SCHEME & SYLLABUS

M.Sc Chemistry

Department of Natural Sciences

UISH

Sant Baba Bhag Singh University

2015 onwards

Index

Semester-I

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	CHM501	Group Theory, Symmetry and Ligand Field Theory	4:0:0	4:0:0	4	4
2	CHM503	Organic Reaction Mechanism-I	4:0:0	4:0:0	4	4
3	CHM505	Thermodynamics and Statistical Thermodynamics	4:0:0	4:0:0	4	4
4	CHM507	Spectroscopic Techniques for Organic Compounds	4:0:0	4:0:0	4	4
5	CSE551	Computers in Chemistry	3:0:0	3:0:0	3	3

II. Practical Subjects

1	CHM509	Inorganic Chemistry Practical-I	0:0:4	0:0:2	4	2
2	CHM511	Organic Chemistry Practical-I	0:0:4	0:0:2	4	2
3	CHM513	Physical Chemistry Practical-I	0:0:4	0:0:2	4	2
4	CSE 553	Computers in Chemistry-Lab-I	0:0:2	0:0:1	2	1
Total					**33**	**26**

Semester-II

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	CHM502	Organometallics Chemistry and Metal Clusters	4:0:0	4:0:0	4	4
2	CHM504	Organic Reaction Mechanism -II	4:0:0	4:0:0	4	4
3	CHM506	Quantum Chemistry and Chemical Dynamics	4:0:0	4:0:0	4	4
4	CHM508	Bonding and Reaction Mechanism in Inorganic Compounds	4:0:0	4:0:0	4	4
5	MAT528	Mathematics for Chemists(for B.Sc. Medical students)	3:0:0	3:0:0	3	3
6	BOT502	Biology for Chemists (for B.Sc. Non Medical students)				

II. Practical Subjects

1	CHM510	Inorganic Chemistry Practical-II	0:0:4	0:0:2	4	2
2	CHM512	Organic Chemistry Practical-II	0:0:4	0:0:2	4	2
3	CHM514	Physical Chemistry Practical-II	0:0:4	0:0:2	4	2
Total					**31**	**25**

Semester-III

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	CHM601	Inorganic Spectroscopy	4:0:0	4:0:0	4	4
2	CHM603	Organic Synthesis and Heterocyclic Chemistry	4:0:0	4:0:0	4	4
3	CHM605	Surface Chemistry and Electrochemistry	4:0:0	4:0:0	4	4
4	CHM607	Photochemistry and Pericyclic reactions	4:0:0	4:0:0	4	4

II. Practical Subjects

1	CHM609	Inorganic Chemistry Practical- III	0:0:4	0:0:2	4	2
2	CHM611	Organic Chemistry Practical- III	0:0:4	0:0:2	4	2
3	CHM613	Physical Chemistry Practical- III	0:0:4	0:0:2	4	2
Total					**28**	**22**

Semester-IV

I. Theory Subjects

S.No	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credits Hours
1	CHM602	Recent Trends in Inorganic Chemistry	4:0:0	4:0:0	4	4
2	CHM604	Natural Products and Plants as source of drugs/antibiotics	4:0:0	4:0:0	4	4
3	CHM606	Chemistry of Materials	4:0:0	4:0:0	4	4
4	CHM608	Bio-Inorganic and Bioorganic Chemistry	4:0:0	4:0:0	4	4

II. Practical Subjects

1	CHM610	Inorganic Chemistry Practical-IV	0:0:4	0:0:2	4	2
2	CHM612	Organic Chemistry Practical-IV	0:0:4	0:0:2	4	2
3	CHM614	Physical Chemistry Practical-IV	0:0:4	0:0:2	4	2
3	CHM600	Chemistry Project		0:0:3	6	3
Total					**34**	**25**

Semester	**I**
Course Code	**CHM501**
Course Title	**Group Theory, Symmetry and Ligand Field Theory**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	The main objective of group theory is to studies the algebraic structures known as groups. The concept of a group is central to abstract algebra: other well-known algebraic structures, such as rings, fields, and spaces. The group theory is closely related to representation theory and have many important applications in physics, chemistry, and materials science. Group theory is also central to public key cryptography.

Unit-I

Symmetry: Symmetry elements, symmetry operations and their matrix representation, group postulates, multiplication tables, point group determination, determination of reducible and irreducible representations, reduction formula for converting reducible representations into irreducible ones, character tables, construction of character tables for C_2v, C_3v (non-abelian group), use of symmetry in obtaining symmetry of orbitals in molecules, use of character table to determine which metal orbitals are used in σ and π bond formation in octahedral, tetrahedral and square planar transition metal complexes, qualitative splitting of s, p, and d orbitals in octahedral, tetrahedral and square planar fields using character tables and without the use of character tables.

Molecular Orbital Theory for Metal Complexes: Ligands symmetry orbitals and metal orbitals involved in molecular orbital formation in octahedral complexes, MOEL diagrams for octahedral, tetrahedral and square planar complexes showing σ and π bonding in transition metal complexes.

Unit-II

Interelectronic Repulsions: Spin-spin, orbital-orbital and spin-orbital coupling, LS and jj coupling schemes, determination of spectroscopic terms of p^n and d^n ions, determination of the ground state terms for p^n, d^n and f^n ions using L.S. scheme, determination of total degeneracy of terms, order of interelectronic repulsions and crystal field strength in various fields, two type of electron repulsion parameters, spin-orbit coupling parameters (λ), energy separation between different j states, The effect of octahedral and tetrahedral fields on S, P, D and F terms (with help of the character table), splitting patterns of and G, H and I terms.

Unit III

Free Ions in Medium and Strong Crystal Fields : Strong field configurations, transition from weak to strong crystal fields, evaluation of strong crystal field terms of d^2 configuration in octahedral and tetrahedral crystal fields (using group theory), construction of the correlation energy level diagrams of d^2 configuration in octahedral field, study of energy level diagrams for higher configurations, selection rules of electronic transitions in transition metal complexes, their proof using group theory, relaxation of the selection rule in centrosymmetric and non-centrosymmetric molecules, Orgel diagrams, Tanabe-Sugano diagrams.

Unit-IV

Electronic Spectra of Transition Metal Complexes: Variation of the Racah parameter, nephelauxetic effect central field covalency, spectrochemical series, band intensities, factors influencing band widths, discussion of electronic spectra of octahedral and tetrahedral d1 to d9 metal ions, calculation of 10Dq and B with use of Orgel and Tanabe Sugano diagrams, low spin complexes of Mn^{3+}, Mn^{2+}, Fe^{3+}, Co^{3+}, Fe^{2+}, comment on the spectra of second and third transition series, spectra of K_2MoCl_6 and $[Rh(NH_3)_6]^{3+}$ spectra of cis and trans$[Co(en)_2X_2]^+$, $[Mn(H_2O)_6]^{2+}$, $CuSO_4.5H_2O$ and its anhydrous complex, comparison of d–d band with f–f bands. Introduction to Charge Transfer Spectra**.**

Magnetic Properties: Van-Vlecks formula for susceptibility, first order Zeeman effect, second order Zeeman effect, KT states, quenching of orbitals angular momentum by ligand field, the magnetic properties of A and E terms, the magnetic properties of T terms, elecronic delocalization, magnetic properties of d^n and f^n metal ions**.** Anomalous magnetic moments, magnetic exchange coupling and spin crossover.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Chemical Application of Group Theory	F.A. Cotton	Wiley Eastern
2	Inorganic Chemistry, 3rd edition	G. L. Miessler, D. A. Tarr	Pearson Education
3	Introduction to Ligand Field	B.N. Figgis	Wiley Eastern
4	Inorganic Electronic Spectroscopy	A.B.P. Lever	Elsevier.
5	Introduction to Magnetochemistry	A. Earnshaw	Academic Press.
6	Advanced Inorganic Chemistry	F.A. Cotton and G. Wilkinson	Wiley Inter-science

Semester	**I**
Course Code	**CHM 503**
Course Title	**Organic Reaction Mechanism- I**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To learn the concepts of stereochemistry, conformational analysis and their Application in the determination of reaction mechanism. To understand the mechanism of nucleophilic and electrophonic substitution reactions.

Unit-I

Nature of Bonding in Organic Reactions: Aromaticity in Benzenoid and non-benzenoid compounds. Hucke Rule, Alternant and non alternant hydrocarbons. Energy levels of Π(pi) molecular orbitals in simple systems. Annulenes, Antiaromaticity, Homoaromaticity, PMO approach.

Stereochemistry: Elements of symmetry, chirality, molecules with more than one chiral center. Threo and erythro isomers, methods of resolution, optical purity. Prochirality – enantiotopic and diastereotopic atoms, groups and faces. Stereospecific and stereoselective synthesis. Asymmetric synthesis.Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes). Chirality due to helical shape.

Unit-II

Reaction Mechanism, Structure and Reactivity: Types of mechanisms in different reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control in product formation. Transition states and reaction intermediates, Isotope effects, Hard and Soft Acid Base concept, Study of reactive intermediates – Types of intermediates, isolation and detection of intermediates, trapping of intermediates.

Unit-III

Aliphatic Nucleophilic Substitution: The S_N2, S_N1 and S_Ni mechanisms, mixed S_N1 & $S_N2$mechanism, SET mechanism. The neighbouring group mechanism (anchimeric assistance). Neighbouring group participation by pi and sigma bonds, Classical non-classical & phenonium cations, Rearrangements in carbocations (general survey). Ester hydrolysis. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon.

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity in mono substituted and di substituted aromatics. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Gatterman-Koch reaction, Pechmann reaction, Houben – Hoesch reaction, Fries rearrangement.

Aromatic Nucleophilic Substitution: ArS_N1, ArS_N2 and ArSN via benzyne (Arynes) mechanisms. Reactivity effect of substrate structure, leaving group and nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

Unit-IV

Free Radical Reactions: Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity.Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation. Coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free Radical Rearrangement. Hunsdiecker reaction, Kolbe reaction, Hydroxylation of aromatics by Fenton's reagent.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Highlights of Organic Chemistry	W.J. L. Nobel	An Advanced Text Book
2	Advanced organic chemistry part-A. 5th Ed	F. A. Carey and R. J. Sundberg	Springer (2007)
3	A guidebook to mechanism in organic chemistry, 6th Ed	Peter Sykes	Orient Longman
4	Stereochemistry conformation and Mechanism	P. S. Kalsi	New Age International
5	Stereochemistry of carbon compounds	Ernest Eliel	McGraw Hill, New York (1962).

Semester	**I**
Course Code	**CHM505**
Course Title	**Thermodynamics and Statistical Thermodynamics**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	The main objective of this branch is to study, , the average behavior of a mechanical system in relation using probability theory with heat and temperature and their relation to energy and work.

Unit-I

Classical Thermodynamics: Brief resume of concepts of thermodynamics, free energy, chemical potential and entropy. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component system, second order phase transitions.

Unit-II

Statistical Thermodynamics: Concept of distribution law, thermodynamic probability and most probable distribution, Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers).Partition functions: Translational, rotational, vibrational and electronic partition function,

Unit-III

Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behavior of solids-chemical equilibria and equilibrium constants in terms of partition functions, Fermi-Dirac statistics, distribution laws, and application to metals. Bose-Einstein statistics- distribution law and application to helium.

Unit-IV

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

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Thermodynamics for Chemists	S. Glasstone	East West Press, New Delhi (1950).

2	Thermodynamics for Students of Chemistry	J. Rajaram and J.C. Kuriacose	Lal Nagin Chand, New Delhi (1986).
3	Elements of Chemical Thermodynamics	L.K. Nash	Addision Wesley (1962).
4	Introduction to statistical thermodynamics	T. L. Hill	Addison-Wesley Publishing

Semester	**I**
Course Code	**CHM507**
Course Title	**Spectroscopic Techniques for Organic Compounds**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To detect functional groups of organic compounds by means of its IR spectra, structure of organic compounds by NMR, fragmentation of compounds in vapour state, transitions involving in organic compounds.

Unit-I

Nuclear Magnetic Resonance: The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW & FT method), solvent used. Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, ring current and aromaticity. Shifts for H and 13C. - Spin-spin interactions, Low and High resolution spectra with various examples, Correlation of H bound to carbon, H bound to other nuclei such as nitrogen, oxygen, sulphur, Complex spin-spiinteraction, between two or more nuclei. Effect of chemical exchange, fluxional molecules, Hindered rotation on NMR spectrum Karplus relationship, nuclear magnetic double resonance, chemically induced dynamic nuclear polarization. Brief introduction to multipulse NMR spectroscopy, Application of structure elucidation of simple organic molecules Lanthanide shift.

Unit-II

Mass Spectroscopy: Introduction, ion production –EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional group, molecular ion peak, meta stable peak, Reteroiels – Alder fragmentation. Mclafferty rearrangement. Nitrogen rule, high resolution mass spectrometery. Example of mass spectral fragmentation of organic compounds with respect to their structure determination.

Unit-III

Ultraviolet and Visible Spectroscopy: The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient. The Frank Condon Principle. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, factors affecting max, Effect of steric hindrance to coplanarity, Solvent Effects. Applications of U.V. spectroscopy.

Unit-IV

Infrared Spectroscopy: Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration, Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect). Sampling Techniques, Absorption of Common functional Groups, Interpretation, Finger print Regions. Applications of Infrared spectroscopy

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Instrumental Methods of Chemical Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.
2	Spectrometric Identification of Organic Compounds	Robert M. Silverstein	7th edition John Wiley
3	Organic Spectroscopy.	W. Kemp	Macmillan; 2nd edition (1987);
4	Organic Spectroscopy: Principles and Applications	Jag Mohan	Himalaya **Publishing** House, Bombay, 1 992.

Semester	**1**
Course Code	**CSE551**
Course Title	**Computers in Chemistry**
Type of course	Theory
L T P	3 0 2
Credits	3 0 1
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To learn the basic concepts of computer related chemistry like Huckel theory, PH titration, kinetics, radioactive decay etc.

Unit-I

Introduction To Computers And Computing: Basic structure and functioning of computers with a PC as illustrative examples. Memory I/O devices secondary storage. Computer languages.operating system with DOS as an example. Introduction to UNIX and WINDOWS.Data processing, principles of programming, Algorithms and flow charts.

Unit-II

Use of Computer to Programmes: The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes. Programmes with data preferably from Physical laboratory. Further the students will operate one or two or the package such as LOTUS, FOXPRO, Word processing Software such as WORDSTAR/MS-WORD.

Unit-II

Programming in Chemistry: Development of small computer codes involving simple formulae in chemistry,such as Vander Waals equation, pH titration, kinetics, radio active decay evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted from a data base such as Cambridge data base.

Unit-III

Computer Programming In FORTRAN/C/BASIC: Elements of the computer language. Constants and variables operators and variable symbols expressions. Arithmetic assignment statement. Statement Input and output. Format statements Termination statements.Branching statement such as IF or go to statement.

Unit-IV

Logical variable Double precision variables. Subscripted variables and DIMENSION. DO statement. Function and SUBROUTINE. COMMON and DATA statements.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Computers and Common Sense	Hunt, R.; Shelley, J.	Prentice Hall.

2	Computational Chemistry	Norris, A.C.	1st edition, John Wiley & Sons, 1981.
3	Computer Programming in FORTRAN IV,	Rajaraman, V.	4th edition, Prentice Hall
4	An Introduction to Digital Computer Design	Rajaraman, V.; RadhaKrishnan, V	Prentice Hall.

Semester	**1**
Course Code	**CHM509**
Course Title	**Inorganic Chemistry Practical-I**
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject.
Course Objective	To synthsise the coordination complexes and study the hardness of water using various experimental techniques.

Estimation of metal in complexes by Electronic Spectroscopy
Analysis of two cation-system using EDTA
Inorganic Preparations (Reinecke salt, Trinitrotriamine cobalt (III), Potassium trioxalatomangnate(III), Ferrous ammonium sulphate, Potassium trioxalatechromate(III).
Determine the total hardness of water.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Sutcliffe Practical Inorganic Chemistry,	Pass, G.	1st edition, Chapmann and Hall Ltd., 1968.
2	Synthetic Inorganic Chemistry,	Jolly, W.L.	2nd edition, Prentice Hall, Inc., 1961
3	Textbook of Quantitative Chemical Analysis	Mendham, J; Denney, R.C.; Barnes, J.D.; Thomas, M. Vogel's	6th edition, Pearson Education, Ltd., 2000

Semester	**1**
Course Code	**CHM511**
Course Title	**Organic Chemistry Practical-1**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject.
Course Objective	To learn the basic organic preparations.

To determine corrected melting points of an unknown organic compound
(Calibration of thermometer).
Adipic acid from cyclohexanol (oxidation).
p- Iodonitrobenzene from p-nitroaniline.
Preparation of benzyl alcohol and benzoic acid (Cannizzaro's reaction).
N- Bromo succinimide (Bromination).
Dibenzal acetone from benzaldehyde (Claisen-Schmidt reaction).

Cinnamic acid from benzaldehyde (Knoevenaegal reaction).
Acetanilide, bromoacetanilide, bromoaniline.
Diphenylmethane from benzylchloride (Friedel Craft's reaction).
Benzanilide (Schotten-Baumann reaction).
o-Benzoylbenzoic acid (Friedel Craft's reaction).

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Experimental Organic Chemistry,	Harwood, L.M., Moody, C.J.	1st edition, Blackwell Scientific Publishers, 1989.
2	Text Book of Practical Organic Chemistry	Vogel, A.I.	ELBS, IVth edition, Longman Group Ltd., 1978.
3	Practical Organic Chemistry	. Mann, F.G.; Saunders, B.C.	4th edition, New Impression, Orient Longman Pvt. Ltd., 1975

Semester	**1**
Course Code	**CHM513**
Course Title	**Physical Chemistry Practical-1**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject.
Course Objective	To be fimilar with equipments involved in spectrophotometers, conductometry, ph metry and other viscosity and surface tension measurements.

Viscosity:
(i) Determination of percentage composition of a liquid mixture by viscosity measurement.
(ii) Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement.

Surface Tension: (i) Determination of Parachor value of >CH2 group.
(ii) To measure interfacial tension and to test the validity of Antonoff's rule.
(iii) To compare cleansing power of two detergents.
(iv) To determine the critical micelle concentration of a soap by surface tension method.

Solubility:
(i) Determination of solubility of inorganic salt in water at different temperatures and hence to draw the solubility curve.
(ii) To study the effect of addition of an electrolyte on the solubility of an organic acid.
(iii) To study the variation of solubility of Ca $(OH)_2$ in NaOH solution and hence determine the solubility product.

Colloidal State:
(i) To compare the precipitation power of Na^+, Ba^{+2} & $A1^{+3}$ ions for As_2S_3 sol.
(ii) To study interaction between arsenious sulphide and ferric hydroxide sol.

Density:
Determine the partial molar volume of ethanol in dil. aqueous solution at room temperature.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Findlay's Practical Physical Chemistry,	Levitt, B.P.	9th edition, Longman Group Ltd., 1973.
2	Experimental Physical Chemistry	Matthews, G. Peter	1st edition, Oxford University Press, 1985.
3	Senior Practical Physical Chemistry	Khosla, B.D.; Garg, V.C. Gulati, A.	11th Edition, R. Chand and Co., 2002.

Semester	**II**
Course Code	**CHM502**
Course Title	**Organometallics Chemistry and Metal Clusters**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Chemistry as one of the main Subject.
Course Objective	The main goal of this branch is to study the structure of those compounds which containing at least one bond between a metal and carbon atom of an organic compound intermediate in size between a molecule and a bulk solid

Unit-I

Organometallics: Energy polarity and reactivity of M-C bond, Stability of Main group organometallics: Methods of preparation in perspective-organo lithium compounds: structure and bonding & reaction of carbolithiatic organometallics of group 2 and 12 e.g. Mg and Zn, Cd and Hg: Preparation and structure of organoaluminium compounds, Technical applications of tris (alkyl) aluminium compounds. 2π- ligands: olefenic and acetylenic complexes, chelating olefenic ligands –synthesis and structure. 2π – ligands: Allylic and 4π – complexes of cyclopentadiene. Synthesis and structure. 4π–ligands: Butadiene, cyclobutadiene, 2π–complexes of cyclopentadiene, fullvalene, heterocyclic pentadiene, cyclic dienes and polymers (e.g. eynes hexadiences, 1,3-cycloheptadienes, Boron containing ligands). 5- Hexadienyl, cyclopentadienyls, carboranes, metallo carboranes – synthesis and structure, MO treatment of ferrocene. 6 – ligands:

Unit-II

Benzene and its derivatives, MO treatment of 6π–complex of cycloheptadiene and cyclooctadiene.Multidecker sandwich compounds. Homogeneous hydrogenation of unsaturated compounds,reversible cis-dihydrocatalysis, monohydrido compounds, asymmetrical hydrogenation, hydrosilation of unsaturated compounds, hydrocyanation of alkenes, alkane metathesis, Ziegler-Natta polymerization of ethylene and propylene, water gas shift reaction, acetic acid synthesis by carbonyls, Oxopalladation reactions

Unit-III

Reaction at Coordinated ligands: The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation,Template and Macrocyclic effect in detail.

π-acid ligands: π-acceptor character of CO, O_2, N_2, NO, PH_3 molecules in terms of MOEL diagram, Metal carbonyls; structure and bonding; vibration spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiaryohosphine as ligand.

Unit-IV

Inorganic Rings, Chains and Metal Cluster: Borazines, Phosphazenes and other heterocyclic inorganic ring, systems, homocyclic inorganicsystems, cages of P and S, oxides & sulphides, Higher boranes, carboranes, metallobranes and metallocarboranes, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Organometallics: A Concise Introduction	C. Elschenbroich and A. Salzer,	2nd Ed., VCH1992.
2	Inorganic Chemistry Principles of Structure and Reactivity	J.E. Huheey	Harper Interscience
3	Wilkinson, Advanced Inorganic Chemistry	F.A. Cotton and G. Wilkinson	Ed. V & VI.Wiley Inter-science.
4	Inorganic Chemistry	G. L. Miessler, D. A. Tarr	3rd edition, Pearson Education

Semester	**II**
Course Code	**CHM504**
Course Title	**Organic Reaction Mechanism-II**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	The main aim of this branch is to study the mechanisms of organic reactions by different means viz E2, E1, E1cb and different rearrangements and oxidations and reductions.

Unit-I

Elimination Reactions: The E2, E1, E1cB mechanisms. Orientation of the double bond. Effects of substrate structure, attacking base, leaving group and medium on reactivity. Mechanism and orientation in pyrolytic eliminations.

Addition to Carbon – Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring.

Unit-II

Addition to Carbon – Hetero Multiple Bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Wittig reaction. Mechanism of condensation reactions involving enolates –Aldol, Kneoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions, Reformatski reaction.

Unit-III

Formation of Carbon-carbon Bond: Principle, disconnections and synthons, electrophilic and nucleophilic carbon species. Base catalyzed condensations; Aldol condensation, Claisen reaction, Perkin reaction, Stobbe condensation, Darzen condensation, Use of malonic, acetoacetic and cyanoacetic esters, Micheal addition, Wittig reactions. Use of acetylides, Acid-catalyzed condensation – self condensation of olefins, Friedal-Craft's reactions, Fries reactions, Diels-Alder reaction, 1-3 Dipolar additions.

Unit-IV

Rearrangements: General mechanistic considerations – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: Pinacol-pinacolone, Wagner-Merwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction.

Oxidation: Introduction**.** Different oxidative processes. Hydrocarbons - alkenes, aromatic rings, saturated CH groups (activated and unactivated). Alcohols, diols, aldehydes, ketones and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium(III) nitrate.

Reduction: Introduction**.** Different reductive processes. Hydrocarbons - alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds – aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Hydrogenolysis.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Principles of Organic Synthesis	Norman and Coxon	CRC Press
2	Advanced Organic Chemistry	Jerry March	Wiley-Interscience; 3rd edition (March 11, 1985)
3	Advanced Organic Chemistry	F.A. Carey, R.J. Sunberg	Springer; 5th edition (May 27, 2008)
4	Highlights of Organic Chemistry	W, J.L. Nobel	Advanced Text Book.

Semester	**II**
Course Code	**CHM506**
Course Title	**Quantum Chemistry and Chemical Dynamics**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	Quantum theory disclosing the relevant facts, with its postulates and applications, study the interaction or perturbation of energy with matter, chemical dynamics involving motion in chemistry.

Unit-I

Quantum Theory: Introduction and Principles: Black body radiations, Planck's radiation law, photoelectric effect, Compton Effect, De- Broglie hypothesis, the Heisenberg's uncertainty principle, Rydberg relation for explaining atomic spectrum of hydrogen. Bohr's Theory and its limitation solution of classical wave equation by separation of variables method, operators and observations, normal and orthogonal functions, Hermitian and unitary operators, introduction to differentiation and integration, Eigen value equation. Hamiltonian operator, interpretation of wave function, postulates of quantum mechanics.

Unit-II

Applications of Quantum Postulates: Solution of particle in one and three dimensional box, degeneracy, the linear harmonic oscillator, rigid rotators, quantization of vibrational and rotational energy levels, hydrogen and hydrogen like atoms.

Angular Momentum: Commutative laws, need of polar coordinates, transformation of Cartesian coordinate into polar coordinate, angular momentum of one particle system, orbital angular momentum, the ladder operator method for angular momentum, spin angular momentum and their relations

Unit-III

General Orbital Theory of Conjugated Systems: Chemical bonding, linear combination of atomic orbital, overlap integral, coulomb's integral, bond order, charge density calculations for ethylene, allyl system, butadiene system, cyclo butadiene cyclo propenyl system.

The Approximate Methods: Need for approximation methods, Perturbation and Variation methods and their application to Helium atom.

Unit-IV

Chemical Dynamics: Methods of determining rate laws, ionic reactions*, kinetic salt effects, steady state kinetics, kinetic & thermodynamic control of reactions, treatments of unimolecular reactions, Dynamic chain (pyrolysis of acetaldehyde composition of ethane),photochemical (H2-cl2) reactions & oscillatory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis, and NMR method, dynamics of molecular motion,

probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction (Lindemann)

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Physical Chemistry, A Molecular Approach	MacQuarrie and Simon	University Science Books, 1997
2	Quantum Chemistry	Ira N. Levine	Prentice Hall
3	Physical Chemistry	P. W. Atkins	ELBS, Oxford, 1997.
4	Quantum Chemistry	H. Eyring, Kimball and Walter	Nabu Press (September 12, 2011)

Semester	**II**
Course Code	**CHM508**
Course Title	**Bonding and Reaction Mechanism in Inorganic Compounds**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	To understand the bonding and reaction mechanism in organic compounds

Unit-I

Stereochemistry and Bonding in Main Group Compounds: VSEPR, Walsh diagrams (tri and tetra-molecules), d π-p π bonds, Bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules..

Metal Ligand Bonding: Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π bonding and molecular orbital theory.

Unit-II

Reaction Mechanism of Transition Metal Complexes: Inert and labile complexes, mechanisms of substitution (dissociative, associative interchange mechanism, the conjugate mechanism, substitution in *trans* complexes, substitution in *cis* complexes, isomerism of chelate rings), *trans* effect, explanation for *trans* effect, Ligand replacement reactions of square planar and octahedral complexes: their factors and mechanism of substitution.

Unit -III

orbital occupation mechanisms. Anation reaction, Metal carbonyl reactions species with 17 electrons. Electron transfer processes with mechanism, key ideas concerning electron transfer reactions between transition Metals. Cross reactions and thermodynamics. Marcus theory, its kinetics and applications. Doubly bridged inner sphere transfer and other electron transfer reactions. Two electron transfer, non-complementary reactions. Stereochemical nonrigidity of coordinate and orgonometallic compounds, trigonal by pyramid, system with six or more coordination number. Isomerization and recemization of trischelates, metal carbonyl scrambling.

Unit-IV

Metal-ligand Equilibria in Solution: Stepwise and overall formation constant and their interaction, trends in step wise constant, factors affecting the stability of metal complex with reference to the nature of metal ion and ligand chelate effect and its thermodynamic origin. Determination of binary formation constants by pH-meter, Job's method and spectrophotometery.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Inorganic Chemistry	K.P. Purcell and J. V. Kotz	W.B. Saunders Co. London, (1977).
2	Inorganic Chemistry	. G. L. Miessler, D. A. Tarr	3rd edition, Pearson Education.

3	Inorganic Chemistry	. F.A. Cotton & Wilkinson	V & VI Ed. Willy Eastern – (1999).
4	Inorganic Chemistry	J.E. Huheey	III & IV Ed. Pearson Education Asia – (2002).

Semester	**II**
Course Code	**MAT528**
Course Title	**MATHEMATICS FOR CHEMISTS**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	To learn basic concept of chemistry numerical like order of reaction, method of partial fractions, area under a curve etc.

Unit-I

Trigonometry: Definition of sin, cos, tan, cot, sec, cosec functions with the help of unit circle, values of sin x cos x cos x for x = 0, n/6, n/3, n/2. Meaning of a trignometrical identity. The following identities (no need of derivation and proof. However, application has to be emphasized). Cos2 x+sin2 x = 1,Sin (x=2)-Sin2 x/½ sin x, Cos (x-2)Cos x, Cos(-x = cos x; sin(-x) = sin x Sin(-x) = sin x ; cos (-x) = --cos x, Sin(+x)= ---xin x; (+x) = --co x, Sin 2x = 2 sin x cos x Cos 2x = 2 sin x cos x, Cos 2x = 2lcosx-1, Tan (x) = -- sin x; cos x,Tan (x) = -- tan x; tan(x/2 – x = cot x), Tan (-x) = -tan x, Tan 2x = 2 tan x/(1-tan2 x)

Unit-II

Determinants and Matrices: Definition and expansion properties of determinants, product of two determinants of 3rd order. Introduction to various terms Matrix, row, column, diagonal unit. Sub, square, equal matrices, null, symmetricular, order of, character of, transpose of, adjoint of, inverse of matrices. Addition multiplication, Multiplication of matrices.

Unit -III

Differential Calculus : Differentiation of standard functions, theorems relating to the derivative of the sum, difference, product and quotient of functions, derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implicit functions, logarithmic differentiation.

Unit-IV

Integral Calculus : Integration as an inverse of differentiation summation, area under a curve, indefinite integrals of standard forms, method of substitution, method of partial fractions, integration by parts, definite integrals.

Recommended books:-

S. No	Name	Author(S)
1	Differential Calculus	Santi Narayan
2	Integral Calculus.	Santi Narayan
3	Higher Engineering Mathematics	B.S. Grewal
4	Mathematical Techniques in Chemistry	Joseph B. Dence
5	Mathematics of Physics and Chemistry	Margenau and Murphy
6	A Text Book of Engineering Mathematics	B.L. Moncha and H.R. Choudhary

Semester	**II**
Course Code	**BOT502**
Course Title	**BIOLOGY FOR CHEMISTS (For Non-Medical Students)**
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	To study about the role of Genetics and diversity of life.

Unit-I

The Organization of Life: Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids. The life of cells – The cell theory, general characteristics of cells, difference between proaiyotic and eukaryotic cells, difference between plant and animal cells, cell organells.Tissues, organs and organ systems.

Unit-II

Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: maristematic tissue, permanent tissues.

Unit-III

Genetics: The basic principle of heredity: Mendals law, monohybrid cross, dihybrid cross.DNA – Double halix structure and replication.Genes expression: Transcription and translation, genetic code.

Unit-IV

The Diversity of Life: Nucleosides, nucleotides, DNA, RNA structure and conformation, Replication, transcription The classification of Living things – Criteria of classification, Whittaker's systems of classification, their characteristics with are example of each. Viruses, structure of Viruses.

Text and Reference books:

S.No.	Name/Title	author	Publisher
1	Cord Biology		South Western Educational Publications, Texas, 2000.
2	Contemporary Enzyme kinetics and Mechanisms	D. L. Purich	Academic Press, 1983.
3	Bio-organic Chemistry, A chemical approach to enzyme action	Dugas H	Springer 2003.
4	Text book of Organic Medical and Pharmaceutical Chemistry, 10th Ed	Wilson, Gisvold & Dorque	Lippincoh pover publishers, 1998.

Semester	**II**
Course Code	**CHM510**
Course Title	**Inorganic Chemistry Practical- II**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	Titrations of different types to standardize the solutions of inorganic compounds and their gravimetric analysis.

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 -1 and C_2O_4 ions.

Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferric alum)

Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ 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.

Complexometric Titrations

Determination of Cu^{2+} and Ni^{2+} by using masking reagent by EDTA titration.

Determination of Ni^{2+} (back titration).

Determination of Ca^{2+} (by substitution method).

Gravimetric Analysis

Determination of Ba^{2+} as its chromate.

Estimation of lead as its lead molybdate.

Estimation of chromium (III) as its lead chromate.

Estimation of Cu^{2+} using Ammonium/ Sodium thiocyanate.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Vogel's quantitative analysis 6 Edn	Mendham, Denny	Pearson Education 2002
2	Synthesis and Technique in Inorganic chemistry	G. S.Girlomi; R.J. Angleci	3rd edn.; University Science Books.
3	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002

Semester	**II**
Course Code	**CHM512**
Course Title	**Organic Chemistry Practical- II**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	Organic synthesis and quantitative analysis of organic compounds.

Organic Synthesis

1. Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination)
2. Synthesis of methyl orange from aniline.
(Aromatic electrophilic substitution and diazocoupling).
3. Synthesis of benzpinacol and its pinacol rearrangement.
4. Synthesis of o-chlorobenzoic acid from phthalimide. Synthesis of acridone from o-chlorobenzoic acid. (Hofmann bromamide and Sandmeyer's reaction).
5. Synthesis of 2, 4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
6. Synthesis of triphenylcarbinol from bromobenzene. (Grignard reaction)

Quantitative Analysis of Organic Compounds:

1. Estimation of phenol/aniline using bromate-bromide solution.
(The application to find the purity of the sample and to determine the amount in given solution).
2. Determine the number of hydroxyl and amino groups in the given sample by the acetylation method.
3. Determine the mol. wt. of the given ketone by using 2,4-DNP method.
4. Estimation of reducing sugar by Fehling solution method.
5. To determine the sponification value of the given fat or oil sample.
6. To determine the iodine number of the given fat or oil sample.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Laboratory Experiments in Organic Chemistry	R. Adams, J. R. Johnson and C. F. Wilcox.	The Macmillan Limited, London.
2	An Introduction to Modern Experimental Organic Chemistry	R. M. Roberts, J. C. Gilbert, L.B.Rodewald and A. S. Wingrove Holt	Ranehart and Winston Inc. New York.
3	Introduction to Organic Laboratory Techniques – A Contemporary Approach	D. L. Pavia, G. M. Lampmana and G. S. Kriz	W. B. Saunders Company, 1976.

Semester	**II**
Course Code	**CHM514**
Course Title	**Physical Chemistry Practical- II**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. with Chemistry as one of the main Subject
Course Objective	To determine the strength of given acids conductmetrically, using ph meter , and activity coefficients by e.m.f measurements.

To determine the strength of given acid by PH metrically.
To determine dissociation constant of given acid pH metrically
Titration of weak acid conductometrically
Titration of strong acid conductometrically
To determine dissociation constant of given acid conductometrically
Determine the dissociation constant of acetic acid in DMSO, DMF and dioxane by titrating it with KOH.
Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.
Compare the cleansing powers of samples of two detergents from surface tension measurements.
Determine the specific refraction, molar refraction and atomic parachor with the help of Abbe's refractometer.
To study the distribution of benzoic acid between benzene and water.
Determine the equilibrium constant of reaction $KI + I_2 = KI_3$ by distribution law and hence find the value of GO of the above reaction
Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance measurements.
Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.
Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically..
Compare the relative strength of:
i) HCl and ii) H_2SO_4 by following the kinetics of inversion of cane sugar polarimetrically.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Experimental Physical Chemistry	Arthur M. Halpern, George C. McBane	Freeman,2006.
2	Experiments in Physical Chemistry, 5th ed.,	Schoemaker et al.	MGH, 1989
3	Chemistry Experiments for Instrumental Methods	Sawyer, Heineman, Beebe	Wiley, 1984 .

Semester	**III**
Course Code	**CHM601**
Course Title	**Inorganic Spectroscopy**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	The main objective of inorganic spectroscopy is the synthesis and behavior of inorganic and Organometallics compounds. This field covers all chemical compounds except the myriad organic compounds (carbon based compounds, usually containing C-H bonds), which are the subjects of organic chemistry.

Unit-I

Vibration and Rotation Spectroscopy: Infrared, Raman and Microwave: Harmonic and Anharmonic oscillators, vibrational energies of diatomic molecules. Potential energy function for a chemical bond. Absorption of radiations by molecular vibration. Selection rules, force constant. Rotational energies of linear molecules.

Rotational energy level populations, merits and demerits of microwave spectroscopy, rotational spectra of rigid, linear molecules, non-rigid rotators. Determination of moment of inertia and bond length from rotational spectra, relative intensities of spectral lines. Rotational spectra of non-linear molecules (brief mention), vibrations in polyatomic molecules. Effects giving rise to absorption bonds. Group vibrations and limitations of group vibration concepts.

Unit II

Polarisations of light. Theories of Raman Effect, Merits and demerits of Raman spectroscopy. Pure rotational Raman spectra of linear molecules. Vibrational Raman spectra selection rules. Rule of mutual exclusion. Rotational Fine IR spectra, vibronic coupling.

Sample handling. Factors affecting absorption frequencies. Interpretation and finger printing regions. Use of symmetry considerations to determine the number of active I.R, and Raman lines (character tables to be provided in the Examination). Applications of Raman and IR selection rules to the determination of Inorganic structure with special emphasis on:

(i) Metal carbonyls. (ii) NSF3 n(iii) Geometrical isomerisan – differentiation between Cis and trans. $[Co(bipy)_2Cl_2]Cl$. (iv) Structures of CO2, N2O, H2O, chlorocomplexes of mercury, camium and zinc and some octahedral complexes ML6 (eg. $SiF6^{2-}$, PF_5^-, SF6). (v) Changes in the spectra of donor molecules upon coordination with special emphasis on N, N – dimethyl – acetamide and DMSO with Fe3+, Cr3+, Zu2+, Pd2+ and Pt2+ ions.

I.R spectroscopy and modes of coordination of $SO4^{2-}$, N2, O2, NO, $CO3^{2-}$, $NO3^-$.

Unit- III

Photo Electron Spectroscopy

Introduction, excitation & ejection of electrons, electronic energy levels in atoms and molecules, Core level photoelectron spectroscopy, symmetry & molecular orbitals, valence electron photo electron spectroscopy, valence excitation spectroscopy. Dissociation, Predissociation, change of

shape on excitation.

Electron Spin Resonance Spectroscopy

Features of ESR spectra, measurement technique hyperfine coupling in isotropic system (C5H5, C6H6, C14H10, biphenyl) Anisotropic splitting, Electron – electron interaction, Transition metal complexes g-value and factors affecting g-value, zerofield splitting, Kramer's degeneracy, Rate of electron exchange, Application to p – benzoseniquinone DPPH, pyrazine.

Double resonance technique ENDOR, ELDOR.

Unit-IV

Nuclear Quadrupole Resonance Spectroscopy: Introduction, effects of magnetic field on the spectra. Relationship between the electric field

gradient and molecular structure. Interpretation of eQ, data, the effect of crystal lattiee on the magnitude of eQ4, double resonance technique, Application (PCI4.PCI6), TeCL4, Na+GaCI4 =, group 14 tetra halides, R3, Mg X2

A) Polyhalide ion, BrCN, HIO3 (1,2)

B) P-dichloro benzene, p-chloroaniline, haloalkanis and holoarenas.

Mossbauer Spectroscopy: Introduction, principles, conditions of MB spectra, parameters from MB spectra. Isomer shift, electric quadrupole interaction, magnetic interaction, use of additive partial quadrupole splitting to predict quadrupole coupling. Application of 57Fe, 119 SN, 151EU compounds, to biological systems to surface study, $I2C_{I6}$, IBr_2 CL_4, XeF_4, $XeCI_4$.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Spectroscopy in Inorganic Chemistry	C.N.R. Rao, I.R. Ferraro	Vol. I and Vol. II, Academic Press, (1970).
2	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. III Edition, (1985).
3	Structural Methods in Inorganic Chemistry	E. A. V. Ebsworth, D. W. H. Rankin and S. Cradock	II Edition, Blackwell Scientific Publications, Oxford, London (1991).
4	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, II Edition, (1986).
5	Chemical Instrumentation	H.A. Strobel	Addison - Wesley Pub. Co., (1976).
6	Fundamentals of Molecular Spectroscopy.	C.N Banwell,	McGraw-Hill Education (India) Pvt Limited, 1994

Semester	**III**
Course Code	**CHM603**
Course Title	**Organic Synthesis and Heterocyclic Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	The main goal of this subject is to study the reaction, mechanism and the synthesis of organic compounds containing N, O, and S like compounds.

Unit-I

Heterocyclic Synthesis: Replacement and systematic nomenclature (Hantzsch-widman System) for monocyclic fused and bridged hetrocycles, Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

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

Six-Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrylium salts and pyrones and their comparison with pyridinium & thiopyrylium salts and pyridones. Synthesis and reactions of quinolizinium and benzopyrylium salts, coumarins and chromones.

Unit-II

Seven-and Large-Membered Heterocycles: Synthesis and reactions of azepines, oxepines, thiepines, diazepines, thiazepines, azocines, diazocines, dioxocines and dithiocines.

Polynuclear Compounds & Macro-Ring Compounds: Introduction, comparative study of aromatic character of Linear and non-Linear-ortho-fused polynuclear hydrocarbons, ortho-and peri-fused polynuclear hydrocarbons. General method of preparation and reactions of indene, fluorene anthracene and phenanthrene. Modern methods of synthesis of macro ring compounds-civiton, muscone and catenoids.

Unit-III

Reagents in Organic Synthesis: Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium disopropylamide (LDA) dicyclohexylcarbodimide. 1,3-Dithiane (reactivity umpolung), trimethylsilyl iodide, tri-n-butyltin hybride, Woodward and prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

Unit-IV

Supramolecular Chemistry: Principles of molecular association and organization as exemplified in biological macromolecules like enzymes, nucleic acids, membranes and model systems like micelles and vesicles. Molecular receptors and design principles. Cryptands, cyclophanes, calixeranes, cyclodextrines, Supramolecular reactivity and catalysis.

Role of bonds length, inter-bond angles, force constant, bond and molecular dipole moments, Molecular and bond polarizability, bond dissociation enthalpy, entropy, intermolecular forces, hydrophobic effects, electrostatic, induction, dispersion, resonance energy and hydrogen bond in elaboration of above process.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Heterocyclic Chemistry	Acheson.	Wiley-Interscience; 3rd edition (March 11, 1985)
2	Advanced Organic Chemistry	F.R.Carey, R.J. Sunberg.	Wiley **Publishers**
3	Highlights of Organic Chemistry	W.J.L. Nobel	An Advanced Text Book
4	Organic Chemistry	Jerry March	Wiley & Sons

Semester	**III**
Course Code	**CHM605**
Course Title	**Surface Chemistry and Electrochemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	This study Deals with the properties of surfaces or phase boundaries and with the chemical changes occurring at a surface or interface.

Unit-I

Adsorption:

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

Micelles: Surface active agents, classification of surface active agents, micellization, ydrophobic interactions, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization – phase separation and mass actionmodels, solubilization, micro emulsion, reverse micelles.

Unit-II

Polymer – definition, types of polymers, electrically conducting, fire resistant, liquids crystal polymers, kinetics of polymerization, thermodynamics of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculations of average dimensions of various chain structures. Importance of polymers, Basic concepts: monomers, repeat units, degree of polymerization. Linear, branched and network polymers.

Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions. Polymerization in homogenous and heterogeneous systems. Number, weight and viscosity average weights.

Unit-III

Structure and Properties: Polymer structure and properties-crystalline melting point Tm-melting point of homogenous series, effect of chain flexibility and steric factors, entropy and heat of fusion. The glass transition temperature, Tg-Relationship between Tm and Tg, effects of molecular weight, diluents, chemical structure, chain topology, branching and chain linking. Property requirements and polymer utilization.

Electrochemistry: Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Bjerrum mode, Thermodynamics of electrified interface equation, Derivation of electro-capillarity, Lipmann equation(surface ecess), method of determination, structure of electrified interfaces, Guoy-Chpmann, Stern models, overpotential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Semiconductor interface theory of double layer at semiconductor electrolyte solution interface, structure of double layer interfaces, effect of light at semiconductor solution interface.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and Prevention

Unit-IV

Voltmametry and Polarography: Polarography, polarographic cells, polarogram, interpretation of polarographic waves, equation for the polarographic waves, effect of complex formation on polarographic wave, polarograms for irreversible reactions, dropping mercury electrode, current variations during life time of a drop, merits and demerits of dme, polarographic diffusion currents, Ilkovic equation, capillary characteristics, temperature, polarograms for mixture of reactants, anodic and cathodic waves, factors affecting polarographic currents, applications of polarography, treatment of data, organic and inorganic polarographic analysis, voltammetry at solid electrodes, cyclic voltammetry and interpretation of data, , pilot-ion and standard addition method for quantitative analysis

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Surface Chemistry	E.M. Mc Cash	Oxford University Press, Oxford (2001).
2	An Introduction to Liquid State	P.A. Eglestaff	Academic Press.
3	Electrochemical methods, Fundamentals and Methods	A.J. Bard, L.R. Faulkner,	Wiley, 1980.
4	Physical Electrochemistry- Fundamentals, Techniques and Applications	EliezerGileadi,	Wiley-VCH 2011.

Semester	**III**
Course Code	**CHM607**
Course Title	**Photochemistry and Pericyclic reactions**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To learn the various types of reactions occurs due to photons/radiations and also learn the basic cycloaddition, substitutions reactions due to bond braking and making process.

Unit-I

Pericyclic Reactions: Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reactions FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMO) approach for he explanation of pericyclic reactions under thermal and photo-chemical conditions. Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allylsystems secondary effects. Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+2) cycloaddition-stereochemical effects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions and cheleotropic reactions.

Unit-II

Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion of configuration, (3,3) and (5,5) sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism, aza-cope rearrangements, introductions to Ene reactions, simple problems on Pericyclic reactions. Elecrocyclic rearrangement of cyclobutenes and 1,3 cyclohexadienes.

Unit-III

Photochemistry

(i) Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

(ii) Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions – photodissociation, gas-phase photolysis.

(iii) Photochemistry of Alkenes: Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclization reactions, rearrangement of 1,4- and 1, - dinenes.

Unit-IV

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β, γ- unsaturated and α,β-unsaturated compounds, Cyclohexadienones. Intermolecular cycloaddition reactions – dimerisations and oxetane formation.

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions.

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides. Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Molecular reactions and photochemistry	Chapman and Depuy	Pearson Education, Limited, 1972.
2	Synthetic Organic Photochemistry	W.H. Horsepool.	Springer
3	Molecular Reactions and Photochemistry	C. H. DePuy and O. L. Chapman	Prentice-Hall
4	Organic reaction mechanism, 3rd ed.	V. K. Ahluwalia	Narosa publishing house, New Dehli
5	Frontier orbital and Symmetry Controlled Pericyclic reactions	Ratan Kar	Books & Allied (P) Ltd
6	Pericyclic Reactions-A mechanistic Study	S. M. Mukherjee	Cambridge University Press

Semester	**III**
Course Code	**CHM609**
Course Title	**Inorganic Chemistry Practical- III**
Type of course	Laboratory Course
L T P	0 0 6
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To learn the various preparation of inorganic compounds.

Preparation of Co. $(acac)_3$,
Preparation of Co. $(acac\text{-}NO2)_3$,
Preparation of $[Fe(H2O)6][Fe(N\text{-}salicyldeneglycinato)_2]_2.3H_2O$,
Preparation of [Ni(NH3)6]Cl2
Preparation of $[Ni(ethylenediamine)_3]Cl_2$
Preparation of $[Fe(NO)(S_2CN(Et)_2)_2]$
Preparation of octahedral and tetrahedral complexes of dichlorodipyridylcobalt(II),
Preparation of VO(acac)2
Preparation of diaquotetraacetataocopper(II),
Preparation of cis- and trans- potassium dioxalato diaquochromate(III).
Preparation of HgCo(NCS)4 , its IR and measure its magnetic moment.
Preparation of sodium tetrathionate
Preparation of Potassium dithionate,
Preparation of bis(acetylacetonato)copper(II), UV-Vis, and IR, magnetic studies,
Demonstration of Jahn Teller effect by solution spectral studies.
Preparation of salicylamide complexes of Copper(II).
To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclo tetradeca-4,11-dienedi(hydrogeniodide) and its complex with Ni(II).
17. Preparation and resolution of tris (ethylenediamine) cobalt (III).

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Introduction to Ligand Field	B.N. Figgis	Wiley Eastern.
2	Inorganic Electronic Spectroscopy	A.B.P. Lever	Elsevier
3	Introduction to Magnetochemistry	A. Earnshaw	Academic Press.
4	Inorganic Chemistry Principles of Structure and Reactivity	J.E. Huheey	Harper Interscience.
5	Advanced Inorganic Chemistry	F.A. Cotton and G. Wilkinson	Wiley Interscience.
6	Chemical Application of Group Theory	F.A. Cotton	Wiley Eastern.

Semester	**III**
Course Code	**CHM611**
Course Title	**Organic Chemistry Practical- III**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	The objective of this study is to prepare the organic compunds with driffent methods using drifferent organic reactents under drifferent physical conditions.

Preparation of the following organic compounds:

Hydroxynaphthaldehyde (Reimer tiemann Reaction)

Benzoin. Benzil. Benzilic acid.

Benzophenone, Benzophenone oxime, Benzanilide (Beckmann Rearrangement).

Trinitrophenol (picric acid) and picrate derivative.

Studies of TLC, column chromatography and paper chromatography for organic mixture.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Modern Experimental Organic Chemistry	R. M. Roberts, J. C. Gilbert et al.,	Ranehart and Winston Inc. New York.
2	Introduction to Organic Laboratory Techniques – A Contemporary Approach	D. L. Pavia et al., G. M. Lampmana and G. S. Kriz, W. B.	Saunders Company, 1976.

Semester	**III**
Course Code	**CHM613**
Course Title	**Physical Chemistry Practical- III**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To determine the partial molar volume, surface tension, molar refractivity of various solvents and molar/equivalent conductance of various electrolytes.

To determine the partial molar volume of
(a) Glycine (b) Urea using dialtometer
To determine the partial molar volume of
(a) methanol (b) n-propanol using dilatometer
To determine the surface tension (double cabillary) of mixture of solid and water by deferential method and hence find out parachor of the mixture.
To determine the specific and molar refractivity of n-propanol, butanol, nexane and carbon tetrachloride and calculate refraction equivalents of C, H and Cl.
To determine the molar refracitivity of water, DMF, Dioxane and mixtures of water, DFM, water-Dioxane and verify the refractivity rule. Predict about the interactions between components of mixture by plotting graph between refractive index and mole fraction.
To determine the equivalent conductance of weak electrolyte acetic at infinite dilution using Kohlrausch law.
Determine equivalent conductance of strong electrolyte at several concentrations and hence verify onsagars equation.
Determine equivalent conductance of weak electrolyte, say, acetic acid at different concentrations and hence test validity of Oswald's dilution law. Also determine dissociation constant of the electrolyte.
To determine dissociation constant of a dibasic acid potentiometrically.
To study complex formation between Fe(III) and salicylic acid and find out the formula of the complex spectrophotometrically.
To determine the formula of the complex ion formed between Fe(III) and Thiocyante ion by Job's method.
To study the kinetics of hydrolysis of crystal violet spectrophotometrically.
To determine the pH of a buffer solution (pH less than 8) using a quinhydrone electrode.
To determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of the acid.
Titrate potentiometrically Zn (II) by K4fe(CN)6 and verify the composition of the complex K2Zn3 [Fe(CN)6]2
Determination of nitrite in water spectrophotometrically.
Determination of molecular weight of polymers by Tirbiditymetery.
Determine the molar refraction of a solid substance by dissolving it in a solvent and its refractive index.

Text and Reference books:

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Findlay's Practical Physical Chemistry,	Levitt, B.P.	9th edition, Longman Group Ltd., 1973.
2	Experimental Physical Chemistry	Matthews, G. Peter	1st edition, Oxford University Press, 1985.
3	Physical Chemistry, 5th ed	Atkins, P. W	Freeman (1994)

Semester	**IV**
Course Code	**CHM602**
Course Title	**Recent Trends in Inorganic Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To study about the Coordination complexes, Substitution in Coordination complexes, to study the Inorganic Photochemistry.

Unit-I

Photo Inorganic Chemistry: Basics of photochemistry- Absorption, excitation, photochemical laws, quantum yield, electronically excited states, life times- measurements of the times Flash photolysis, energy adiddipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages-primary and secondary processes, Kashia's rule, Thexi state, Photo substitution reactions, Adamson's rules, Photo substitution reactions of Cr(III)-Polypyridyls, Rh(III) Ammine Complexes, Ru-Polypyridyl complexes, Ligand photo reactions, photoredox reactions, comparison of Fe(II) and Ru(II) complexes, Photo reactions and Solar energy conversions, Photo synthesis in plants and Bacterio chlorophyll photosynthesis, photolysis of water using Inorganic precursors.

Unit-II

Oxidative-Addition and Migration (Insertion Reactions): Introduction: Acid base behaviour of metal atoms in complexes, Protonation and Lewis Base behaviour, acceptor properties of Lewis acidity of complexes, oxidative addition and reductive elimination, addition of specific molecules, Hydrogen addition, HX additions, Organic halides addition of some other molecules productive elimination, migration (Insertion) reaction promotion of alkyl migration, insertion of CO into M-H bonds, other aspects of CO insertion reactions, transfer of other molecules, CO2, SO2 , NO2 , RCM, Insertion of alkenes and C-C unsaturated compounds, Cleavage of C-H bonds; alkane activation, Cyclometallation reactions. Reactions of free hydrocarbons.

Unit-III

Transition Metal Compounds with Bonds to Hydrogen : Characteristics of hydride complexes, synthetic methods, chemical behaviour of hydride compounds, mononuclear polyhydrides, homoleptic polyhydride anions; carbonyl hydrides and onion. Molecular hydrogen compounds; metal hydrogen interaction with C-H bonds; MH interactions; complexes of boron hydride and aluminohydrides, synthetic applications of metal hydrides.

Unit-IV

Transition Metal Complexes in Catalysis : Hydroformylation of unsaturated compounds, Reductive carbonylation of alcohols and other compounds; Carbonylation Reaction: Methanol and methyl acetate, Adipic ester. Synthesis and other carbonylation reactions, decarbonylation reactions. Catalytic addition of molecules to C-C multiple bonds homogeneous hydrogenation, hydrocyanation of unsaturated compounds, hydrosilation of unsaturated compounds, hydrocyanation of alkenes, Polymerization, Oligomerisation and metathesis reactions of alkenes

and alkynes, Ziegler-Natta polymerization of ethylene and propylene oligomerisation and related reactions, Cluster compounds in catalysis, supported homogeneous and phase transfer catalysis, Oxidation reaction: Oxidative carbonylations, Palladium catalysed oxidation of ethylene, Acrylonitrile synthesis, oxygen transfer from peroxo- and oxo- species, oxygen transfer from NO2 groups.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Concepts of Inorganic Photochemistry	A. W. Adamson and P. D. Fleischauer	Wiley.
2	Inorganic Chemistry	W.W. Porterfield	A Unified Approach
3	Advanced Inorganic Chemistry, 5th ed	F.A. Cotton and G. Willkinson	John Wiley & Sons, New York.
4	Organometalics: A Concise Introduction, 2nd Ed.	C. Elschenbroich and A. Salzer	VCH 1992.

Semester	**IV**
Course Code	**CHM604**
Course Title	**Natural Products and Plants as source of drugs**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To study the chemistry of natural products their classification, structure, and mechanisms involved in their formation.

Unit-I

Studies on Biosynthetic Pathwas of Natural Products

The acetate hypothesis, poly-ketoacids, their addol type cyclisations and meta orientations of hydroxyl groups in naturally occurring phenols. Isoprene rule, mechanism of formation of mevalonic acid from acctyl coenzyme, Biogenetic isoprene rule.

Terpenoids: General classification, General Methods of structure determination, Chemistry of Camphor, Abietic acid, Santonin biosynthetic studies on tri and tetra Terpenoids.

Unit-II

Steroids: General biosynthetic studies on steroids, chemistry of Cholesterol, cortisone, progesterone, oestrone, transformations in steroid molecules.

Alkaloids: Classification, chemistry of nicotine, quinine, papaverine, morphine and reserpine.

Unit-III

Haemin and Chlorophyll:

Structure and synthesis of Porphyrins. Chemistry of Haemin and chlorophyll.

Antibiotics:

Introduction, chemistry of pencillins, streptomycines, chloromphenicol, tetracyclins.

Prostaglandins:

General study, nomenclature, structure of PGE and synthesis of PGE1, PGE2, PGF2x

Unit-IV

Peptides and Proteins:

Sequence determination insulin and oxytocin, Proteins: structure conformation and properties. Enzymes, Kinetics, inhibition mechanism.

Plants as source of drugs:

Intorduction to plant based drugs, drug development from plants.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Organic Chemistry, Vol. 2, 5th edition	Finar, I.L.	ELBS, 1975.

2	1. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas	Hostettmann, Kurt; Gupta, M.P.; Marston, A.	Harwood Academic Publishers.
3	Introduction to Flavonoids	Aggarwal, O.P.	2. Harwood Academic Publishers.
4	3. Natural Products: Chemistry and Biological Significance,	Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B.	. Longman, Esse

Semester	**IV**
Course Code	**CHM606**
Course Title	**Chemistry of Materials**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To study about the various advanced topics like Nanochemistry, Smart Materials, Glasses and Ceramics etc.

Unit-I

Solid State Chemistry: Types of solids, band and bond theories, crystal lattice energy, point defects in metals and ionic compounds, energy and entropy of defects, their concentration, diffusion and electrical conduction via defects, non stoichiometry types, colour centres and electrical properties of alkali halides, electron theories for metal conduction in metals , in insulators, impurity semi conductors, reactions in organic solids, photochemical reactions, solid-solid reactions, decomposition and dehydration reaction.

Unit-II

Nanochemistry: Introduction, definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots – Quantum wire-Core/Shell structures. Carbon Nanotubes (CNT),

Unit-III

Glasses and Ceramics: Factors affecting glass formation, oxide glasses, electronegativity and bond type, viscosity, structural effects(zachariasen's rule(1932), criteria of SUN and Rawson, thermodynamics of glass formation, behavior of liquids on cooling, kinetics of crystallization and glass formation,structure of glasses: vitreous silica, silicate glasses, vitreous B2O3 and borate glasses, viscosiy, electrical conductivity of glasses and the mixed alkali effect, commercial silicate and borate glasses, metallic glasses , glass ceramics, refractories, important glass-ceramics compositions, properties of glass ceramics, applications.

Unit-IV

Smart Materials: Methods of preparation- conventional ceramic methods, hot pressing and hot static pressing techniques, precursor method, gel method, co-precipitation method, glass crystallization methods, vacuum techniques- chemical vapor deposition method. , organic superconductors, , magnetism in organic materials, magnetic nano materials, energy storage materials, nano materials for targeted drug delivery,, fullerenes as superconductors.High temperature ceramic superconductors, electrical and magnetic properties of superconductors, critical temperature Tc, thermodynamics of superconductors, London equation, BCS theory, applications.

Text and Reference books:

S.No.	Name/Title	Author	Publisher

1	Principles of polymer chemistry	P J Flory	Cornell University Press
2	Physical chemistry of polymers	A J Tager	Mir Publishers
3	Solid state chemistry and its applications	A R West	Wiley Publishers
4	Solid state chemistry of drugs	S R Byrn	Academic Press
5	Principles of physical chemistry	Puri-Sharma-Pathania	Vishal Publisher

Semester	**IV**
Course Code	**CHM608**
Course Title	**Bio-Inorganic and Bioorganic Chemistry**
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	Main aim to Study the role of metals in biology. Bioinorganic chemistry includes the study of both natural phenomena such as the behavior ofmetalloproteins as well as artificially introduced metals.

Unit-I

BIO-ORGANIC CHEMISTRY

Enzymes: Introduction, classification and nomenclature, characteristics mechanisms of enzyme Action, factors affecting enzyme activity, Coenzymes NAD, NADP, applications and Clinical use of enzymes. Methods of immobilization of enzymes, effect of immobilization on enzyme activity.
Vitamins: Introduction of fat soluble and water soluble vitamins, sources, structure, requirements and functions of vitamin A,D,E and vitamin B1 and C.
Antibiotics: ß- Lactumrings, structure and synthesis of penicillin – G, penicillin-V, Amoxycillin, cholamphenicol, streptomycin.

Unit-II

BIO-INORGANIC CHEMISTRY

Role of Metal ions in Biological Systems: Functions of metal ions in biological systems. Transport of ions through cell membrane - Na+/K+ Pump.
Oxygen carrier Systems: Structure and function of Hemoglobin, Myoglobin, Hemerythrin & Hemocyanin. Mechanism of dioxygen binding with heme proteins. Nature of Iron-dioxygen linkage in Hemoglobin, Model system - Model Synthetic complexes of Iron and Cobalt as Oxygen carrier.
Photosynthetic Pigments: Complexes of Porphyrin. Redox mechanism in Photosystems (PS-I and PS-II), Cleavage of Water in PS-II.
Biological Nitrogen Fixation: Enzymetic reduction of Nitrogen to Ammonia - Nitrogenase Structure and mechanism. Molybdenum Nitrogenase - Spectroscopic and other studies. Model Systems for Nitrogenase.

Unit-III

Electron Transfer in Biology: Structure and Function of Metallic Proteins in Electron Transport Process, Cytochrome, Iron-sulphur Proteins.
Metal Storage, Transport and Biomineralisation : Metal Storage and Transport Structure and Function of Feritin, Transfrsin and Siderophores. Biomineralisation.
Calcium in Biology: Role of Calcium in living systems. Transport and regulation of Calcium - pathways and mechanism, Calcium Channels and pumps. Calcium binding proteins - Intracellular, Mediated membrane and Extracellular.

Unit-IV

Metal - Nuclic Acid Interactions: Metal ions and Nucleic Acids Interactions (binding) - Types & suitable examples. Metal complexes (e.g., Cisplatin) interaction with DNA. (b) Metals in Medicine: Metal Deficiency and disease. Toxic effects of Metals. Metals used for diagnosis. Metals used in Chemotherapy with particular reference to Anticancer drugs.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Principles of Bioinorganic Chemistry,	S. J. Lippard and J. M. Berg,	University Science Books (1994)
2	Bioinorganic Chemistry	Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine	Viva Books Pvt. Ltd., New Delhi (1998
3	Biological Inorganic Chemistry: Structure and Reactivity	Harry B. Gray, Edward I. Stiefel et al.,	University Science Books.
4	Biological Inorganic Chemistry: An Introduction	Robert Crichton	.Elsevier Science (2008)
5	Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, An Introduction and Guide	W. Kaim and B. Schwederski	Wiley, New York (1995)
6	Inorganic Chemistry of Biological Processes, 2nd Ed.	M. N. Hughes	JohnWiley & Sons, New York (1981),

Semester	**IV**
Course Code	**CHM610**
Course Title	**Inorganic Chemistry Practical- IV**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	Preperation of inorganic compounds and their geometric isomers and chomatography methods to determine the Rf values.

Preparation of pipertidien complex of Bis(2,4-pentanedionato) vanadium(IV) oxide, VO(acac)2.
a) Preparation of VO(acac)2
b) Preparation of [VO(acac)2 HNC5H10]
c) Discuss the nature of the V-O bond in VO(acac)2.
d) Compare the v(VO) in VO(acac)2 and [VO(acac)2HNC5H10]complexes.
e) Measure the magnetic susceptibility of [VO(acac)2HNC5H10] and calculate the magnetic moment.
Preparation of cis- and trans- Potassiumdioxalatodiaquachromate(III), K[Cr(C2O4)2(H2O)2].
a) Prepare cis- and trans- isomers.
b) Record and interpret the electronic absorption spectra of the two isomers and assign the observed transitions.
c) Analyse any of the isomers for oxalate by titration against standardized permanganate.
Synthesis and characterization of the Ni(II) complex of a Schiff-base ligand derived from Salicylaldehyde and ethylenediamine.
a) Synthesis the Schiff-base lignad.
b) Interpret the 1H NMR and IR spectra of the ligand.
c) Synthesis the Ni(II) complex of the ligand and compare its IR spectrum with that of the ligand.
Separation of the metal cations by
a) Column chromatography with gradient elution Co(II) and Ni(II).
b) Paper chromatography [Fe(II), Co(II), Ni(II) and Cu(II). Determine the Rf values
for the separate standard cations and use these to identify the cations present in the unknown mixture.

Book:

Practical Inorganic Chemistry by Marr and Rockett.

Semester	**IV**
Course Code	**CHM612**
Course Title	**Organic Chemistry Practical- IV**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	To study the preparation and mechanism of organic compounds.

Synthesis and Reactivity of benzalacetophenone
a. Bromination (Electrophilic additions) & subsequent debromination (Elimination)
b. Epoxidation (Cycloaddition, nucleophilic) and ring opening with hydroxide ion.
c. Michael addition of aniline.
d. Conversion of benzalacetophenone to its oxime (nucleophilic addition at C=O)
e. Conversion of oxime to amide (Beckmann rearrangement) and oxazole
(Understand the reactivities at conjugated C=O and C=C) bond.
Synthesis of Cyclohexene from cyclohexanol and its conversion to 1, 2- *cis* and 1, 2- *trans* – cyclohexanediols.
a. Epoxidation with peracid (Cycloaddition) and *anti*- ring opening with sodium hydroxide to *cis*- cyclohexane -1, 2- diol.
b. Dihydroxylation with KMnO4 (Mechanism of *syn*- and *anti*-cyclohexane-1,2-diol)
Preparation and characterization of the Aldol-dehydration products from various combinations of aromatic aldehydes and ketone.
Effect of substituents on aromatic aldehydes on the product distribution.
a. Aldehyde:benzaldehyde, 4-methylbenzaldehyde. 4-methoxybenzaldehyde.
b. Ketone: acetone, cyclopentanons, cyclohexanone (Book 4)6.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	An Introduction to Modern Experimental Organic Chemistry	R.M. Roberts, J.C. Gilbert, L.B. Rodewald and A.S Wingrove	Holt Rinehart and Winston Inc, New York. 1969.
2	Laboratory Experiments on Organic Chemistry	R. Edemas, J.R. Johnson and C.F. Wilcox	The Macmillan Limited, London, 1970.
3	Modern Projects and Experiments in Organic Chemistry	J.R. Mohrig, C.N. Hammonad, P.F. Schatz and T.C. Morrill, W.H	Freeman and Company, New York 2003.

Semester	**IV**
Course Code	**CHM614**
Course Title	**Physical Chemistry Practical- IV**
Type of course	Laboratory Course
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Non Medical or B. Sc. Medical with Chemistry as main subject
Course Objective	Experiments based on chemical kinetics, activity and activity coefficients, and some polarographic techniques.

CHEMICAL EQUILIBRIUM

Study the effect of solvent on the conductance of AgNO3/Acetic acid and determine the degree of dissociation and equilibrium constant in different solvents and their mixtures
(DMSO, DMF, dioxane, acetone, and water) and test the validity of DEBYEHUCKEL-ONSAGER'S equation.

To determine acid and base dissociation constant of amino acid pH metrically.

To calculate thermodynamic parameters, G, S and H for the reaction,
Zn + Hg2SO4 □□2Hg + Zn SO4 by emf measurement.

CHEMICAL KINETICS

Study the salt effects and the solvent effect on the rate law of alkaline hydrolysis of crystal violet.

Determine the degree of hydrolysis and hydrolysis constant of CH3COONa/NaCl/aniline hydrochloride.

Determine the order of reaction by analyzing the kinetic dependence of individual reactant (e.g. saponification of ester).

Determine the energy of activation for the reaction studied above.

ACTIVITY AND ACTIVITY COEFFICIENTS

Determination of mean activity coefficient of given electrolyte by cryoscopy.

Determine activity coefficients by EMF method.

PHASE EQUILIBRIUM

Draw the phase diagram for any one of the following three component partially immiscible liquid systems.
i) DMSO/water/benzene ii) water/benzene/acetic acid

POLAROGRAPHIC TECHNIQUES

Estimation of ions in mixture of Pb2+ and Cd2+ by successive reduction. Evaluate diffusion coefficient of Cd2+

Polarographic determination of Cu and Zn in the given sample of brass.

Determine stability constants of Cd2+ with EDTA.

SPECTROPHOTOMETRIC METHODS

To study the effect of extended conjugation on the wave lengthy of maximum absorption of organic compounds.

ADSORPTION

To determine the adsorption isotherms of heavy metals like Cd, Zn, Cr, Pb. Ni by using nonconventional adsorbents.

TURBIDITYMETRY

To determine concentration of sulphate ions with the help of turbidity meter.

Determine the CMC by turbidimetric method.

LEAST SQUARE FITTING

To draw calibration curve for the concentration determination of potassium ions by flame photometry and to study the least square fitting of the data.

Text and Reference books:

S.No.	Name/Title	Author	Publisher
1	Advanced Practical Physical Chemistry	J.B. Yadav	KRISHNA Prakashan Media (P) Ltd, 2012
2	Experimental Physical Chemistry	C. Das, B. Behera	Tata McGraw Hill Publishing Company Limited.