Semester IV						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH 308	Non-transition and transitional metal chemistry	3	0	0	6
2	CH 310	Organic reactions and reagents	3	0	0	6
3	CH 309	Chemical Bonding and Symmetry	3	0	0	6
4	CH 320	Molecular Energetics and Dynamics	3	0	0	6
5		Program Elective-I	2	1	0	6
6	CH 311	Chemistry laboratory-I	0	0	3	3
		Total Credits				**33**

1	**Title of the course (L-T-P-C)**	**Non-transition and transitional metal chemistry (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Fundamental concepts and applications of chemistry (CH101)**
3	**Course content**	**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. 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. **Chemistry of Lanthanides and Actinides:** Electronic configuration, colour and magnetism, properties of lanthanides and actinides. Synthesis of trans-Uranic elements, chemistry of uranium compounds. **Chemistry of non-transition metals:** non-transition elements, stereochemistry and bonding in non-transition elements and compounds: alkali metals, metal hydrides and dihydrogen complexes, the boron and carbon groups, the nitrogen and oxygen groups, the halogens and the noble gases. Review of inorganic chains,- rings- and- cages.
4	**Texts/References**	• F. A. Cotton and G. Wilkinson, Basic Inorganic Chemistry, Wiley Easter, 1978. • M. J. Sienko and R.A. Plane, Chemical Principles and Properties, McGraw Hill, 1975. J. D. Lee, Concise Inorganic Chemistry, Van Nostrand Reinhold, 1977 • J. E. Huheey, E. A. Keiter, and R. L. Keiter, Inorganic Chemistry – Principles of Structure and Reactivity, 4ed, Pearson Education, 2006 • Inorganic Chemistry. D. F. Shriver, and P. W. Atkins. 3rd Edn. Oxford University, Oxford, 1999. • 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)**	**Organic reactions and reagents (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Fundamental concepts and applications of chemistry (CH101)**
3	**Course content**	Functional group transformations, common named reactions, oxidations, reductions and rearrangements and their applications in organic synthesis. Carbon-Carbon Bond Forming Reactions *via* enolate, enamine and imine chemistry, Grignard, cuprate and other conjugate reactions, Radical reactions, and other classes (via organo silane, borane and tin based reagents, Baylis-Hillman reaction), Selectivity and protecting groups: Illustration of chemoselectivity, regioselectivity and enantioselectivity, stereoselectivity; protecting groups for alcohols, amines, acids, ketones and aldehydes. common catalysts and reagents for reactions (organic, inorganic, organometallic and enzymatic), pericyclic and photochemical reactions in organic synthesis
4	**Texts/References**	**1.** Carey, F. A., Sundberg, R. J. Advanced Organic Chemistry, Part A and B, Springer, 2007. **2.** Clayden, J., Greeves, N., Warren, S., Wothers, S. Organic Chemistry, Oxford University Press, **2001**. **3.** Carruthers, W., Coldham, I. Some Modern Methods of Organic Synthesis, Cambridge University Press, **2004**. **4.** Smith, M. B. and March, J. Advanced Organic Chemistry, Wiley Interscience, **2007**. **5.** G. S. Zweifel and M. H. Nantz, Modern Organic Synthesis-An Introduction, W. H. Freeman and Company, 2006 **6.** K. Peter C. Vollhardt and Neil E. Schore "Organic Chemistry" W. H. Freeman and Company, 1999. **7.** T.W. Greene, "Protecting Groups in Organic Synthesis" (3rd edition), J. Wiley & Sons, **1999**.

1	**Title of the course (L-T-P-C)**	**Chemical Bonding and Symmetry (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Fundamental concepts and applications of chemistry (CH101)**
3	**Course content**	Postulates of quantum mechanics; Hermitian operators; complete set. Derivation of the uncertainty relations. Exactly solvable problems, orbital angular momentum, and the hydrogen atom. Spin, spin orbitals, and characteristics of a many-electron wave function. Variation theorem, variation method, the linear variation method, and the non-crossing rule. Applications: Many-electron atoms, self-consistent field, atomic orbitals, Slater Type Orbitals, Time-dependent and time dependent perturbation theory The valence bond treatment of hydrogen molecule; Resonance; Polarity and dipole moment; Electronegativity; Valence-bond wave functions for polyatomic molecules. Introduction to molecular symmetry, point groups, characters and character tables and applications in atomic structure and spectroscopy, Structures of different lattices and diffraction methods.
4	**Texts/References**	**1.** R. McWeeny, Coulson's Valence, Oxford University Press, 1979. **2.** D. A. McQuarrie, Quantum Chemistry, Oxford University Press, 1983. **3.** I. R. Levine, Quantum Chemistry, Prentice Hall India (Ltd), 1995. **4.** P. Atkins, J. de Paula and J. Keeler, Atkins' Physical Chemistry, 11th Ed.,OUP (2018).

1	**Title of the course (L-T-P-C)**	**Molecular Energetics and Dynamics (3-0-0-6)**
2	**Pre-requisite courses(s)**	**Nill**
3	**Course content**	Laws of thermodynamics. Estimations of enthalpy and free energy. Fugacity and activity and their determinations Application to chemical reactions. Overview of rate laws and determining rates and orders of reactions. Complex Reactions. Catalysis. Temperature dependence and Arrhenius law. Potential energy surfaces. Kinetic theory of collisions. Transition state theory. RRK and RRKM theories. Reaction cross-sections, rate coefficients, reaction probabilities. Photochemical reactions. Ultrafast reactions. Diffusion in solids, liquids and solutions. Chemical oscillations and nonlinear dynamics.
4	**Texts/References**	**1.** P. Atkins and J. de Paula, Atkins' Physical Chemistry, 8th edition, Oxford University Press, 2006. **2.** G. W. Castellan, Physical Chemistry, 3rd edition, Addison - Wesley/Narosa Publishing House, 1993. **3.** G. N. Lewis and M. Randall, Thermodynamics, (Revised by K. S. Pitzer and L. Brewer), International Students Edition, McGraw Hill, 1961. **4.** Chemical Kinetics and Dynamics, Jeffrey I. Steinfed, Joseph S. Francisco and William L. Hase. **5.** Chemical Kinetics and Reaction Dynamics, Paul L Houston

1	**Title of the course** (L-T-P-C)	**Chemistry laboratory-I** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	
3	**Course content**	**Inorganic chemistry**: Basic concepts of quantitative analysis, redox, precipitation and complexometric titrations. Solubility product and precipitation, organic precipitants and extractants. A brief survey of separation methods: solvent extraction and chromatography. Volumetric analysis involving redox, precipitation and complexometric titrations. **Organic chemistry**: Determination of physical constants, purification of solids and liquids and methods of checking their purity. Separation of enantiomers and measurements of optical rotation. Studies of electrophilic/nucleophilic substitution reactions, redox reactions **Physical chemistry**: **1.** Ionization constant by spectrophotometry, enzyme kinetics, use of immobilized enzyme electrode, adsorption isotherm
4	**Texts/References**	