in Inorganic Chemistry Drago, PB, R. S, Affiliated East-West Press Pvt. Ltd.-New Delhi, 2012. 3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish, Ellis Hardwood, 1991. 4. Structural Methods in Molecular Inorganic Chemistry, D. W. H. Rankin, Norbert Mitzel, Carole Morrison, Wiley, 2013.	
CHE552	**Polymer Chemistry/Molecular Bio-physical Chemistry** **Elective-IV**	**3**
	Polymer Chemistry **Unit 1:** Classification of polymers, polymerization reactions and kinetics, Molar mass determinations, molecular Forces and chemical Bonding in polymers, solubility of polymers, thermal stability, theta solvents. Glass Transition Temperature, Polymer Degradation, Polymer Reactions, Thermodynamics and friccohesity of metallic and silicon polymers. **Unit 2:** Copolymerization: Basic, Types of co-polymerizations, Kinetics of free Radical Copolymerization, Binary copolymerization equation, Composition of copolymers, Step polymerization: Mechanism of step polymerization, polyfunctional step polymerization. Crystallinity in polymer: Degree of crystallinity, Determination of Crystallinity, Morphology of Crystalline Polymer. **Unit 3:** Polymer Synthesis: bulk polymerization, precipitation, Emulsion polymerization, Suspension polymerization, Interfacial polymerization, Methods for determination of average molecular weight of polymer: (colligative property measurement, Light Scattering method, Dilute solution viscometry survismetry, Ultra	

	Centrifugation,Weight Distribution Methods. Rheology of polymer: Structural stress and strain, survismetrically studies of silicon polymers, Rheological and interfacial properties of silicone oil emulsions **Books Suggested:** 1. Survismeter: Science vision and invention by Man Sing, New Delhi 2013. 2. Introduction to polymer chemistry C. E. Carraher New York CRC Press 2010. 3. Polymer chemistry by P. C Hiemenz New York CRC Press 2007.	
	Molecular Bio-physical Chemistry **Unit I**: **Molecular Bio-physical Chemistry** Electrophoresis- principles of free electrophoresis, zone electrophoresis, gel electrophoresis and its applications in qualitative and quantitative study of proteins. Determination of isoelectric point of a protein. Electroosmosis and streaming potential and its biological significance. Diffusion of solutes across bio membranes and its application in the mechanism of respiratory exchange. "Salting In" and "Salting Out" of proteins. **Unit II**: Osmotic behaviour of cells and osmoregulation and its application in the evolution of excretory systems of organisms. Effect of temperature and pH on the viscosity of biomolecules (albumin solution). Effect of temperature, solute concentration (amino acids) on surface tension. **Biological significance of surface tension** Application of sedimentation velocity and sedimentation equilibrium method for molecular weight determination of proteins. Surface	

	energy and friccohesity of particles in process of coagulation. **Unit III:** **Macromolecules** Polypeptides, helix random coil transition in polypeptides. Structure of proteins, Ramachandran plot, protein folding, protein denaturation, Hierarchy of protein structure, experimental methods to determine protein structure. **Structure of nucleic acids** Watson Crick model, supercoiled DNA, denaturation and renaturation of DNA, polymerase chain reactions. **Books Suggested:** 1. Introduction to Physical Organic Chemistry, R.D. Gilliom, Madison – Wesley, USA (1970). 2. Physical Organic Chemistry, Reaction Rate and Equilibrium Mechanism – L.P. Hammett, McGraw HillBook, Co., (1970). 3. Biophysical Chemistry, Principle and Technique – A. Upadhyay, K. Upadhyay and N. Nath, Himalaya Publishing House, Bombay, (1998).	
CHE553	**Advanced Organic Chemistry/ Organic Synthesis /Elective-IV**	
	Advanced Organic Chemistry **Unit-I:** **Optical activity in the absence of chiral atoms:** Chirality in biphenyls, adamentanes, ansa compounds, cyclophanes, *trans*-cyclooctene, catenanes, rotaxanes and helicenes. Chirality of organic compounds due to the presence of silicon, nitrogen, phosphorous, arsenic and sulphur atoms. **Functional group protection**; protection of NH groups, OH groups, Diols, Carbonyl groups, carboxyl group, double and triple bonds. **Unit-II:** **Retrosynthetic Analysis** Reversal of the carbonyl group polarity, steps in planning synthesis, construction of the carbon skeleton, functional group	

interconversion, linear and convergent synthesis, Synthesis of saturated heterocycles and 3-, 4-, 5- and 6-membered rings. Synthesis of some complex molecules using disconnection approach.

Unit III:

Formation of C-C single bonds using organometallic reagents

Organolithium reagents, Organo magnesium reagents, Organolithium reagents, Organocerium reagents, organocopper reagents, organochromium reagents, organozinc reagents, organoboron reagents, organosilicon reagents, palladium catalysed coupling reactions.

SUGGESTED BOOKS

1. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
2. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd Edn., 1998.
3. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd Edn., New Age International Publishers, 2001.
4. Designing organic synthesis: A disconnection approach, S. Warren, John Wiley & Sons, New York, 2nd Edn. 1987.
5. Advanced organic chemistry Part B, F. A. Carrey and J. Sundberg, Plenum Press, 1999.

Organic Synthesis

Unit-I:

Oxidation

Oxidation of alcohols to aldehydes and ketones, reagents for alcohol oxidation, chemo selective agents for oxidising alcohols, oxidation of tertiary allylic alcohols, oxidation carboxylic acids, oxidation of terminal alkynes, allylic oxidation of alkenes.

	Unit-II: **Reduction** Reduction of carbonyl compounds, nucleophilic reducing agents, electrophilic reducing agents, regio and chemoselective reductions, diastereoselective reduction of cyclic ketones, diastereofacial selectivity in reduction, enantioselective reductions. **Unit III:** Hydrogenation of carbon -carbon double bonds; dissolving metal reductions, hydroboration, organoboranes and asymmetric synthesis of alcohols from alkenes, oxymercuration- demercuration, epoxidation of alkenes, epoxides from halohydrins, preparation of epoxides from ketones, epoxidation of allylic alcohols, dihydroxylation of alkenes, halolactonisation. Reduction of carbon -carbon triple bonds; semi reduction of alkyne (Lindlar type catalyst), hydroboration of alkynes and enynes, preparation of trans-alkenes from alkynes, reduction of propargylic alcohols. **SUGGESTED BOOKS** 1. Modern synthetic reactions, H. O. House, W. A. Benjamin, California, 2nd ed. 1972. 2. Some modern methods of organic synthesis, W. Carruthurs, Cambridge Univ. Press, London, 2nd ed. 1978. 3. Advanced organic chemistry Part B, F. A. Carrey and J. Sundberg, Plenum Press, 1999.	
CHE554	**Advanced Analytical Methods/ Medicinal Chemistry Elective-IV**	**3**
	Advanced Analytical Methods **Unit -I:** **NMR Spectroscopy** CW and PFT techniques- types of C-NMR spectra- Homonuclear	

	(^{13}C ^{13}CJ) and heteronuclear (^{13}C–^{1}H, ^{13}C – ^{2}HJ) couplings. **Unit -II:** **2D- NMR** Correlation spectroscopy (COSY) - HOMOCOSY, HETERO – COSY, INADEQUATE NOESY. HSQC, HMBC and TOCSY. Applications **Unit -III:** **Mass spectrometry** principle, instrumentation, ionization methods-EI, CI, FAB, arc and spark, photo ionization; thermal ionization; FI and FD, ESI, APCI, laser induced, photoelectric ionization, SIMS, mass analyzers-magnetic, double focusing, time of flight; single and triple quadrupolar, ion trap, ion cyclotron resonance analyzer, MALDI. **SUGGESTED BOOKS** 1. Mass Spectrometry: A Textbook Gross, Jürgen H. 2nd ed., Springer, 2011. 2. Mass Spectrometry: Principles and Applications Edmond De Hoffmann, Vincent Stroobant J. Wiley, 20-Nov-2007. 3. Electrospray and MALDI Mass Spectrometry: Fundamentals, Instrumentations, Practicalities and Biological Applications *Ed.* Richard B. Cole J. Wiley 2010 4. Spectroscopic Identification of Organic Compounds; R.M. Silverstein and Webster 5. NMR in Chemistry – A Multinuclear Introduction; William Kemp 6. Understanding NMR Spectroscopy, Second Edition by James Keeler.	
	Medicinal Chemistry **Unit I:**	

	Pharmacokinetics, Pharmacodynamics, Theories of drug activity& Drug design Basics of drug receptor interactions. Theories of drug activity. Hansch equation. Computer-aided drug design and molecular modeling. **Antibiotics** Structure elucidation and synthesis of streptomycin, penicillins, cephalosporin-C, chloromycetin and tetracyclins (terramycin and aureomycin). **Antidiabetics** Sequence of A- & B- chains of insulin, glibenclamide, metformin, ciglitazone. **Antihistamines** Methapyrilene, chlorpheniramine. **Antivirals** Acyclovir, amantidine, rimantidine and zidovudine. **Unit II:** **Antineoplastic agents:** Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melaphan, uracil mustards and mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products. **Unit III:** **Cardiovascular drugs** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrite, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol, oxyprenol. **Local anti-infective agents**	

	Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, dapsone, aminosalicyclic acid, isoniazide, ethionamide, ethambutal, fluconazole, econozole, griseofulvin, chloroquin and primaquin. **SUGGESTED BOOKS** 1. Burger's Medicinal Chemistry and Drug Discovery, Vols. 1-6 Ed. D.J. Abraham, John Wiley, 2003 2. An Introduction to Medicinal Chemistry, P Graham, III Ed., Oxford, 2006 3. Medicinal Chemistry, N Weaver, Oxford, 2006 4. Goodman and Gilman's Pharmacological Basis of Therapeutics, 11th Edn., Tata McGraw-Hill, 2005. 5. The Organic Chemistry of Drug Design and Drug Action, R B Silverman,II Edn,Academic Press, Amsterdam, 2004. 6. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical chemistry, J H Block and J M Beale, Jr., Eds., Lippincott, Williams and Wilkins, 2003.	
CHE591	**Project**	**6**
TOTAL CREDITS		**72**