Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH306T	Coordination and organometallic chemistry	3	0	0	6
2	CH606T	Concepts in organic synthesis	3	0	0	6
3	CH503T	Molecular spectroscopy	3	0	0	6
4	CH401L	Chemistry laboratory II	0	0	3	3
5		Program Elective-II	2	1	0	6
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)	**Coordination and organometallic chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101) and Transitional metals and coordination chemistry.
3	**Course content**	Coordination compounds: Valence bond theory, crystal field theory, molecular orbital theory and their applications, inner sphere electron transfer, outer sphere electron transfer, classification of ligands, trans effect, stability constant, Jahn-Teller effect, ploy nuclear complexes, reaction of coordination compounds. Bonding and Electronic Spectra: MO theory of transition metal complexes spectroscopic term symbols, selection rules, Orgel diagrams, and charge transfer bands; Magnetism of Coordination Complexes. Organometallic chemistry: General concepts: Types of ligands, soft vs hard ligands. 18e rule and its exceptions, isolobal and isoelectronic analogies. s and π bonding, Structure, bonding and reactivity studies of metal carbonyls, nitrosyls, dinitrogen complexes. Organometallic Reactions and Mechanisms: oxidative addition, reductive elimination reactions, organometallic complexes with metal-metal bonds. Metal–ligand Multiple Bonds: Fischer and Schrock type carbene complexes, carbyne complexes, and metal–heteroatom (O/N) multiple bonds
4	**Texts/References**	• R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, 6ed, Wiley, 2013. • J. Hartwig, Organo-transition Metal Chemistry: From Bonding to Catalysis, University Science Books, 2010. • B. D. Gupta and A. J. Elias, Basic Organometallic Chemistry: Concepts, Syntheses and Applications, 2ed, Universities Press, 2013. • G. L. Miessler and D. A. Tarr, Inorganic Chemistry, 3ed, Pearson, 2008. • B. Douglas, D. McDaniel, and J. Alexander, Concepts and Models of Inorganic Chemistry, 3ed, Wiley, 2010. • 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. • S. F. A. Kettle, Physical Inorganic Chemistry – A Coordination Chemistry Approach, Springer, 1996.

1	**Title of the course** (L-T-P-C)	**Concepts in organic synthesis** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101) and organic reactions and reagents
3	**Course content**	Synthesis, reactions, mechanisms, and selectivity involving the following-alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines. Use of compounds of Mg, Li, Cu, B and Si in organic synthesis. Concepts in multistep synthesis- retrosynthetic analysis, disconnections, synthons, synthetic equivalents, linear and convergent synthesis, reactivity umpolung, selectivity, protection and deprotection of functional groups, Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst-controlled reactions; enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
4	**Texts/References**	• Clayden, J., Greeves, N., Warren, S., Wothers, S. *Organic Chemistry*, Oxford University Press, **2001**. • Carruthers, W., Coldham, I. *Some Modern Methods of Organic Synthesis*, Cambridge University Press, **2004**. • Smith, M. B. and March, J. *Advanced Organic Chemistry*, Wiley Interscience, **2007**. • Carey, F. A., Sundberg, R. J. *Advanced Organic Chemistry*, *Part A and B*, Springer, **2007**. • Smith, M. B. *Organic Synthesis*, McGraw-Hill, **2001**. • Warren, S. *Organic Synthesis: The Disconnection Approach*, Wiley, **1983**. • G. S. Zweifel and M. H. Nantz, *Modern Organic Synthesis-An Introduction*, W. H. Freeman and Company, 2006

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)	**Chemistry laboratory II** **0-0-3-3**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Inorganic chemistry: Complex material analyses: minerals/ alloys. Quantitative estimations using conductometry and spectrophotometry. Organic chemistry: Qualitative analysis of organic compounds. Chemical separation of binary mixtures and their qualitative analysis, Synthesis of organic compounds and chromatography Physical chemistry: Phase equilibria, viscosity and molecular weight of polymers, surface tension, reaction kinetics (rates, order of reaction, influence of ionic strength), use of thermocouples, transition temperature determinations.
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. • In-house laboratory manual with the experimental procedures and relevant literature.