S.No	New Course code	Name of Course	L-T-P-C	Proposed Level (UG/PG)
1	CH 901	Coordination Chemistry, Organometallics and Organometallic Reagents	3-0-0-6	PG
2	CH 903	Interpretative NMR Spectroscopy and Mass Spectrometry	3-0-0-6	PG
3	CH 904	Advanced Computational Chemistry	3-0-0-6	PG
4	CH 910	Seminar	2-0-0-4	PG
5	CH 911	Bioorganic Chemistry and Chemical Biology	3-0-0-6	PG
6	CH 913	Fundamentals and Applications of Organic Photochemistry	3-0-0-6	PG
7	CH 916	Optical and electronic properties of π-conjugated compounds	3-0-0-6	PG
8	CH 917	Organic Reactions and Mechanisms	3-0-0-6	PG
9	CH 918	Topics in Chemistry	3-1-0-8	PG
10	CH 921	Green Chemistry	3-0-0-6	PG
11	CH 919	Advanced Quantum Chemistry	3-0-0-6	PG

1	**Title of the course** (L-T-P-C)	**Coordination chemistry, Organometallics and organometallic reagents (3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	**1.** Coordination chemistry: Fundamentals, theory and applications. **2.** History and types of Organometallic compounds, 18 Valence Electron Rule and Classification. **3.** Sigma-Donor ligands: Preparation and Properties and its application. **4.** C−H activation, characterization and bonding. C−C Bond activation, Transition Metal Perfluoroalkyl (RF−TM) Complexes and its preparation. C−F Activation **5.** Transition Metal Alkenyl/Aryl/Alkyne/Carbene/carbynes Complexes **6.** Transition Metal Carbonyls: Bonding properties, Reactivity, Carbonyl Metallates, Carbonyl Hydrides and its application, application of Metal Halides and Metal Alkenes **7.** Transition Metal Olefin Complexes: Reactivity, Bonding Properties. **8.** Transition Alkyne Complexes: Reactivity.
4	**Texts/References**	Organometallics by Christoph Elschenbroich Organometallic Chemistry of Transition Metals by Robert H Crabtree.

1	**Title of the course** (L-T-P-C)	**Interpretative NMR spectroscopy and mass spectrometry (3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
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 and applications of NMR in chemistry and biology. **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**.**
4	**Texts/References**	**1.** R. Silverstein, F. Webster, D. Kiemle, and D. Bryce "Spectrometric identification of organic compounds", 8th Ed., Wiley, 2015. **2.** P. Crews, J. Rodriguez, and M. Jaspars, "Organic structure analysis", 2nd Ed., OUP USA, 2009. **3.** D. Williams and I. Fleming, "Spectroscopic methods in organic chemistry", 6th Ed., McGraw Hill Education, 2011. **4.** W. Kemp, "Organic spectroscopy", 2nd Ed., Red Globe Press, 2019. **5.** D. Pavia "Introduction to spectroscopy" Cengage Learning India Private Ltd., 5th Ed., 2015. **6.** C. Banwell and E. McCash "Fundamentals of molecular spectroscopy" 4th Ed., McGraw Hill Education, 2017. **7.** J. Keeler "Understanding NMR spectroscopy" 2nd Ed., Wiley, 2011. **8.** K. Chary and G. Govil "NMR in biological systems: from molecules to human" 1st Ed., Springer, 2008.

1	**Title of the course** (L-T-P-C)	**Advanced computational chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Introduction to computer programming in Fortran, Elementary programming methods, arrays, do loops, functions and subroutines. Elementary numerical methods, error analysis, interpolations, matrix methods, integration, differential equations, integral transforms and random numbers. Use of Scilab in numerical methods and graphics. Classical molecular dynamics and Monte Carlo Simulations. Use of Gromacs software for classical molecular dynamics
4	**Texts/References**	T. R. McCalla, Introduction to Numerical Methods and Fortran Programming (1967), Amazon Books M. P. Allen and D. J. Tildesley, Computer Simulation of Liquids, Oxford University Press (1990) NPTEL/MOOCS videos and course materials on Computational Chemistry Gromacs manual

1	**Title of the course** (L-T-P-C)	**Bioorganic chemistry and Chemical Biology** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Aminoacids, peptides and proteins: physicochemical properties and chemical synthesis; peptide bond formation, amino acid analysis and peptide sequencing; brief introduction to ribosomal protein synthesis; combinatorial chemistry; enzyme chemistry; proteins as drug targets. Carbohydrates: Introduction; structure, configuration, and conformation; common protecting groups and protecting group strategies; glycosylation: general concepts, various methods of glycoside bond formation; strategies in oligosaccharide synthesis: carbohydrate-based drug discovery. Nucleic acids: Introduction, structure, chemical and enzymatic synthesis, DNA, RNA polymerases, ligases, restriction enzymes, PCR and sequencing, nucleic acid as drug targets, ribozymes, DNA enzymes and riboswitches; antisense, RNA interference and aptamers; DNA damage and repair. Structure, function, physicochemical properties of lipids and fatty acids Biological chemistry and principles of chemical biology, Chemistry of biological pathways, role of chemistry in understanding biology
4	**Texts/References**	**1.** P. Lloyd-Williams, F. Albericio, E. Giralt, Chemical Approaches to the Synthesis of Peptides and Proteins, 1st Edition, CRC Press, Boca Raton,1997 **2.** S. Doonan, Peptides and Proteins, 1st Edition, RSC Publishing House, London, 2002 **3.** T. Bugg, An Introduction to Enzyme and Coenzyme Chemistry, 2nd Edition, Blackwell Science, Oxford, 2004 **4.** B. G. Davis & A.J. Farbanks, Carbohydrate Chemistry, 1st Edition, Oxford University Press, 2002 **5.** R. V. Stick., Carbohydrates: The Essential Molecules of Life, 2nd Edition, Academic Press, 2009 **6.** D. E. Levy and P. Fugedi, The Organic Chemistry of Sugars, CRC Press, 2006 **7.** G. M. Blackburn, M. J. Gait, D. Loakes, D. M. Williams, Nucleic Acids in Chemistry and Biology, 3rd Edition, RSC Publishing, London, 2006 **8.** S. Doonan, Nucleic Acids, 1st Edition, RSC Publishing House, London, 2000 **9.** A. Lehninger, D. L. Nelson, Cox, M. M. Principles of Biochemistry, 5th Edition, W.H Freeman, 2008

1	**Title of the course** (L-T-P-C)	**Fundamentals and Applications of Organic Photochemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	Principles of photochemistry • Resonance energy transfer (RET), Fluorescence resonance energy transfer (FRET), excited state intra-molecular proton transfer (ESIPT) mechanisms • Solid state optical properties: aggregation induced enhanced emissions • Optical and electronic properties of polycyclic aromatic compounds • metal-organic based p-conjugated molecules • Organic one-dimensional (1D) and 2D polymers and Metal based π-conjugated compounds • Electronic properties of p-conjugated compounds: fundamentals of electrochemical techniques • HOMO and LUMO and band gap evaluations • spectroelectrochemistry • Electrochemical sensors • Applications of π-conjugated compounds for optoelectronic applications: OLEDS, solar cells, OLETs etc.
4	**Texts/References**	**1.** Petr Klan and Jakob Wirz "Photochemistry of organic compounds: from concepts to practice (postgraduate chemistry series)", 1st Ed., Wiley-Blackwell, 2009. **2.** N. J. Turro, V. Ramamurthy, J. C. Scaiano "Modern Molecular Photochemistry for Organic Molecules" 1st Ed.' Viva books, 2017. **3.** Yongfang Li (editor) "Organic optoelectronic materials (lecture notes in chemistry)" 1st Ed., Springer, 2015. **4.** K. K. Rohtagi-Mukhejee "Fundamentals of photochemistry", 3rd Ed., New age international publishers, 2017. **5.** J. R. Lakowicz "Principles of Fluorescence Spectroscopy", 2nd Ed., Springer, 1999.

1	**Title of the course** (L-T-P-C)	**Optical and electronic properties of π-conjugated compounds (3-0-0-6)**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	Principles of photochemistry and electrochemistry• Optical and electronic properties of polycyclic aromatic compounds; Organic one-dimensional (1D) and 2D polymers and Metal based π-conjugated compounds• Applications of π-conjugated compounds; Principles of photochemistry • Resonance energy transfer (RET), Fluorescence resonance energy transfer (FRET), excited-state intramolecular proton transfer (ESIPT) mechanisms • Solid-state optical properties: aggregation-induced enhanced emissions • Optical and electronic properties of polycyclic aromatic compounds • metal-organic based p-conjugated molecules • Organic one-dimensional (1D) and 2D polymers and Metal-based π-conjugated compounds • Electronic properties of p-conjugated compounds: fundamentals of electrochemical techniques • HOMO and LUMO and band gap evaluations • spectroelectrochemistry • Electrochemical sensors • Applications of π-conjugated compounds for optoelectronic applications: OLEDs, solar cells, OLETs, etc.
4	**Texts/References**	1. Organic optoelectronic materials (lecture notes in Chemistry) 2015th edition by Yongfang Li 2. Photochemistry of organic compounds: from concepts to practice (first edition) by Petr Klan and JakobWirz

1	**Title of the course** (L-T-P-C)	**Organic reactions and mechanisms** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	Reactive Intermediates**:** An overview and revision of the chemistry of carbenes, nitrenes, radicals, carbocations, carbanions and benzynes. Classification of reactions: A brief introduction to substitution, elimination, addition, oxidation, reduction, rearrangement and pericyclic reactions. Named reactions, mechanisms and applications: Aldol reaction, alkene and alkyne metathesis, Baeyer-Villiger oxidation, Barton reaction, Beckmann rearrangement, benzilic acid rearrangement, benzoin and acyloin condensation, Bergman cycloaromatization reaction, Birch reduction, Brown hydroboration, Buchner reaction, Buchwald-Hartwig cross- coupling, Burgess dehydration, Cannizzaro reaction, Claisen condensation, Claisen rearrangement (including Johnson, Ireland and Eschenmoser modifications), Cope reaction, Cope rearrangement (including aza-Cope and oxy Cope), Corey and related reactions, Criegee oxidation, Curtius rearrangement, Dakin oxidation, Darzens condensation, Danishefsky's diene cycloaddition, Dess-Martin oxidation, Dieckmann condensation, Diels-Alder cycloaddition, Ene reaction, Eschenmoser-Tanabe Fragmentation, Favorskii rearrangement, Fischer indole synthesis, Friedel- Crafts reaction, Fries rearrangement, Gabriel synthesis, Grignard reaction, Heck reaction, HVZ reaction, Hoffmann reaction and elimination, Hoffman rearrangement, Jacobsen epoxidation, Jones oxidation, Julia olefination, Knoevenagel condensation, Kolbe-Schmitt reaction, Lossen rearrangement, Mannich reaction, McMurry coupling, MPV reduction, Michael addition, Mitsunobu reaction, Negishi cross coupling, Oppenauer oxidation, Paterno-Buchi reaction, Perkin reaction, Peterson olefination, Pictet-Spengler reaction, Pinacol rearrangement, Prevost reaction, Pummerer rearrangement, Reformatsky reaction, Reimer-Tiemann reaction, Robinson annulation, Schmidt reaction, Sandmeyer reaction, Sharpless epoxidation and dihydroxylation, Shapiro reaction, Smiles rearrangement, Sonogashira cross-coupling, Staundinger reaction, Stevens rearrangement, Stille coupling, Stobbe condensation, Strecker reaction, Suzuki cross-coupling, Swern oxidation, Tebbe olefination, Tsuji-Trost reaction, Ugi reaction, Ullmann reaction, Wacker oxidation, Wagner- Meerwein rearrangement, Williamson ether synthesis, Wolff rearrangement, Wollf-Kishner reduction, Wurtz coupling, Witting reaction and Wittig rearrangement
4	**Texts/References**	**1.** Jerry March and Michael Smith, "Advanced Organic Chemistry", 7th Ed., Wiley. **2.** F. A. Carey and R. J. Sundburg, "Advanced Organic Chemistry, Part A and B", Fifth Ed., Plenum Press. **3.** J. Clayden, N. Greeves, S. Warren and P. Wothers, "Organic Chemistry", 2nd Ed., Oxford University Press. **4.** W. Carruthers, "Some Methods of Organic Synthesis", Cambridge University Press. **5.** Laszlo Kurti and Barbara Czako, "Strategic applications of named reactions in organic synthesis" **6.** Norman and Coxon, "Principles of organic synthesis, 3rd edition, CRC press. **7.** Robert Grossman, "Art of writing reasonable organic reaction mechanisms", 2nd edition 8.Organic chemistry by Paula Bruice/ Wade Jr/Solomons

1	**Title of the course** (L-T-P-C)	**Topics in Chemistry** **(3-0-1-8)**
2	**Pre-requisite courses(s)**	NIL
3	**Course content**	**Organic and Inorganic: Chemistry of Materials** • Introduction to materials, Periodic table, its physical and chemical properties of elements, Introduction to solid state chemistry -1&2, Carbon chemistry – physical and chemical properties, Bulk to nano transition - physical phenomena, 3D, 2D, 1D, OD nano systems, Introduction to nanoscience and nanotechnology - Metals, semiconductors, Introduction to nanoscience and nanotechnology -Carbon nanotubes, fullerenes, Quantum dots. • Systems under technological importance - Naturally occurring materials, Optical and magnetic systems based on metals, • Inorganic semiconductors - optical materials, magnetic materials • Organic semiconductors -optoelectronic materials, optoelectronic materials Self-assemblies of nanoparticles, Nano systems - catalysis, Surface coating technology, High temperature superconductivity, Application of high temperature superconductivity, Complex metal oxide, Giant magneto resistance, Spintronic. • Chemical and non-chemical approach to materials synthesis - Solution based material synthesis - Precipitation methods, hydrothermal etc., Solution based materials synthesis - Micro- emulsion, Sol-gel, Phase transfer reactions, Synthesis and properties of monolayer capped metal nanoparticles, Material synthesis using microwave radiation and ultra-sonic waves, Solid state synthesis, Hybrid methods for materials synthesis - synthesis of rational shaped molecules and semiconductors. • Modern Characterization of materials (SEM, TEM, XPS, AFM, powder X-ray etc., Routine characterization tools-UV-visible spectrophotometer, Fluorimeter, NMR, IR, Particle size analyzer, Powder X-ray microscopy). **Physical: Ab Initio Molecular Orbital Theory** SCF and HartreeFock Methods, Roothan Equations, Configuration Interaction, Density Functional Theory, Perturbation theory and applications.
4	**Texts/References**	**1.** J. D. Lee, Concise Inorganic Chemistry, Fifth edition, Blackwell publishing (2008) **2.** Robert T. Morrison, Robert N. Boyd, and Robert K. Boyd, Organic Chemistry, 6th edition Benjamin Cummings, (1992) Charles P. Poole Jr. Frank J. Owens, Introduction to Nanotechnology, John Wiley & Sons, Inc. (2003) **3.** Nan Yao, Zong Lin Wang, Handbook of Microscopy for Nanotechnology, Kluwer academic publishers, London (2005) Pople, J.A. and Beveridge, D.L. Approximate Molecular Orbital Theory. McGraw-Hill, New York. (1970) **4**. Ab Initio Molecular Orbital Theory by W. J. Hehre, L. Radom, **5**. P. v. R. Schleyer, and J. A. Pople, John Wiley, New York, 548, (1986) **6**. Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory, by Attila Szabo, Neil S. Ostlund, Dover Publications, New York (2000) **7**. Introductory Quantum Chemistry/Quantum Mechanics Books by authors such as Pilar, McQuarrie, Pauling, and Wilson, NPTEL Web and Video courses in quantum chemistry and computational chemistry

1	**Title of the course** (L-T-P-C)	**Green Chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Introduction and metrices of green chemistry, Principles of green chemistry, Designing a sustainable synthesis, Bioremediation, Use of benign solvents in synthesis, Applications of green chemistry in real world, Renewable feedstock, Recycling of materials and chemicals, Toxic chemicals in environment, Green materials synthesis, New Green and sustainable synthetic methods, Society reliant chemicals, Bio catalysis, Green analytical methods, Alternate energy sources, Challenges and Future trends in Green chemistry.
4	**Texts/References**	**1**. Anne E. Marteel-Parrish and Martin A. Abraham, Green Chemistry and Engineering: A pathway to sustainability. Wiley, 2014. **2**. Manahan, S. E. Environmental Chemistry, Eighth Edition; CRC Press, 2005 **3**. Sankar, D; Nayim, S. A textbook of Green Chemistry, 2021, **4**. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998). **5**. Lancaster, M. Green Chemistry: An Introductory Text, Third Edition; RSC Publishing; 2016. **6**. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001). **7**. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American Chemical Society, Washington (2002). **8**. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.

1	**Title of the course** (L-T-P-C)	**Advanced Quantum Chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Brief review of Quantum chemistry, Schrödinger equation for multielectron systems, Approximation methods in Quantum mechanics, Variational methods and time-independent Perturbation theory, atomic term symbol Born-Oppenheimer approximation, Valence bond and Molecular orbital methods, H_2^+ ion, Slater determinant, Derivation of Hartree-Fock Methods, Roothaan Equation, Population Analysis, Electron correlation, Configuration interactions, Huckel theory for pi-systems, Density functional theory
4	**Texts/References**	**1.** Quantum Chemistry by Donald A. McQuarrie, 2nd Edition 2008, University Science Books. **2.** Quantum Chemistry by I. N. Levine, 7th Edition, Pearson Education, 2000. **3.** Modern Quantum Chemistry: Introduction to advanced electronic structure theory, by Attila Szabo and Neil S. Ostlund, MacMillan Publishing Co. 1989. **4.** A Chemist's Guide to Density Functional Theory by Wolfram Koch, Max C. Holthausen, 2nd Edition 2001, Wiley-VCH and John Wiley & Sons, Weinheim