Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH512T	Transition Metals and Coordination Chemistry	3	0	0	6
2	CH513T	Concepts and Mechanisms in organic chemistry	3	0	0	6
3	CH503T	Molecular spectroscopy	3	0	0	6
4	CH511T	Main group chemistry	3	0	0	6
5	CH401L	Chemistry laboratory-II	0	0	3	3
6		Program Elective-III	2	1	0	3
7		Program Elective-IV	2	1	0	3
		Total Credits				**33**

1	**Title of the course** (L-T-P-C)	**Transition Metals and Coordination Chemistry (3-0-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	1.Chemistry of transition metals: Introductory survey of transition elements with reference to electronic configuration, oxidation states, complex compounds. Introductory concepts of molecular symmetry. Spectral and magnetic properties. 2. Chemistry of titanium, vanadium, chromium, manganese sub-group elements, iron, cobalt, nickel, platinum metals, copper and zinc sub-group elements, group III, IV, V, VI, VII and rare gases with reference to isolation, properties, uses and important compounds. 3. Chemistry of Lanthanides and Actinides: Electronic configuration, colour and magnetism, properties of lanthanides and actinides. Synthesis of trans-Uranic elements, chemistry of uranium compounds. 4. Introduction to Coordination Compounds: Werner's work, structure, isomerism, thermodynamics of complex formation. 5. Bonding in Transition Metal Complexes: Valence bond theory, crystal field theory, ligand field theory, pi-acceptor/donor interactions. 6. Electronic Spectra: Energy levels in an atom, coupling of orbital angular momenta, spin angular momenta, and spin-orbit, ground state terms-Hund's rules, microstates, electronic spectra (selection rules), splitting of electronic energy levels and spectroscopic states, Tanabe-Sugano diagrams. 7. Reactions and Mechanism: Ligand substitution reactions, base hydrolysis, stereochemistry, isomerization reactions, redox reactions (the inner-sphere mechanism, the outer- sphere mechanism), photochemical reactions.
4	**Texts/References**	1. Concise Inorganic Chemistry by J. D. Lee, 5th edition, Blackwell Publishing, 2006. 2. Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr,5th edition, 2014. 3. Catherine E. Housecroft and Alan G. Sharpe, Inorganic Chemistry, 5th edition., 2018. 4. Atkins, P., et al., Shriver and Atkins Inorganic Chemistry, 5th Ed., Oxford UniversityPress, 2010. 5. Organometallics by Christoph Elschenbroich, 3rd edition, 2006. 6. The Organometallic Chemistry of the Transition Metals by Robert H Crabtree, 2014. 7. J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4th Ed, Pearson Education, 2006. 1. Advanced Inorganic Chemistry by F. A. Cotton, G. Wilkinson C. A. Murillo and M. Bochmann, John Wiley,Chichester, 6th edition, 1999.

1	**Title of the course** (L-T-P-C)	**Concepts and Mechanisms in Organic Chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	Basic mechanistic concepts – kinetic versus thermodynamic control, Hammond's postulate and Curtin-Hammett principle. Methods of determining reaction mechanisms through kinetics, identification of products, intermediates and isotopic labeling. Linear free-energy relationship – Hammett and Taft equations. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. Geometrical isomerism and optical isomerism. Atropisomerism, and neighboring group participation on reactivity and selectivity. Reactive Intermediates: Generation, structure, properties and reactions of carbenes, nitrenes, radicals, carbocations, carbanions and benzynes. Introduction to different reaction types:substitution, elimination, addition, oxidation, reduction, pericyclic and concerted reactions (electrocyclic, cycloaddition and sigma tropic) and molecular rearrangements
4	**Texts/References**	1. Jerry March and Michael Smith, "Advanced Organic Chemistry", 7th Ed., Wiley, 2015. 2. F. A. Carey and R.J. Sundberg, "Advanced Organic Chemistry, Part A", 5th Ed., Springer, 2008. 3. J. Clayden, N. Greeves, and S. Warren, "Organic Chemistry", 2nd Ed., Oxford University Press, 2014. 4. W. Carruthers and I. Coldham, "Modern Methods of Organic Synthesis", 4th Ed., Cambridge University Press, 2015. 5. P. Bruice, "Organic Chemistry" 7th Ed., Pearson, 2013.

1	**Title of the course** (L-T-P-C)	**Molecular spectroscopy** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Introduction to spectral energy domains and measurement of spectra, Implications of discrete energy levels, Population of States – Boltzman Distribution, Interaction of radiation with matter, origin of linewidths in molecular spectra, Transition dipole moment and Fermi's Golden Rule, Einsteins Coefficients, Lasers and Masers. Rotational (Microwave) spectroscopy, Molecular vibrations - Infrared spectroscopy, Normal mode analysis, Raman Scattering, Selection Rules from Group Theory, Molecular electronic spectra, Photophysical processes, Non-Linear Spectroscopy, Nuclear Magnetic Resonance, Relaxation times, FT-NMR, spin-spin coupling, ESR, Nuclear Quadrupolar Resonance.
4	**Texts/References**	1. J. L. McHale, Molecular Spectroscopy, Pearson Education, 1999. 2. M. Hollas, Modern Spectroscopy, Wiley; 4th edition, 2004. 3. F. A. Cotton, Chemical Applications of Group Theory, 3rd edition, Wiley-Interscience, 1990. 4. D. C. Harris, M. D. Bertolucci, Symmetry and Spectroscopy, Dover, 1990. 5. C. M. Banwell, E. M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill, 1983 6. G. M. Barrow, Molecular Spectroscopy, McGraw Hill, 1962 7. J. I. Steinfeld, Molecules and Radiation: An Introduction to Modern Molecular Spectroscopy, 2nd edition, Dover, 2005. 8. J. D. Graybeal, Molecular Spectroscopy, McGraw Hill 1993. 9. D. A. McQuarrie and J. D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. 1998.

1	**Title of the course** (L-T-P-C)	**Main group chemistry** **3-0-0-6**
2	**Pre-requisite courses(s)**	--
3	**Course content**	• General characteristics of s- and p-block elements comparative study of second short period elements (B to F)with heavy congeners (Al to Cl), Electron deficient molecules and hypervalency. • Hydrogen and hydrides, the boron and carbon groups, the nitrogen and oxygen groups, the halogens and the noble gases. • Review of inorganic chains, rings and cages, Inorganic chains, rings, and cages. • Nuclear magnetic resonance (NMR) and Electron paramagnetic resonance (EPR) spectroscopy of Inorganic System • Mössbauer spectroscopy • Vibrational spectroscopy: Fourier transform infrared (FT- IR) and Raman spectroscopy, resonance Raman spectroscopy • UV-vis, X-ray absorption spectroscopy (XAS)
4	**Texts/References**	• Atkins, P., et al., Shriver and Atkins Inorganic Chemistry, 5th edition, Oxford University Press, 2010. • Lee, J. D., Concise Inorganic Chemistry, 5th edition, Blackwell Publishing, 2006. • Douglas, B., McDaniel, D., Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India (P.) Ltd., India, 2010. • J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4th edition, Pearson Education, 2006. • Chemistry of the Elements, by N.N. Greenwood and A. Earnshaw, Butterworth-Heinmann, London, 1997. • Advanced Inorganic Chemistry by F. A. Cotton, G. Wilkinson C. A. Murillo and M. Bochmann, John Wiley, Chichester, 1999.

1	**Title of the course** (L-T-P-C)	**Chemistry laboratory III (CH 313)** **0-0-3-3**
2	**Pre-requisite courses(s)**	--
3	**Course content**	• Inorganic chemistry: Determination of composition of complexes in solution. Synthesis and characterization of transition metal complexes (including organometallic compounds) and their study by various methods (spectral, thermal and magnetic etc). • Organic chemistry: Chemical separation of ternary mixtures and characterization of the components. Simple one or two step preparations involving different techniques, Isolation of naturalproducts, chromatographic analysis of complex mixtures, selectivity in synthesis, enzymatic and chemo-enzymatic synthesis, characterization, Analysis of biomolecules such as DNA and proteins and their spectrophotometric characterization • Physical chemistry: Determination of the following physical quantities: partial molal volumes, dipole moments, activities by freezing point, quantum yields, heats of vaporization and depressions of freezing points of solutions, velocity constant and activation energy. Electrodes with different substrates for H2 evolution, photoelectrochemical solar cells.Vacuum measurement. IR spectrum of HCl, Use of M.O. theory, solution of Schrodinger equation for polyatomics.
4	**Texts/References**	• G. Svehla and B. Sivasankar, "Vogel's qualitative inorganic analysis", Pearson Education India, 7th Ed, 2023. • G. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, B. Sivasankar, "Vogel's quantitative chemical analysis" Pearson education India, 6th Ed. 2009. • A. J. Elias, "A collection of interesting general chemistry experiments"Sangam Books Ltd. First Ed. 2002. • B. Viswanathan, and P. S. Raghavan, Practical Physical Chemistry, Viva Books, 1st Ed., 2010 • A. M. Halpern, and G. C. McBane, Experimental Physical Chemistry: A Laboratory TextBook, 3rd Edition, W. H.Freeman, 2006. • B. S. Furniss, A. J. Hannaford, P.W.G. Smith, A.R.Tatchell, "Vogel's textbook of practical organic chemistry" Pearson education India, 5th Ed. 2003. • K. Wilson and J. Walker, "Principles and Techniques of Practical Biochemistry"Cambridge University Press 5th Ed., 2000 • In-house laboratory manual with the experimental ,procedures and relevant literature.