M.Sc. III-SEMESTER

Semester No.	Category	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of SEE (Hrs)
			IA	SEE	Total	L	T	P		
THIRD	HCT31	Applied Inorganic Chemistry	20	80	100	4	-	-	4	3
	HCT32	Theoretical and Solid State Chemistry	20	80	100	4	-	-	4	3
	HCT33	Spectroscopy	20	80	100	4	-	-	4	3
	SCT31	Heterocyclic and Synthetic Organic Chemistry	20	80	100	4	-	-	4	3
	SCT32	Medicinal Chemistry	20	80	100	4	-	-	4	3
	SCT33	Agro, Health and Medicinal Care Chemicals	20	80	100	4	-	-	4	3
	OET31	Instrumental Analytical Techniques	10	40	50	2	-	-	2	2
	OET32	Bioanalytical Techniques	10	40	50	2	-	-	2	2
	HCP31	Inorganic Chemistry Practicals-III	10	40	50	-	-	4	2	4
	HCP32	Physical Chemistry Practicals-III	10	40	50	-	-	4	2	4
	SCP31	Organic Chemistry Practicals – III	10	40	50	-	-	4	2	4
Total Marks for III Semester					**600**				**24**	

M.SC. CHEMISTRY THIRD SEMESTER

Course Title: APPLIED INORGANIC CHEMISTRY	**Course Code: HCT31**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To acquint with the applications of organometallic chemistry
2.	Understand the importance and applications of nuclear chemistry
3.	To gain knowledge on bioinorganic chemistry related to biological processes
4.	To provide advanced aspects of halogen chemistry

Unit	Description	Hours
01	**Reactions and Catalytic Applications of Organometallic Compounds** Fundamental reactions: Substitution in carbonyl complexes, Mechanisms, Insertion reactions, CO, SO2, olefin insertions, oxidative additions, one electron, addition of oxygen, reductive elimination, CH activation, Use of Organometallic Compounds as catalysts – Catalytic behaviour – Homo catalysis –. Anchoring of Catalysts Hydrogenation. Hydrogenation of olefins (oxo reaction-cobalt and rhodium oxo catalysts), carbonylation of alcohols – Monsanto acetic acid process, Wacker process. Polymerization of olefins and acetylenes: Ziegler – Natta catalysis systems. Fischer – Tropsch reaction, Water Gas Shift reactions.	15hrs
02	**Bioinorganic Chemistry-I** Metal ions in biological systems, essential and trace metals, disease due to metal deficiency and treatment: Iron, zinc, copper, manganese, sodium, potassium, magnesium and calcium. Metal complexes as therapeutic agents: Metal complexes in cancer therapy, metal complexes for the treatment of rheumatoid arthritis, vanadium in diabetes, metal complexes as radio diagnostic agents. Treatment of toxicity due to inorganics: Chelation therapy and requirements of a chelate/antidote. Mechanism of antidotes with poison rendering it inert: Arsenic, lead, mercury, iron, copper, plutonium, cyanide and carbon monoxide poisoning. Ion transport across membranes and active transport of ions across biological membranes, ionophores. Metal complexes in transmission of energy: Chlorophyll, photo systems-I and II in cleavage of water and model systems.	15hrs
03	**Nuclear Chemistry** Nuclear Stability – Mass Defect and Binding Energy..	15hrs

	Radioactivity: Radioactive elements, general characteristics of radioactive decay, interaction of α, β and γ – rays with matter. Nuclear reactions Types of nuclear reactions, Nuclear fission. Applications of Radioactivity: Synthesis of various useful isotopes, use of isotopes in the elucidation of reaction mechanism, structure determination, kinetics of exchange reactions, measurement of physical constants including the diffusion constants, isotope dilution techniques, NAA, PGNAA, neutron absoptiometry and age determination, radio isotopes in field of medicine	
04	**Halogens in positive oxidation states, Chemistry of Astatine.** Lanthanide series: Review on electronic structure, oxidation states, spectral and magnetic properties, lanthanide contraction, abundance and extraction. Lanthanides as shift reagents. Separation of lanthanides: Solvent extraction and ion–exchange. Chemical properties of compounds of lanthanides in II, III, and IV oxidation states. Actinides: Review on Electronic structure and position in the periodic table, oxidation states, occurrence and synthesis of the elements. Spectral and magnetic properties of compounds of actinides in comparison with those of lanthanides and d-block elements. Trans actinides Chemistry of Trans –uranium elements.	15hrs

References:

1. Inorganic Chemistry-Principles of Structure and Reactivity, 4thEdn-J. E. Huheey, E.A. Keiter, R. L. Keiter and O.K. Medhi. Pearson Education (2009).
2. Shriver & Atkins' Inorganic Chemistry, 5th Edn-P. Atkins, Tina Overton, J. Rourke, Mark Weller and F.Armstrong.Oxford University Press (2010)
3. Concepts and models of Inorganic Chemistry-B.Douglas, D. McDaniel & J.Alexander, 3rd Edn. Wiley Student Edn.(2013).
4. Fundamentals of photochemistry-K. K. Rohatgi-Mukherjee, Revised Edn. New Age International.
5. Ferraudi G. L, Elements of Inorganic photochemistry, Wiley Eastern, 1988
6. Photochemistry and Photophysics of Ru(11) polylpyridine complexes in the Bologna group. From early studies to recent developments, Coodinatiom chemistry reviews, Vincenzo Balzani, Alberto Juris, 211, 97-115 ((2001).
7. F.A.Cotton and G.Wilkinson : Advanced Inorganic Chemistry, Wiley, 1991.
8. Environmental Chemistry-A. K. De (Wiley Eastern).
9. Environmental Chemistry-S. K. Banerji, (Prentice Hall India), 1993.

Course outcomes:

1.	Acquint and able to apply organoometallic reactions.
2.	Learn to apply nuclear chemistry to related applications
3.	Able to prepare and comment on properties of various halogen compounds
4	Gain knowledge on the importance of inorganic chemistry in biological porcesses

Course Title: THEORETICAL AND SOLID STATE CHEMISTRY	**Course Code: HCT32**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04

Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	Understand the concepts of thermodynamics and statistics
2.	Gain knowledge in the area of quantum chemistry
3.	Study the solid state properties of materials
4.	Acquint with the knowledge of colloids

Unit	Description	Hours
01	**Statistical Thermodynamics and Quantum Statistics:**Microstates' and Microstates, Assemblies of localized and Non-localized systems, Phase space, γ-Space, μ-Space, andEnsembles. Classical Statistics: Maxwell-Boltzman distribution law for ideal gases and mixture of gases equipartition of energies, Maxwell-Boltzman distribution of velocities and energies(no derivation). Quantum Statistics: Relationships between probabilities and entropy, Sterling approximation. Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann Statistics and comparison between them. Heat capacity of Ortho-Para hydrogen systems. Einstein'sheat capacity for solids. Partition Function: Definition and separation of partition functions. Translational, Vibrational, Rotational and Electronic partition functions for Monoatomic, Diatomic, andPolyatomic gaseous molecules. Sackur-Tetrode equation. Calculation of thermodynamic quantities in terms of partition functions, Residual entropy.	15hrs
02	**Quantum Chemistry:** Review of concepts of operators. Applications of Schrödinger wave equation to Hydrogen like atoms, rigid Rotor, Harmonic oscillators and HartreeSelf consistent field theory. Ab intio and Density functional analysis. Approximation Methods-Variation theory and Perturbation theory (zero, first,). MO Theory: MO Theory of Hydrogen molecule and ion, Bonding and Anti-bonding orbitals. Examples of MO of simple HOMO and HETERO nuclear molecules. Notations of few molecular orbitals, correlation diagrams and Non-crossing rules, Simple Huckel theory of linear conjugated systems (HMO) and applications to systems like, ethylene and butadiene molecules. VB Theory: Secular equation and determinants, Columbic, exchange and overlap integrals. VB theory of H_2 molecule. Comparison of VB and MO theories.	15hrs
03	**Solid State Chemistry:** Solid state reactions: General principles and classification of reactionsMethods of Single Crystal Growth: Solution growth; Melt Growth-Bridgeman, **Instrumentation** **Thermal analysis:** TGA, DTA, DSC (Instrumentation, applications in characterizing solid materials)	15hrs

	Electrical properties: Band theory of solids; semiconductors - extrinsic and intrinsic, Hall effect; thermoelectric effects (Seebeck); Fermi energy levels and their determination for semiconductors. ferroelectric, pyroelectric and piezoelectric properties; ionic and superionic conductors.Superconductivity: Basics, discovery and high Tc materials **Magnetic properties**: dilute and concentrated magnetic systems. Dia, para, ferro, ferri, and antiferro magnetic types; soft and hard magnetic materials; select magnetic materials such as spinels, garnets and perovskites and hexaferrites magnetoresistance and giant magnetoresistance. Understannding. **Optical properties optical, reflectance, photoconductance structure and properties** of amorphous materials (glasses) and zeolites	
04	**Themodynamics, Non-equilibrium Thermodynamics and Colloids:** Solutions: Introduction, partial molar quantities, Gibb's function of mixing and other thermodynamic mixing functions(Gibbs-Duhmen and Duhmen-Margules equations), chemical potential of liquids and liquid mixtures, Excess function for non-ideal solutions. Non-equilibrium Thermodynamics: Microscopic reversibility, entropy production in irreversible process. Different types of forces and fluxes, stationary states. phenomenological equations. Onsagar's reciprocity relations (quantitative), Principle of minimum entropy production, phenomenological in non-linear region. Colloids: Electro kinetic phenomena of colloids, Classification of Surface active agents, Critical Micellar concentration (CMC), determination of Surface tension by different Method'.	15hrs

References :

1. Theoretical Chemistry- Glasstone.
2. Statistical Mechanics- Davidson.
3. Elements of Statistical Thermodynamics- E. K. Nash
4. Statistical Thermodynamics- M.C.Gupta
5. Introduction to Quantum Chemistry- A.K.Chandra
6. Quantum Chemistry- R.K.Prasad
7. Textbook of Quantum Mechanics-P M Mthews & P Venkateshan
8. Problems in Quantum Mechanics- G.L.Squiras.
9. Introduction to Solids- I. V. Azarrof.
10. Solid State Chemistry- A.R.west
11. Modern aspects of Solid State Chemistry- Ed. By C.N.Rao
12. New direction in Solid State Chemistry- C.N.Rao & Gopal Krishnan
13. Thermodynamics by L.M. Koltz & R.M. Rosenberg
14. Thermodynamics by Glasstone
15. Physical Chemistry by P.W. Atkins.
16. Molecular Quantum Chemistry by A. J. Atkins.
17. P. Ball, Designing the Molecular World: Chemistry at the Frontier,

Course outcomes:

1.	Able to apply thermodynamic aspects in chemical reactions
2.	Apply quantum chemistry aspects for various compounds
3.	Interpret the the properties of solid state materials and colloids

Course Title: SPECTROSCOPY	Course Code: HCT33
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand the basic concepts of spectroscopy
2.	To gain knowledge on principle and instrumentation
3.	To familiarize with the working and applications

Unit	Description	Hours
01	**IR Spectroscopy** **IR Spectroscopy:** Basic principles of vibrational spectroscopy, Theory of Infrared Absorption, Vibrational modes and molecular vibrations, calculation of vibrational frequencies. Relationship between molecular structure and IR spectra.**Instrumentation**:Types of IR spectrometers, Single bean and double beam, Key components: source, interferometer, detector, **Quantitative Analysis with IR Spectroscopy:** Basics of Quantitative Analysis, Beer-Lambert Law and its application in IR spectroscopy, Calibration methods for quantitative measurements, Sample Preparation and Handling of solid, liquid, and gaseous samples, interpretation of IR spectra, factors affecting group frequencies and band shapes. IR spectra of coordination modes of ligands like nitrate, thiocyanate, sulphate, carbonate (bridging, bidentate etc.,) and water.Applications in Analytical Chemistry. **Advanced IR Techniques**: **ATR (Attenuated Total Reflection) Spectroscopy**: Principles and applications, Advantages over traditional transmission measurements.	15hrs
02	**HNMR Spectroscopy** Introduction – Nuclear spin and magnetic moment, origin of NMR spectra, Theory of NMR spectroscopy, resonance flipping, instrumentation and sampling, inter pretation of NMR spectrum, equivalent and non-equivalent protons, chemical shifts(down field and up field), factors influencing chemical shifts, anisotropic effects, NMR scale, units, internal references, simple and complex splitting / coupling, coupling constant, correlation chart of chemical shifts, spin-spin relaxations, equivalence of protons–chemical and magnetic equivalence, spin– systems. solvent effects and Nulear Overhauser Effect. Karplus relationships (Karplus curve–variation of coupling constant with dihedral angle), double resonance techniques, first order and second order patterns, lanthanide shift reagents, exchange phenomena. . High resolution 1H NMR. FT NMR and its advantages. Applications of NMR spectroscopy in structure elucidation of simple organic and inorganic molecules. Pulse techniques in NMR, two dimensional and solid state NMR. Use of NMR in Medical diagnostics. Deuterium exchange techniques limitations of H NMR spectroscopy .	15hrs

03	**Introduction and applications of 13C NMR spectroscopy**, Broad band and off resonance coupling methods of detection. 13C Chemical shifts of different classes of organic compounds–alkanes, alkyl halides, alkenes, alcohols, ethers, carbonyl compounds and aromatic compounds. 2 DNMR spectroscopy, use of PMR spectrum in structural elucidation of organic compound.^{31}P and ^{19}F NMR. COSY, NOESY (Nulear Overhauser Effect) and EXSY (Exchange Spectroscopy), MRI. Conformational analysis, keto-enol tautomerism, Hbonding. Spectra of simple organic molecules, phosphates, polyphosphates, PH_3, phosphor halides, fluoro acetic acid, SF_4, P_4S_4, HPF_2. Raman Spectroscopy: Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid. Classical theory of Raman Effect – rotational Raman spectra – Linear – Vibrational Raman Spectra, rule of mutual exclusion principle.Instrumentation. Resonance Raman Spectroscopy: Resonance Raman Effect and its applications. Non-linear Raman effects: Hyper, stimulated and inverse Raman effects. Coherent Anti-Stokes Raman Scattering and its applications..	15hrs
04	**Mass Spectroscopy:** Introduction, Basic theory, ionsation, types of ions, molecular ion, fragment ion, meta stable ion, base peak, instrumentation, factors affecting fragmentation, intensity of M^+ peaks of alkanes, alkenes, alkynes, alcohols, amines, aldehydes and other compounds, Mc Laffarty rearrangement nitrogen rule, some simple examples of fragmentations, applications of mass spectrometry. **Advanced Mass Spectrometry Techniques:** Introduction to advanced MS techniques such as tandem MS (MS/MS) and high-resolution MS (HRMS). **Gas Chromatography (GC):** Principle, instrumentation, columns, detectors (thermal conductivity, flame ionization, electron capture, mass spectrometry), factors affecting separation, applications, GC-MS and its applications. **High-Pressure Liquid Chromatography (HPLC):** Apparatus, pumps, column packing, characteristics of detectors (UV, IR, refractometer, fluorescence), advantages, applications, HPTLC, and its applications. **Hyphenated Techniques:** Introduction to hyphenated techniques like LC-MS/MS and GC-MS/MS. Advantages and applications of combining chromatography with mass spectrometry.	15hrs

References:

1. Mass Spectrometry: Principles and Applications" by Edmond de Hoffmann and Vincent Stroobant (John Wiley & Sons).
2. Interpretation of Mass Spectra by Fred W. McLafferty and FrantišekTureček (University Science Books).
3. Mass Spectrometry in Chemistry and Biochemistry by Victor R. Preedy (CRC Press).
4. "Introduction to Mass Spectrometry: Instrumentation, Applications, and Strategies for Data Interpretation" by J. Throck Watson and O. David Sparkman (John Wiley & Sons).
5. "Liquid Chromatography-Mass Spectrometry: An Introduction" by Robert E. Ardrey (John Wiley & Sons).
6. Fundamental of Analytical Chemistry. D.A.Skoog, D.M.West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
7. Analytical Chemistry. G.D. Christian, 5thedn, 2001 John Wiley & Sons, Inc,India.
8. Gas Chromatography Mass Spectrometry: Principles, Applications, and Reference Standards" by Jean-Francois Focant and Pat Sandra (Academic Press).
9. Tandem Mass Spectrometry: Molecular Characterization" by G. L. Glish and J. V. F. Martin (Wiley-Interscience).
10. "Practical LC-MS Method Development" by John W. Dolan and Thomas J. Moon (CRC Press).
11. An introduction to Magnetic Resonance spectroscopy, D.N. Sathyanarayana, I.K. International, 2013.
12. Spectroscopy of Organic compounds – P.S. Kalsi, New Age International Publications, New Delhi (6th Edn.), 2007.
13. Organic Spectroscopy – William Kemp 3rd Edn. ELBS, 1991
14. Instrumental methods of analysis. L. L. Meritt, J. A. Dean, F.A., settle 6th Edn. (Van Nostnoand).
15. Principles of Instrumental Analysis. D. S. Kooj (Sander Colley).
16. Fundamentals of Analytical Chemistry. Skoog, West, Holler, 7Th Edn. Harcourt Agra. Publication Harcourt College Publishers.
17. Principles of instrumental analysis. Skoog, Haller, Nieman, 5th Edn. Harcourt.
18. Treatise an analytical chemistry. F. J. Kohthiff& F. T. Elhiy, (M. Interscience).
19. Nuclear and Radiochemistry. G. Dridelandey, J. M. Millar, M. M. Keondy& E. S. Macias (John Willey).
20. Essentials of Nuclear Chemistry. H. J. Arnikar (Wiley Eastern).
21. Text Book of quantitative chemical analysis. A.I. Vogel (ELBS).
22. Introduction to NMR Spectroscopy – R.J. Abraham, J. Fisher, P. Loftus, - Wiley Publications, 1988.

Course outcomes:

1.	Acquint and able to apply spectroscopic techniques for qualitative and quantitative analysis
2.	Skilled with their handling and interpretation of data

Course Title: HETEROCYCLIC AND	**Course Code: SCT31**

SYNTHETIC ORGANIC CHEMISTRY	
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand the basic concepts of heterocyclic compounds
2.	To gain knowledge on principle and mechanism involved in photochemical, pericyclic and retro synthesis.
3.	To acquire theroretic skills in bond extension reactions

Unit	Description	Hours
01	**Heterocyclic compounds:** Nomenclature of heterocyclic compounds. Synthesis (Each two methods) and reactivity (towards electrophilic and nucleophilic reactions) – Pyrroles, Furans, Thiophenes, Pyridines, Azepines, Oxepins, Thiepins. **Fused heterocycles: S**ynthesis (Each two methods) and chemical properties towards electrophilic and nucleophilic reactions of benzopyrroles, benzofurans, benzothiophenes, quinolines and isoquinolines. **Mesoinonic compounds:** Nomenclature, synthesis, reactions and applications of Sydnones	15hrs
02	**Photochemistry and Pericyclic reactions:** **Photochemistry and concerted reactions**: Introduction, light absorption and electronic transitions, Jablonski diagram, intersystem crossing, energy transfer, sensitizers, quenchers Photochemistry of olefins, conjugated dienes, aromatic compounds, ketones, enones, photooxidations, photoreductions Norrish type I and II reactions, Paterno-Buchi reaction, Barton reaction, Di-pi-methane rearrangements. **Pericyclic reactions**: Electrocyclic reactions: Stereochemistry, Symmetry and Woodward-Hofmann rules for electro cyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadine and cyclohexadiene systems. **Cycloaddition reactions**: [2+2] [3+2] and [4+2] cycloadditions, analysis by FMO and correlation diagram method. **Sigmatropic reactions**: Classification, stereochemistry and mechanisms.	15hrs
03	**Retro synthesis via disconnection approach:** **Organic Synthesis:** Introduction to synthons, synthetic equivalents, functional group interconversions, **Protection and de-protection in organic synthesis –** Protection of hydroxyl, carboxyl, carbonyl, amino, thiol groups and their de-protection. Illustration of protection and deportation in organic synthesis with examples. **Disconnection approach:** One group C-X disconnection- Carbonyl	15hrs

	compounds, ethers and sulphides (Benzyl benzoate, propanil, p-methyanisole, isopentyl benzyl ether, chlorobenside). **Two group disconnection**- 1, 1- difunctionalized compounds (Acetals, cyanohydrins, amino acids etc.), 1,2-difunctionalized compounds (1,2-dicarbonyl compounds, α- hydroxyl carbonyl compounds). **Retrosynthesis:** Retrosynthesis of benzocaine, 4-methoxy acetophenone, saccharin, bisvoline, canthredine, lycorane and multstrin.	
04	**Named reactions:** **C–C Bond forming reactions:** Aldol condensation, Claisen condensation reaction, Michael reaction, Robinson annulations, Stobbe condensation, Wittig reaction, Acylion synthesis. Alder – Ene reaction, Bischler – Napieralski, Dieckmann condensation, Knoevenagel condensation, Mannich reaction. **Coupling reactions:** Hiyama cross-coupling reaction, Negishi cross-coupling reaction, Stille coupling, Suzuki – Miyaura coupling, **C–N Bond forming reactions:** Buchirer reaction, Buchwald – Hartwig amination, Stork enamine reaction, Hofmann – Loffler – Freytag reaction, Barton reaction. **C–O Bond forming reactions:** Dakin reaction, Mislow – Evans rearrangement, Mukaiyama reagent, Bayer – Villager reaction.	15hrs

References:

1. Modern Synthetic Reactions, H.O. House, W.A Benjamin
2. Some Modern Methods of Organic Synthesis, W Carruthers, Cambridge Univ. Press
3. Principles of Organic Synthesis, R.O.C Norman and J.M. Coxon, Blackie Academic & Professional
4. Advanced organic chemistry.F.A.carey and R.J.sunderberg
5. Rood's Chemistry of Carbon Compounds, S. Coffey.
6. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhmop and G. Penzillin.
7. Guide Book to Organic Synthesis, R.K. Mackie & D.M. Smith, ELBS.
8. Organic Synthesis, V.K. Ahuwalia and Renu Agarwal, Narosa
9. Synthesis, Approaches in Organic Chemistry, R.K. Bansal, Narosa
10. Advanced Organic Chemistry -Reactions, Mecha- nism and Structure, Jerry March, John Wiley.
11. Designing Organic Synthesis, S.Warren, Wiley.
12. Organic Synthesis , Stuart warren, 2012 John Wieley and sons camebridge University.

Course outcomes:

1.	Able to carry out complex organic reactions
2.	Predict the reaction mechanism and conditions for reaction and synthetic applications.

Course Title: MEDICINAL CHEMISTRY	**Course Code: SCT32**
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand the basic concepts of medicinal chemistry
2.	To gain knowledge on drug action, designing and pharmacokinetics.
3	To acquint with the process of drug discovery

Unit	Description	Hours
01	**Introduction to Medicinal Chemistry**: History and development of medicinal chemistry, Physicochemical properties in relation to biological action, Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. Drugs: Essential Drugs, Nomenclature of Drugs, Routes of Drug Administration, Adverse effects of Drugs, IUPAC Naming of Drugs.	15hrs
02	**Drug discovery process**: Brief introduction to bioinformatics and chemo informatics, Molecular modeling: Energy minimization, geometry optimization, conformational analysis. Drug discovery process: Computer Aided Drug Design (CADD), Development of New Drugs, Factors Affecting development of New Drugs. Concept of prodrugs and soft drugs, Drug Receptors. Molecular docking: Rigid docking, flexible docking, manual docking. Autodock and Dock softwares with examples.	15hrs
03	**Pharmacokinetics**: Introductions, Drug Absorption, Distribution, Metabolism (Phase I and Phase II), Excretion and Toxicity (ADMET). Pharmacodynamics: Introduction, Drug receptor interaction, Types of Interactions, Enzyme Stimulation, Enzyme Inhibition, Membrane Active Drugs, QSAR- 2D QSAR and 3D-QSAR.	15hrs
04	**Drug Action**: Theories of Drug Action, Molecular Recognition in Drug-Receptor Binding, Enzyme Inhibitors (Modes of inhibition). Antibacterial, Antifungal, Antiviral and Anticancer drugs (Major drug classes, mechanism of drug action, Drug resistance). Analgesic Drugs, anesthetics (general, local), Neurotransmitters (adrenergic, cholinergic effects; psychopharmacology), CNS depressants (sedative/hypnotic, major/minor tranquilizers), CNS stimulants, Steroids.	15hrs

References:

1. The Organic Chemistry of Drug Design and Drug Action, by Richard B. Silverman, 2nd Edition. Elsevier Academic Press, 2004, ISBN 0-12-643732-7.
2. Foye's Principles of Medicinal Chemistry, 5th Edition, by David A. Williams and Thomas L. Lemke, Lippincott Williams & Wilkins, 2002.
3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd Edition, by Thomas Nogrady and Donald F. Weaver, 2005.
4. Medicinal Chemistry, An Introduction, by Gareth Thomas, John Wiley & Sons, 2000.
5. The Practice of Medicinal Chemistry, ed. Camille Wemuth, Academic Press, 1996.

Selected Medicinal Chemistry Journals

1. Journal of Medicinal Chemistry
2. Journal of Medicinal Chemistry Letters (starting with 2010, Volume 1)
3. Bioorganic & Medicinal Chemistry
4. Bioorganic & Medicinal Chemistry Letters

European Journal of Medicinal Chemistry 6.ChemMedChem

Course outcomes:

1.	Able to comments on the drug action
2.	Design the drug molecules based on their pharmacokinetics

Course Title: AGRO, HEALTH AND MEDICINAL CARE CHEMICALS	Course Code: SCT33
Teaching Hours/Week (L-T-P): 4 - 0 - 0	**No. of Credits:** 04
Internal Assessment: 20 Marks	**Semester End Examination:** 80 Marks

Course objectives:

1.	To understand the chemistry of general chemicals of routine use
2.	To gain knowledge on the composition of agro chemicals and health care chemicals.
3.	To acquire concepts and metholdology of clinical chemistry

Unit	Description	Hours
01	**Fertilizers:** Introduction, Essential plant Nutrients, Classification of Essential Nutrients, Primary Nutrients, Secondary Nutrients, Micronutrients, Macronutrients, Classification of Fertilizers Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures, Feed Stock/ Raw materials- Nitrogenous Fertilizers, Phosphatic Fertilizers, Potassic Fertilizers, Manufacture and general properties of Fertilizer products- Intermediates- Ammonia, Nitric Acid, Sulphuric Acid, Phosphoric Acid, Nitrogenous Fertilizers- Ammonium Sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Calcium Nitrate, Ammonium Chloride, Urea, Phosphatic Fertilizers, Ground Rock Phosphate, Single Superphosphate, Triple Superphosphate, Potassic Fertilizers- Potassium Chloride (Muriate of Potash), Potassium Sulphate (Sulphate of Potash), Potassium Nitrate, Complex Fertilizers- Ammonium Phosphate Sulphate, Ammonium Phosphates, Mono Ammonium Phosphate (MAP), Di-Ammonium Phosphate (DAP), Nitrophosphates, Urea Ammonium Phosphates, NPK Complex Fertilizers, Fertilizer mixtures-Physical Mixtures, Granulated Mixtures.	15hrs
02	**Insecticides:** Introduction, classification, Organochlorine insecticides- BHC, DDT, endosulfan, sevin, Insect pheromones, general introduction and applications in integrated pest management. **Repellents:** Survey & synthesis of the repellents-N,N-diethyltoluamide, 2-ethyl-1,3-hexanediol. **Fungicides:** Introduction, Inorganic & organic fungicides, Systemic fungicides-types & examples. **Herbicides:** Introduction, study of sulfonyl ureas, Mechanism of action and toxicities of insecticides, fungicides and herbicides.	15hrs
03	**Perfumery**: Introduction, Compounds used in perfumery and their classification, methods of preparation and importance of phenyl ethanol, Yara yara, Ionone musk ketone, musk ambrette, musk xylene, phenyl	15hrs

	acetic acid and its esters, benzyl acetate, synthetic musks and jasmine. Essential oils: Source, constituents, isolation & uses. **Dyes:** Classification of dyes according to the mode of applications and according to the chemical constitution; Methods of preparation of commercial dyes of different classes with suitable examples; Typical manufacturing processes of dyes; Fluorescent brightening agents	
04	**Oils, soaps and Detergents**: Refining of edible oils, manufacturing of soaps, detergents classification-anionic, cationic, non-ionic and amphoteric detergents, detergent builders and additives, liquid soaps. Manufacturing of fatty acids and glycerol, greases from fatty acids, Turkey red oil. **Clinical Chemistry**: Composition of blood collection, and preparation of samples, clinical analysis – serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acidic and alkaline phosphates, Immunoassay , principals of radio immunoassay and applications. The blood- gas analysis –trace elements in the body.	15hrs

References:

1. Statistical Quality Control, 2nd Edn., Manohar Mahajan Dampat Rai and Sons, 1995.
2. Quality management: a process improvement approach,Fryman Mark A, Cengage learning, 2002.
3. Quality Control, Paranthaman D, Tata, McGraw Hill,1987. 4. Gupta R. N. Chemical warfare and casuality management 2011
5. Vyas M. N. Safety and hazards management in chemical industries 2013.Atlantic publication. 6. Dikshith T.S.S Safety evaluation of environmental chemicals. New Age International, 1996.
7. Chemical Safety Matters-IUPAC-IPCS, Cambridge univ. Press, 1992.
8. Environmental Chemistry, A.K. Dey, Wiley Eastern.
9. Environmental Chemistry, S.K.Banerji, Prentice Hall India, 1993.
10. Chemistry of Water Treatment, S.D. Faust and O.M. Aly, Butterworths, 1983.
11. Environmental chemistry, Ahluwalia V K, Anne Books India, 2008.
12. Chemistry for Environmental Engineering, Sawyer and McCarty, McGraw Hill, 1978.
13. Environmental Chemistry, I.Williams, John Wiley, 2001 14. Engineering Chemistry by Jain and Jain.
15. Industrail electrochemistry by Peltcher 16. Modern Electrochemistry, Vol I, IIA & IIB(1998) J.O.M. Bockries and A.K.N.Reddy
17. Chemical Engineers Hand Book, 8th Edn., Robert H. Perry, Mc Graw Hill, 1995. 18. Principles of Industrial Chemistry, C. A. Clausen and G. Matts

Course outcomes:

1.	Able to understand the synthesis and composition of routinely used dyes, fertilizers and health care products
2.	Comment on their use and applications

Course Title: INSTRUMENTAL ANALYTICAL TECHNIQUES	**Course code: OET 31**

Total Contact Hours: 30	**Course Credits: 02**
Formative Assessment Marks: 10	**Duration of ESA/Exam: 2h**
Summative Assessment Marks: 40	

Course Objectives:

1.	Study the basics and fundamentals of analytical techniques
2.	Acquire knowledge on spectroscopic techniques for the analysis of simple compounds
3.	To understand the principle and applications of spectroscopic techniques for qualitative and quantitative analysis

Unit	Description	Hours
1	**Introduction:** Qualitative and quantitative analysis; Concentration terms; Sampling and its Importance **Conductometry:** theory, types of conductometric curves , Instrumentation and applications **Potentiomtry**: principle, instrumentation and applications **Polarography**, reference electrodes, dropping mercury electrode, instrumentation and applications **Spectroscopic techniques:** Interaction of electromagnetic radiation with matter, Beer-Lambart's law-Limitations; **UV-Vis-Spectroscopy**: Principle, Instrumentation and applications for determination of composition of metal to ligand; metal ions like Fe, Ti and biological samples **FTIR spectroscopy**: Principle, sample preparation, Instrumentation and applications for determination of functional groups of hydrocarbons, alcohols, carbonyl compounds, amines, etc **Fluorescence Spectroscopy:** Principle and applications	15

2	**NMR Spectroscopy**: Principle, sample preparation, chemical shift, factors affecting chemical shift, Interpretation of spectra and applications for simple molecules **Mass spectroscopy:**Principle, fragmentation process, factors affecting fragmentation, base peak and molecular ion peak, nitrogen rule, Interpretation of spectra and applications for simple molecules. **Raman Spectroscopy**: Principle , Instrumentation and applications **X-ray diffraction:** measurement of X-rays, GM counter, Ionization counter, Semicinductor detectors, Scintillation counters, X-ray absorption and emission spectroscopy, Bragg's law, Debye Scherrer X–ray diffraction method, applications **Electron microscopic techniques:** Principle, Instrumentation and applications of SEM, TEM and AFM	15

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York, (2005).
2. Analytical Chemistry, G.D. Christian, 5th ed, John Wiley & Sons, Inc, India (2001).
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th Edn, prentice Hall, Inc. New Delhi, 1993.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint. Pearson Education Pvt. Ltd., New Delhi, (2003).
5. Spectroscopy of Organic compounds – P.S. Kalsi, New Age International Publications, New Delhi (6th Edn.), 2007.

Course Outcomes:

1.	Capable to predict the structure of simple compounds
2.	Helps in scientific career

Course Title: BIOANALYTICAL TECHNIQUES	Course code: OET 32
Total Contact Hours: 30	**Course Credits: 02**
Formative Assessment Marks: 10	**Duration of ESA/Exam: 2h**
Summative Assessment Marks: 40	

Course Objectives:

1.	Study the basics principles of separation techniques
2.	Understand the importance of separation techniques for qualitative and quantitative analysis
3.	Learn the principle and applications of basic spectroscopic techniques

Unit	Description	Hours
1	**Distillation:** Importance, Principle, methodology, distillation of high boiling solvents, applications **Filtration:** Principle, methodology and application **Crystallization:**Principle, methodology and application **Ultracentrifugation:** Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications. **Solvent extraction:** Principle, Distribution law, types, methodology, application for the extraction of Fe, Cu **Thin layer Chromatography:** Principle, methodology, RF value, application in identification and monitoring of the reaction **Electrophoresis:** types, the basic of electrophoretic separations, migration rates and plate heights, electro osmotic flow, instrumentation, capillary zone electrophoresis, capillary gel electrophoresis, capillary isolectrophoresis	15

2	**Column chromatography:** Principle, methodology, application in identification and monitoring of the reaction **Gas chromatography:** Mobile phase, stationary phase**,** Principle, Components and instrumentation, applications in the analysis of volatile compounds**,** Assay **High Performance liquid chromatography:** Principle, Components and instrumentation, applications in the analysis of volatile compounds**,** Assay and purity **UV-Vis-Spectroscopy**: Principle, Instrumentation and applications for determination of composition of metal to ligand; metal ions like Fe, Ti and biological samples **FTIR spectroscopy**: Principle, sample preparation, Instrumentation and applications for determination of functional groups of hydrocarbons, alcohols, carbonyl compounds, amines, etc	15

References:

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York, (2005).
2. Analytical Chemistry, G.D. Christian, 5th ed, John Wiley & Sons, Inc, India (2001).
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, prentice Hall, Inc. New Delhi, (1993).
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint. Pearson Education Pvt. Ltd., New Delhi, (2003).

Course Outcomes:

1.	Capable to separate the simple products in a mixture
2.	Able to adopt the skills of separation

Course Title: INORGANIC CHEMISTRY PRACTICALS-III	**Course Code: HCP31**
Teaching Hours/Week (L-T-P): 0 - 0 - 4	**No. of Credits:** 02
Internal Assessment: 10 Marks	**Semester End Examination:** 40 Marks

Course objectives:

1.	To acquint with the analysis of industrial samples
2.	Hands-on training for the colorimetric analysis of the samples.
3.	Acquire knowledge o the analsis of natural samples.

List of Experiments: **60 hrs**

1.	Analysis of solder.
2.	Analysis of copper- nickel alloy.
3.	Analysis of pyrolusite ore.
4.	Analysis of steel
5.	Estimation of Iron content in Heamatite
6.	Estimation of Calcium and Magnesium by complexometric titrations
7.	Colorimetric determination of Fe, Ti and V

References:

1.	Vogel's Text book of Quantitative Inorganic Analysis – J.Basett, R.C.Denney, G.H.Jeffery and J.Mendhaman, Longamans Green and Company Ltd.
2.	Practical Inorganic Chemistry-G.Pass and H.Sutchliff
3.	General Chemistry Experiment- A.J.Elias
4.	Practical Inorganic Chemistry, G. Marr and B. W. Rockett, VonNostrand Reinhold Co., London 1972.

Course outcomes:

1.	Evaluate the industrial products for quantitative analysis
2.	Capable to perform spectrophotometric analysis

Course Title: PHYSICAL CHEMISTRY PRACTICALS-III	**Course Code: HCP32**
Teaching Hours/Week (L-T-P): 0 - 0 - 4	**No. of Credits:** 02
Internal Assessment: 10 Marks	**Semester End Examination:** 40 Marks

Course objectives:

1.	To acquint with the conductometric and potentiometric titrations
2.	Study of kinetics, phase diagram, etc
3.	Gain knowledge on the surface tension.

List of Experiments:

1.	Effect of added salt (Uni-Uni and Bi-Bi salts.
2.	Determination of rate constant and order of reaction between $K_2S_2O_8$ and KI
3.	Determination of equilibrium constant of reaction between KI + I_2 = KI_3 by distribution method.
4.	Kinetic study of iodination of an acetone
5.	Study of kinetics of inversion of cane sugar by Polarimetry
6.	Phase diagram of three component system.
7.	Titration of p-Toludine against HCI by conductometry.
8.	Determination of end point of some typical titrations. (Precipitation & replacement) conductometrycally.
9.	Potentiometric titration of o-phosphoric acid against alkalies NaOH.
10.	Potentiometric titration of halide mixture against $AgNO_3$.
11.	Titration of mixture of HCl, AcOH ,$CuSO_4$ against conductometrycally
12.	Determination of equivalent conductance at infinite dilution of a strong electrolyte and verification of Onsgars law.
13.	Potentiometric titration of $Pb(NO_3)_2$ vs EDTA
14.	Potentiometric titration of mixture of weak acids, HCOOH, CH+COOH, $ClCH_2COOH$ Vs NaOH Estimation of metal ions solution by plarographic method.
15.	Determination of surface tension.

References:

1.	Fridley's Practical Physical Chemistry- B.P.levitt.
2.	Advanced Practical Physical Chemistry- G.B.Yadav
3.	Experiments Practical Physical Chemistry- Shomaker
4.	Systematic experimental Physical Chemistry- S.W.Rajbhoj & T.K.Chondeker
5.	Senior Physical Chemistry Practical- Kholsa et.al

Course outcomes:

1.	Evaluate the conductometric and potentiometric titrations
2.	Capable to perform kinetics of reactions

Course Title: ORGANIC CHEMISTRY PRACTICALS-III	**Course Code: SCP31**
Teaching Hours/Week (L-T-P): 0 - 0 - 4	**No. of Credits:** 02
Internal Assessment: 10 Marks	**Semester End Examination:** 40 Marks

Course objectives:

1.	To acquint with the analysis of industrial samples
2.	Hands-on training for the colorimetric analysis of the samples.
3.	Acquire knowledge on synthetic principles of simple organic compounds

List of Experiments:

I. Preparation of dyes and drug	
1.	Preparation of Methyl Orange
2.	Preparation of Fluorescein
3.	Synthesis of Crystal violet
4.	Synthesis of Phenolphthalein
5.	Preparation of paracetamol (acetaminophen)
6.	Preparation of phenacetin
7.	Synthesis of Sulfanilamide
8.	Synthesis of Antipyrine
9.	Synthesis of Aspirin
II. Estimations	
1.	Estimation of Cholesterol by Colorimetry.
2.	Estimation of Amino acids by Colorimetry.
3.	Estimation of Proteins by Colorimetry.
4.	Estimation of Carbohydrates by Colorimetry.
5.	Iodine value of fat or oils
6.	Estimation of Aspirin by titration

References:

1.	Advanced Practical Organic Chemistry N K Vishnoi Second edition, Vikas Publishing House Pvt. Ltd, 1996
2.	Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis Renu Aggarwal
3.	Systematic Laboratory Experiments in Organic Chemistry Arun Sethi, New Age International, 2003.
4.	Comprehensive Practical Organic Chemistry: Qualitative Analysis Ahluwalia V.K. Sunitha Dhingra
5.	Practical Organic Chemistry: Qualitative Analysis Bhutani S.P. Chhikara A, First edition, ANE books-new Delhi, 2009
6.	Vogel's Textbook of Practical Organic Chemistry Brian S. Furniss, 5th Edition, Pearson India, 2005.
7.	Laboratory techniques in Organic chemistry, V.K. Ahluwalia , Pooja Bhagat & Renu Aggarwal, I.K. International Publishing House Pvt. Ltd.
8.	Laboratory Manual of Organic Chemistry Raj K. Bansal. 5th edition, New Age international, 2008
9.	Practical Organic Chemistry F.G. Mann, B.C Saunders, Fourth edition, Pearson India, 2009.

Course outcomes:

1.	Evaluate the industrial products for quantitative analysis
2.	Capable to perform spectrophotometric analysis