| Semester VI | | | | | | |
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| **S.No** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** |
| 1 | CH514T | Organometallic chemistry and catalysis | 3 | 0 | 0 | 6 |
| 2 | CH515T | Instrumental Methods for Structure Determination | 3 | 0 | 0 | 6 |
| 3 | CH402L | Chemistry laboratory-III | 0 | 0 | 3 | 3 |
| 4 | | Program Elective-III | 2 | 1 | 0 | 3 |
| 5 | | Program Elective-VI | 2 | 1 | 0 | 6 |
| 6 | | Institute Elective – II | 3 | 0 | 0 | 6 |
| | | **Total Credits** | | | | **30** |

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| 1 | **Title of the course** (L-T-P-C) | **Organometallic Chemistry and Catalysis**<br>**3-0-0-6** |
| 2 | **Pre-requisite courses(s)** | -- |
| 3 | **Course content** | • Organometallic Chemistry: 18-electron rule. Ligands: Carbo monoxide, phosphines, hydrides and dihydrogen complexes alkyl, -alkenyl, -alkynyl, and -aryl ligands, Alkene and -alkyn ligands, nonconjugated diene and polyene ligands, butadiene cyclobutadiene, and cyclooctatetraene, benzene and other arenes, the allyl ligand, cyclopentadiene and cycloheptatriene carbenes, alkanes, agostic hydrogens, dinitrogen and nitroge monoxide.<br>• Compounds: d-Block carbonyls, metallocenes, metal–metal bonding and metal clusters.<br>• Reactions: Ligand substitution, oxidative addition and reductive elimination, s-Bond metathesis, 1,1-migratory insertion reactions 1,2-insertions and b-hydride elimination, α, β, ✿-Hydride eliminations and cyclometallations.<br>• Catalysis: Organometallic catalysts, Terminology in catalysis: Turnover, turnover number (TON), turnover frequency (TOF). Hydrogenation, Hydroformylation, Monsanto process, Wacker process, Ziegler-Natta polymerization, C-C coupling reactions Olefin Metathesis and metathesis polymerization, catalytic methods for the production of green hydrogen and ammonia<br>• Organometallic Reagents: Organometallic compounds of s- block elements: Organo-lithium, beryllium and magnesium compounds. |
| 4 | **Texts/References** | • M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th edition, Oxford University Press, 2014. (South asia edition 2015)<br>• E. Huheey, E. A. Keiter, R.L. Keiter and O. K. Mehdi, Inorganic Chemistry, Principles of Structure and Reactivity, 4th edition, Pearson, 2006.<br>• D. Gupta and A. J. Elias; Basic Organometallic Chemistry: Concepts, Synthesis, and Applications, 2nd edition, Universities Press (India), 2013.<br>• Organometallics by Christoph Elschenbroich, 3rd edition, 2006.<br>• Atkins, P., et al., Shriver and Atkins Inorganic Chemistry, 5th edition, Oxford University Press, 2010.<br>• The Organometallic Chemistry of the Transition Metals by Robert H Crabtree, 2014.<br>• Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr, 5th edition, 2014. |

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| 1 | **Title of the course** (L-T-P-C) | **Instrumental methods for structure determination** **(3-0-0-6)** |
| 2 | **Pre-requisite courses(s)** | Fundamental concepts and applications of chemistry (CH101) |
| 3 | **Course content** | NMR spectroscopy: Basic principles of $^{1}$H-NMR, instrumentation and interpretation of NMR spectrum, chemical shift: principles, chemical shift values of major organic compound classes, and factors affecting chemical shift, spin-spin coupling, spin systems, coupling with other nuclei, 2D-NMR (COSY, TOCSY), NOE (NOESY), $^{13}$C-NMR- principles and chemical shifts for major organic compound classes, $^{1}$H- $^{13}$C-2D NMR (HSQC, HMBC), DEPT, $^{31}$P and $^{19}$F-NMR, solid state NMR and applications in chemistry.<br>Mass Spectrometry: Instrumentation and techniques (ionization techniques, mass analysers, and detection techniques, tandem MS or MS/MS, LC-MS, GC-MS, MALDI-TOF-MS etc.), interpretation of mass spectra, fragmentation patterns of major organic compound classes including rearrangement reactions and applications of mass spectrometry in chemistry and biology.<br>FTIR and UV-Visible spectroscopy: Basic concepts and applications in functional group characterization and organic structure elucidation |
| 4 | **Texts/References** | 1. R. Silverstein, F. Webster, D. Kiemle, and D. Bryce "Spectrometri identification of organic compounds", 8th Ed., Wiley, 2015.<br>2. P. Crews, J. Rodriguez, and M. Jaspars, "Organic structure analysis", 2nd Ed., OUP USA, 2009.<br>3. D. Williams and I. Fleming, "Spectroscopic methods in organic chemistry", 6th Ed., McGraw Hill Education, 2011.<br>4. W. Kemp, "Organic spectroscopy", 2nd Ed., Red Globe Press, 2019.<br>5. D. Pavia "Introduction to spectroscopy" Cengage Learning India Private Ltd., 5th Ed., 2015.<br>6. C. Banwell and E. McCash "Fundamentals of molecular spectroscopy" 4th Ed., McGraw Hill Education, 2017.<br>7. J. Keeler "Understanding NMR spectroscopy" 2nd Ed., Wiley, 2011.<br>8. K. Chary and G. Govil "NMR in biological systems: from molecules to human" 1st Ed., Springer, 2008. |

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| 1 | **Title of the course** (L-T-P-C) | **Chemistry laboratory-III (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).<br><br>Organic chemistry: Chemical separation of ternary mixtures and characterization of the components. Simple one or two step preparations involving different techniques, Isolation of natural products, chromatographic analysis of complex mixtures, selectivity in synthesis, enzymatic and chemo-enzymatic synthesis, characterization<br><br>Physical chemistry: Determination of the following physical quantities: partial molal volumes, dipole moments, activities by freezing point, quantum yields, heats of vaporisation 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** | -- |