Semester I						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH 102	Fundamental concepts and applications of chemistry	3	0	0	6
2	MA 109	Calculus I (1st Half)	3	1	0	4
3	MA 121	Calculus II (2nd Half)	3	1	0	4
4	PH 101	Quantum Physics and Applications	2	1	0	6
5	BB 103	Introduction to Modern Biology	2	1	0	6
6	CS 103	Introduction to Programming - 1 (Using C) (1st Half)	3	0	2	4
7	EE 103	Introduction to Programming - 2 (Using Python) (2nd Half)	3	0	2	4
8	PH 113	Hands on Science Laboratory - I	0	0	3	3
9	HS 103	Introduction to Fine Arts				PP/NP
10	HS 106	Design Thinking and Creativity				PP/NP
11	NO 101/ NO 103	National Sports Organization (NSO)/National Service Scheme (NSS)				PP/NP
		Total Credits				**37**

1	**Title of the course** (L-T-P-C)	**Fundamental Concepts &Applications of Chemistry** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	**Organic and Inorganic (Inorganic): a. Harness the power of periodic table** Periodic properties: trends in size, electron affinity, ionization potential and electronegativity • Role of chemical elements in water contamination • Hardness of water • Desalination of brackish and sea water • Role of silicon in semiconducting applications • metal atom (Cu, Au, Pt, Pd etc.) based nanoparticles **b. Coordination complexes** Transition metal chemistry: inorganic complexes, bonding theories, magnetism, bonding aspects and structural distortion **(Organic): a. M.O. theory and π-conjugated compounds** Molecular orbitals of common functional groups, Qualitative Huckel MOs of conjugated polyenes and benzene. Aromaticity. Configuration, molecular chirality and isomerism, Conformation of alkanes and cycloalkanes **b. Polymers** Types and classification of polymers • polymerization techniques • Structure-property relationships of polymers • Conducting polymers **Physical Chemistry:** **a. Quantum chemistry** Schrodinger equation, Origin of quantization, Born interpretation of wave function, Hydrogen atom: solution to □-part, Atomic orbitals, many electron atoms and spin orbitals. Chemical bonding: MO theory: LCAO molecular orbitals, Structure, bonding and energy levels of diatomic molecules. Concept of sp, sp^2 and sp^3 hybridization; Bonding and shape of many atom molecules; Intermolecular Forces; Potential energy Surfaces-Rates of reactions; Steady state approximation and its applications; Concept of pre-equilibrium; Equilibrium and related thermodynamic quantities **b. Electrochemistry** Electrochemical cells and Galvanic cells • EMF of a cell Single electrode potential • Nernst equation • Electrochemical series • Types of electrodes • Reference electrodes • Batteries • Modern batteries • Fuel cells • corrosion
4	**Texts/References**	1. J. D. Lee, "Concise Inorganic chemistry" 5th Edition. Wiley India. Ed. 2. J. E. Huheey, E. A. Keiter, R. L. Keiter, O. K. Medhi, "Inorganic Chemistry: Principles of structure and reactivity" 4th Edition, Person. 3. P. Atkins, J. de Paula, "physical chemistry" 5th Edition, Oxford. 4. J. Clayden, N. Greeves, S. Warren, "Organic chemistry" 2th Edition, Oxford. 5. George Odian, Principles of polymerization, 4th edition, Wiley student edition, Wiley India Pvt Ltd. 6. F. W. Billmeyer, Text book of Polymer Science, 3rd edition, Wiley student edition, Wiley India Pvt Ltd. 7. A. K. De, Environmental Chemistry, 8th edition, New Age International publishers. 8. B. K. Sharma, Environmental Chemistry, 16th edition, Krishna Prakashan Media Pvt Ltd. 9. A. R. West, Solid State Chemistry and Its Applications, Wiley student edition, Wiley India Pvt Ltd. 10. T. Pradeep, Nano: The essentials, McGraw-Hill Education publishers. 11. Geoffrey A Ozin and André Arsenault, Nanochemistry: A Chemical Approach to Nanomaterials, 2nd edition, RSC publishing.

1	**Title of the course** (L-T-P-C)	**Calculus I** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Review of limits, continuity, differentiability. Mean value theorem, Taylor's Theorem, Maxima and Minima. Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume. Convergence of sequences and series, power series.
4	**Texts/References**	1. B. V. Limaye and S. Ghorpade, A Course in Calculus and Real Analysis, Springer International Publishing (2004) 2. James Stewart, Calculus (5th Edition), Thomson Brooks/Cole (2003) 3. T. M. Apostol, Calculus, Volume 1, Wiley Eastern (1980)

1	**Title of the course** (L-T-P-C)	**Calculus II** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Calculus I
3	**Course content**	Partial Derivatives, gradient and directional derivatives, Chain rule, Maxima and Minima, Lagrange multipliers. Double and Triple integration, Jacobians and change of variables formula. Parametrization of Curves and Surfaces, Vector fields, Line and Surface integrals. Divergence and Curl, Theorems of Green, Gauss, and Stokes.
4	**Texts/References**	1. B.V. Limaye and S. Ghorpade, A Course in Multivariable Calculus and Real Analysis, Springer International Publishing (2010) 2. James Stewart, Calculus (5th Edition), Thomson Brooks/Cole (2003) 3. T. M. Apostol, Calculus, Volume 2, Wiley Eastern (1980) 4. Marsden and Tromba, Vector calculus (First Indian Edition), Springer (2012)

1	**Title of the course** (L-T-P-C)	**Quantum Physics and Applications** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	• Quantum nature of light: Photoelectric Effect and Compton Effect. • Stability of atoms and Bohr`s rules. • Wave particle duality: De Broglie wavelength, Group and Phase velocity, Uncertainty Principle, Double Slit Experiment. • Schrödinger Equation. • Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-value Problem. • Solution of Schrödinger equation for simple boundary value problems. • Reflection and Transmission Coefficients. Tunneling. • Particle in a three dimensional box, Degenerate states. • Exposure to Harmonic Oscillator and Hydrogen Atom without deriving the general solution. • Quantum Statistics: Maxwell Boltzmann, Bose Einstein and Fermi Dirac Statistics by detailed balance arguments. • Density of states. • Applications of B-E statistics: Lasers. Bose-Einstein Condensation. • Applications of F-D statistics: Free electron model of electrons in metals. Concept of Fermi Energy. • Elementary Ideas of Band Theory of Solids. • Exposure to Semiconductors, Superconductors, Quantum Communication and Quantum Computing.
4	**Texts/References**	1. Quantum Physics: R. Eisberg and R. Resnick, John Wiley 2002, 2nd Edition. 2. Introduction to Modern Physics: F. K. Richtmyer, E. H. Kennard and J.N. Cooper, Tata Mac Graw Hill 1976, 6th Edition. 3. Modern Physics: K. S. Krane, John Wiley 1998, 2nd Edition. 4. Introduction to Modern Physics: Mani and Mehta, East-West Press Pvt. Ltd. New Delhi 2000. 5. Elements of Modern Physics: S. H. Patil, Tata McGraw Hill, 1984. 6. Concepts of Modern Physics, A Beiser, Tata McGraw Hill, 2009.

1	**Title of the course** (L-T-P-C)	**Introduction to Modern Biology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Quantitative views of modern biology. Importance of illustrations and building quantitative/qualitative models. Role of estimates. Cell size and shape. Temporal scales. Relative time in Biology. Key model systems – a glimpse. Management and transformation of energy in cells. Mathematical view – binding, gene expression and osmotic pressure as examples. Metabolism. Cell communication. Genetics. Eukaryotic genomes. Genetic basis of development. Evolution and diversity. Systems biology and illustrative examples of applications of Engineering in Biology.
4	**Texts/References**	Campbell Biology 12th edition, Pearson publication by Lisa Urry,Michael Cain,Steven Wassserman

1	**Title of the course** (L-T-P-C)	**Introduction to Programming – 1** **(3-0-2-4)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	This course provides an introduction to problem solving with computers using C Topics covered will include: **Utilization**:Developer fundamentals such as editor, integrated programming environment, Unix shell, modules, libraries. **Programming features**: Machine representation, data types, arrays and records, objects, expressions, control statements, iteration, procedures, functions and recursion, Pointers, Structures and basic I/O. **Applications**: Sample problems in engineering, science, text processing, and numerical methods.
4	**Texts/References**	The C Programming Language Brian W Kernighan, Dennis M Ritchie, Prentice Hall India , 2nd edition, 1988 Programming with C (Second Edition) Byron Gottfried, Schaum's Outlines Series, Tata-Mcgraw Hill, 2011 How to Solve It by Computer, by G. Dromey, Prentice- Hall, Inc., Upper Saddle River, NJ, 1982. How to Solve _It (2nd ed.), by Polya, G., Doubleday and co, 1957. Let Us C, by Yashwant Kanetkar, Allied Publishers, 1998.

1	**Title of the course** (L-T-P-C)	**Introduction to Programming-2** **(3-0-2-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	This is a continuation of the CS101 (first half semester) course. In the first half semester, the students are introduced to basic programming. This course (second half semester) provides an introduction to problem solving with computers using python language. Topics covered will include: Basic python programming: variables, expression and statements, Functions, conditional and recursions, iterations, strings, lists/NumPy and dictionaries. Other topics: Introduction to object oriented programming, classes and objects in python, polymorphisms, introduction to different libraries in python. Applications: Sample problems in engineering, data pre- processing, and plotting tools.
4	**Texts/References**	1.Python Programming: An Introduction to Computer Science, 3rd edition by John M. Zelle, Franklin, Beedle and Associates. 2.Think Python: How to Think Like a Computer Scientist, 2nd edition, by Allen B. Downey, O'Reilly, 2015.

1	**Title of the course** (L-T-P-C)	**Introduction to Fine Arts: Urban Dance in India: A Brief & Partial Introduction in Theory & Practice (1-0-0-0)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Body and Movement, Classical Dance in India, Contemporaneity: Modern & Postmodern Forms & Modes of Sustenance for a Dancer, Experimenting, Making Your Own Dance Work (Dance-pieces)
4	**Texts/References**	--

1	**Title of the course** (L-T-P-C)	**Design thinking and Creativity** **(1-0-0-0)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	1. Problem Exploration- Students move around and find problems that need solutions. 2. They analyse the problem (not solution) and evolve a problem space. The problem space is converted into a story boar and presented in a poster session. 3. Feedback at the poster session is used to refine the problem definition(s). 4. Solution Exploration: Creative solutions (solution space) are now explored and presented using story boards. 5. The solutions are converted into "embodiments"
4	**Texts/References**	1."Stuff Matters" Prof. Mark Miodownik, Penguin 2. "Design and Technology" by James Garratt, Cambridge University Press. 3. How it works in the home: Walt Disney:9780894340482- Amazon.com. 4. How it works in the City (Walt Disney available on Amazon.com) 5. Change by design – Tim Brown There are some additional books in this "How it Works" series.

Semester II						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MA 102	Linear Algebra (1st Half)	3	1	0	4
2	MA 103	Differential Equations - I (2nd Half)	3	1	0	4
3	CS 201	Data Structures and Algorithms	3	0	0	6
4	CS 211	Data Structures and Algorithms Laboratory	0	0	3	3
5	PH 102	Electricity and Magnetism	2	1	0	6

6	BB 201	Biomolecules	2	1	0	6
7	CH 203	States of Matter (2nd Half)	3	0	0	3
8	CH 201	Organic Chemistry (1st Half)	3	0	0	3
9		Hands On Science Laboratory - II	0	0	3	3
10	NO 102/ NO 104	National Sports Organization (NSO)/National Service Scheme (NSS)	0	0	0	PP/NP
		Total Credits				**38**

1	**Title of the course** (L-T-P-C)	**Linear Algebra** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Vectors in R^n, notion of linear independence and dependence, linear span of a set of vectors, vector subspaces of R^n, basis of a vector subspace. Systems of linear equations, matrices and Gauss elimination, row space, null space, and column space, rank of a matrix. Determinants and rank of a matrix in terms of determinants. Abstract vector spaces, linear transformations, matrix of a linear transformation, change of basis and similarity, rank-nullity theorem. Inner product spaces, Gram-Schmidt process, orthonormal bases, projections and least squares approximation. Eigenvalues and eigenvectors, characteristic polynomials, eigenvalues of special matrices (orthogonal, unitary, hermitian, symmetric, skew-symmetric, normal). Algebraic and geometric multiplicity, diagonalization by similarity transformations, spectral theorem for real symmetric matrices, application to quadratic forms.
4	**Texts/References**	1. H. Anton, Elementary linear algebra with applications (8th Edition), John Wiley (1995). 2. G. Strang, Linear algebra and its applications (4th Edition), Thomson (2006) 3. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000) 4. E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999)

1	**Title of the course** (L-T-P-C)	**Differential Equations -I** **(3-1-0-4)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Exact equations, integrating factors and Bernoulli equations. Orthogonal trajectories. Lipschitz condition, Picard's theorem, examples on non-uniqueness. Linear differential equations generalities. Linear dependence and Wronskians. Dimensionality of space of solutions, Abel-Liouville formula. Linear ODE's with constant coefficients, the characteristic equations. Cauchy-Euler equations. Method of undetermined coefficients. Method of variation of parameters. Laplace transform generalities. Shifting theorems. Convolution theorem.
4	**Texts/References**	1. E. Kreyszig, Advanced engineering mathematics (10th Edition), John Wiley (1999) 2. W. E. Boyce and R. DiPrima, Elementary Differential Equations (8th Edition), John Wiley (2005)

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming
3	**Course content**	Introduction: data structures, abstract data types,analysis of algorithms. Creation and manipulation of data structures: arrays,lists, stacks, queues, trees, heaps, hash tables, balanced trees, tries, graphs. Algorithms for sorting and searching, order statistics, depth-first and breadth-first search, shortest paths and minimum spanning tree.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Pressand McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael T. Goodrich, Roberto Tamassia, and David M. Mount,Wiley, 2004.

1	**Title of the course** (L-T-P-C)	**Data Structures and Algorithms Laboratory** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	Exposure to Computer Programming (CS 102)
3	**Course content**	Laboratory course for CS 211 is based on creatingand manipulating various data structures and implementation of algorithms.
4	**Texts/References**	1. Introduction to Algorithms, 3rd edition, by T. Cormen, C. Leiserson, R. Rivest, C. Stein, MIT Press and McGraw-Hill, 2009. 2. Data structures and algorithms in C++, by Michael T.Goodrich, Roberto Tamassia, and David M. Mount, Wiley, 2004.

1	**Title of the course** (L-T-P-C)	**Electricity and Magnetism** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Review of vector calculus: Spherical polar and cylindrical coordinates; gradient, divergence and curl; Divergence and Stokes` theorems; Divergence and curl of electric field, Electric potential, properties of conductors; Poisson's and Laplace's equations, uniqueness theorems, boundary value problems, separation of variables, method of images, multipoles; Polarization and bound charges, Gauss` law in the presence of dielectrics, Electric displacement D and boundary conditions, linear dielectrics; Divergence and curl of magnetic field, Vector potential and its applications; Magnetization, bound currents, Ampere`s law in magnetic materials, Magnetic field H, boundary conditions, classification of magnetic materials; Faraday's law in integral and differential forms, Motional emf, Energy in magnetic fields, Displacement current, Maxwell's equations, Electromagnetic (EM) waves in vacuum and media, Energy and momentum of EM waves, Poynting`s theorem; Reflection and transmission of EM waves across linear media.
4	**Texts/References**	(1) Introduction to Electrodynamics (4th ed.), David J. Griffiths, Prentice Hall, 2015. (2) Classical Electromagnetism, J. Franklin, Pearson Education, 2005.

1	**Title of the course** (L-T-P-C)	**Biomolecules** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	Major classes of biological molecules: Comparison of the alphabets and sources of structural diversity of proteins, nucleic acids, carbohydrates and lipids. Proteins: Ramachandran plot, evolution of protein structure, structure-function relationships: myoglobin and adaptations in myoglobin structure in deep diving mammals; allostery in hemoglobin; Bohr effect (for pH and carbon dioxide); adult and foetal hemoglobin. Post-translational modifications: special types of covalent bonds found in proteins. Protein folding: Natively folded and natively disordered proteins; miniproteins and peptide toxins; Anfinsen's observations, Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, diseases associated with protein folding. Carbohydrates: Sources of structural diversity; structure- function relationship in glycogen and cellulose, Difficulty associated with sequencing of glycans. Lipids: Structure and properties of storage and membrane lipids. Self-assembly of lipids: packing parameter; Biomembrane organization - sidedness and function; membrane bound proteins - structure, properties and function; transport phenomena. Nucleic acids: Historical perspective leading up to the proposition of DNA double helical structure with emphasis on the innovativeness of experimental design; Secondary structure of RNA; chromatin organization. Enzymes: General principles of catalysis; quantitation of enzyme activity and efficiency; Henri-Michaelis-Menten and Briggs-Haldane relationships; Transition state: definition Pauling's intuition and proposal, catalytic antibodies; Catalytic strategies; Isozymes: Haldane relationship between kinetic constants and equilibrium constant; Zymogens. Bioenergetics: basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; recurring motifs in metabolism. Relevant metabolic pathways may be included to discuss relevant concepts.
4	**Texts/References**	1. Rodney F Boyer, Concepts in Biochemistry. John Wiley & Sons; 3rd Ed (2 December 2005). 2. Thomas Miilar, Biochemistry Explained: A Practical Guide to Learning Biochemistry CRC Press; 1 edition (30 May 2002) Lubert Stryer et al., Biochemistry.W. H. Freeman; 6th Edition edition (14 July 2006) 4. David L Nelson, and Michael M Cox et al., Lehninger principles of biochemistry WH Freeman; 7th ed. 2017 edition (1 January 2017)

1	**Title of the course** (L-T-P-C)	**States of matter** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	The Gaseous State: Gas laws, Equation of state, Concept of temperature, pressure, partial pressure, density, Mole concept. Kinetic Theory of Gases: Maxwells distribution of molecular velocities, Collisions theory. Viscosity of gases. Energy distribution function, Phase rule and equilibria. Real Gases: Deviations from ideal behaviour, Compressibility factors, van der Waals and Virial equation, Reduced equation of state, Law of corresponding states, Critical phenomena, Intermolecular forces. The solid and liquid states and their properties.
4	**Texts/References**	1. K. L. Kapoor, A Textbook of Physical Chemistry, States of Matter and Ions In Solution (SI Units) - Vol. 1 | 6th Edition 2. P. Atkins, Julio de Paula, J. Keeler, Atkins' Physical Chemistry: International Eleventh Edition

1	**Title of the course** (L-T-P-C)	**Organic chemistry** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	**Reactive Intermediates**: An overview of the chemistry of carbenes, nitrenes, radicals, carbocations, carbanions and benzynes. Introduction to substitution, elimination, addition, oxidation, reduction, rearrangement types of reactions **Epoxidation named reactions**: Jacobsen and Sharpless. **Olefination named reactions**: Wittig, Julia, Wharton, Peterson, Tebbe. **Cross-Coupling named reactions**: Buchwald-Hartwig, Negishi, Sonogashira, Suzuki, Wurtz, Ullmann, McMurry, Heck, Stille. **Pericyclic reactions**: Diels-alder cycloaddition, Ene reaction, Cope rearrangement, Claisen rearrangement (Johnson, Ireland and Eschenmoser). **Organic chemistry in industry**: Pharmaceuticals, dye, and agrochemicals
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 and B", 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. Laszlo Kurti and Barbara Czako, "Strategic applications of named reactions in organic synthesis", 1st Ed., Elsevier, 2005. 6. R. B. Grossman, "Art of writing reasonable organic reaction mechanisms", 2nd Ed., Springer, 2010. 7. P. Bruice, "Organic Chemistry" 7th Ed., Pearson, 2013. 8. Penny Chaloner, "Organic chemistry: A mechanistic approach, CRC Press; 1st edition, 2014

Semester III						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	HS 201	Economics	3	0	0	6
2	BB 301	Basics of Cell Biology and Genetics	2	1	0	6
3	CH 204	Physical Organic and Bioorganic Chemistry (1st Half)	3	0	0	3
4	CH 202	Inorganic Chemistry (2nd Half)	3	0	0	3
5	MA 209	Introduction to Probability Theory	3	1	0	8
6	PH 103	Waves, Oscillations & Optics	2	1	0	6
7	MA 223	Mathematics Laboratory	0	0	3	3
		Total Credits				**35**

1	**Title of the course** (L-T-P-C)	**Economics** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Basic economic problems. resource constraints and Welfare maximizations. Nature of Economics: Positive and normative economics; Micro and macroeconomics, Basic concepts in economics. The role of the State in economic activity; market and government failures; New Economic Policy in India. Theory of utility and consumer's choice. Theories of demand, supply and market equilibrium. Theories of firm, production and costs. Market structures. Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, savings, and investments. Commercial and central banking. Relationship between money, output and prices. Inflation - causes, consequences and remedies. International trade, foreign exchange and balance payments, stabilization policies : Monetary, Fiscal and Exchange rate policies.
4	**Texts/References**	. 1. P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995. . 2. A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989. 6. R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987. . 4. William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. . 5. R.S. Pindyck and D.L. Rubinfeld. Microeconomics Th (7 Edition), Pearson Prentice Hall, New Jersey, 2009. . 6. R. Dornbusch, S. Fischer, and R. Startz. Macroeconomics (9th Edition), McGraw-Hill Inc. New York, 2004.

1	**Title of the course** (L-T-P-C)	**Basics of Cell Biology and Genetics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	1. QuantitaIntroduction to genetics 2. Mendelian genetics: Mendel's law and examples, Monohybrid and di- hybrid cross, recessive and dominant mutation, concept of allele 3. Non-Mendelian genetics: incomplete dominance, semi- dominance, and introduction to epigenetics, Cytoplasmic inheritance, infection heredity. 4. Genetic interactions: approach towards generating a network (epistasis, redundancy, synthetic lethality, lethal interactions) 5. Model organisms and studies on molecular and genetic interactions 6. Structure of prokaryotic and eukaryotic cells 7. Introduction of cell biology, classification of living organisms, Prokaryotic cells, eukaryotic cells. 8. Membrane structure and function. 9. Structure and Composition of the Cell Membrane, Membrane Proteins, Transport across the Cell Membrane. 10. Structural organization and function of intracellular organelles Structure and function of cytoplasm, Cytoskeletal elements and architecture, Structure and Function of mitochondria, Ribosomes, Endoplasmic reticulum, Rough endoplasmic reticulum and protein secretion, Lysosomes, The Golgi Complex, Peroxisomes, Vacuoles, plant cell organelles, Cell locomotion
4	**Texts/References**	Anthony JF Griffiths et al., An Introduction to Genetic Analysis W.H. Freeman and Co 7th Edition 2000 2. Watson et. al., Molecular Biology of the Gene, Pearson, 7th Edition 2013 3. Jocelyn E. Krebs et al., Lewin's Gene Jones & Bartlett Learning; 11 edition (December 31, 2012) 4. Richard Kowles, Solving Problems in Genetics Springer; 2001 edition (June 21, 2001) 4. Gerald Karp, Cell Biology, WILEY (Feb. 4th, 2013) 5. Bruce Alberts et al., Essential Cell Biology; Richard Goldsby and Thomas J, &F/Garland, 4th Edition, (2014) Alberts, Bruce.; Molecular Biology of the Cell, Garland Science; 5th edition (2 January 2008)

1	**Title of the course** (L-T-P-C)	**Physical Organic and Bioorganic Chemistry** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Symmetry-adapted orbitals, pericyclic reactions and frontier molecular orbital approach (FMO), Mixing rules and build-up approach to molecules, Thermodynamic and kinetic control of reactions, linear free energy relationships, Hammond's postulate, Curtin-Hammett principle, substituent and reaction constants, isotope effects, Stereoelectronic effects, reaction mechanism models 1. Organic chemistry of biological macromolecules (proteins, carbohydrates, nucleic acids, fats etc.) and chemistry of biological pathways, chemical biology and role of chemistry in understanding life processes and medicine
4	**Texts/References**	1. E. V. Anslyn and D. A. Dougherty, *Modern Organic Chemistry*, University Science, 2005. 2. Carey, F. A., Sundberg, R. J. *Advanced Organic Chemistry*, *Part A and B*, Springer, 2007. 3. T. H. Lowry and K. H. Richardson, *Mechanisms and Theory in Organic Chemistry*, Harper and Row, 1976. 4. Isaacs, N. S. *Physical Organic Chemistry*, Prentice Hall, 1996. 5. Deslongchamps, P. *Stereoelectronic Effects in Organic Chemistry*, Elsevier Science, 1983. 6. B. G. Davis & A.J. Farbanks, Carbohydrate Chemistry, 1st Edition, Oxford University Press, 2002 7. S. Doonan, Nucleic Acids, 1st Edition, RSC Publishing House, London, 2000 8. 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)	**Inorganic Chemistry** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	Fundamental concepts and applications of chemistry (CH101)
3	**Course content**	Concepts and principles of non-transition metal chemistry: An overview of bonding models (ionic & covalent) in inorganic chemistry , Chemical forces, Bent's rule, Application of molecular orbital theory to triatomic linear molecules (localized and delocalized orbitals), Walsh diagrams. Main group Chemistry: 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.
4	**Texts/References**	1. Atkins, P., et al., Shriver and Atkins Inorganic Chemistry, 4th Ed., Oxford University Press, 2006. 2. Lee, J. D., Concise Inorganic Chemistry, 5th Ed., Blackwell Publishing, 2006. 3. Cotton, F. A., Wilkinson, G., Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., John Wiley and Sons Press, 1995. 4. Douglas, B., McDaniel, D., Alexander, J., Concepts and Models of Inorganic Chemistry, 3rd Ed. Wiley India (P.) Ltd., India, 2010.

1	**Title of the course** (L-T-P-C)	**Introduction to probability theory** **(3-1-0-8)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	Combinatorial probability and urn models, Independence of events, Conditional probabilities, Random variables, Distributions, Expectation, Variance and moments, probability generating functions and moment generating functions, Standard discrete distributions (uniform, binomial, Poisson, geometric, hypergeometric), Independence of random variables, Joint and conditional discrete distributions. Univariate densities and distributions, standard univariate densities (normal, exponential, gamma, beta, chi-square, Cauchy). Expectation and moments of continuous random variables. Transformations of univariate random variables. Tchebychev's inequality. Modes of convergence. Law of large numbers. Central limit theorem.
4	**Texts/References**	• 1. K. L. Chung and F. AitSahlia, Elementary Probability Theory., 4th Edition, Springer Verlag, 2003 • R. Ash : Basic Probability Theory, Dover publication, • W. Feller : Introduction to Probability Theory and its Applications, Volume 1, Wiley-India Edition • W. Feller : Introduction to Probability Theory and its Applications, Volume 2, Wiley India Edition

1	**Title of the course** (L-T-P-C)	**Waves, Oscillations and Optics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	Linear oscillators. Coupled oscillators and normal modes with mechanical and electromagnetic examples. Inertia, restoring force and damping. Driven systems and resonance. The continuum limit. Waves and wave equations. Dispersion relations. Phase. Interference and diffraction. Wave packets. Impedance, reflection, absorption and transmission. Polarization. Geometrical optics. Brief introduction to nonlinearity.
4	**Texts/References**	1. Waves, Berkeley Physics Course (Vol 3), Frank S. Crawford Jr., McGraw Hill, 2017. 2. Vibrations and Waves, G. C. King, John Wiley & Sons, 2009 3. Optics, Principles and applications, K. K. Sharma, Elsevier (2006) 4. Optics, M. V. Klein and T. E. Furtak, Wiley (1986) 5. Principles of Optics, M. Born and E. Wolf, McMillan, 1974. 6. Introduction to Modern Optics, G. B. Fowles, Dover, 1975. 7. Fundamentals of Optics, F. Jenkins and H. White, McGraw Hill, 2017.

Semester IV						
S.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)**	Nil
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

Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CH 323	Coordination and organometallic chemistry	3	0	0	6
2	CH 321	Concepts in organic synthesis	3	0	0	6
3	CH 322	Molecular spectroscopy	3	0	0	6
4	CH 312	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.

Semester VI						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CE 301	Environmental Studies	3	0	0	6
	CH 307	Instrumental Methods for Structure Determination	3	0	0	6
	CH 313	Chemistry laboratory-III	0	0	3	3
		Program Elective-V	2	1	0	3
		Program Elective-VI	2	1	0	6
	PH 311	Institute Elective – I	3	0	0	6
		Total Credits				**30**

1	**Title of the course** (L-T-P-C)	**Environmental studies** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Module A: Natural Resources, Ecosystems, Biodiversity and its conservation: Natural resources and ecosystems, Forest, grassland, desert and aquatic ecosystems, biodiversity at global, national and local levels, conservation of biodiversity Module B: Air Pollution Introduction to understanding air quality management, fundamental processes of meteorology, Air Pollutants – Gaseous and particulate, Criteria for pollutants, ambient and source standards, Aerosols: Characterisation of aerosols, size distributions, measurement methods; Transport behaviour: diffusion, sedimentation, inertia; Visibility; principles of particulate control systems. Module C: Water Treatment Discussion of water quality constituents and introduction to the design and operation of water and wastewater treatment processes. Module D: Solid Waste Management and Climate Change Different aspects of solid and hazardous waste management. Climate change and greenhouse gas emissions, technologies would reduce the greenhouse gas emissions. Climate change and its possible causes. Module E: Sociology/Environmentalism Description: Environmentalism in sociological tradition, Sustainability, North-South divide, Political economy approaches in environmental studies, Debates over environmental issues Module F: Economics Energy economics and financial markets, Market dynamics, Energy derivatives, Energy Efficiency; Sustainable Development: Concept, Measurement & Strategies, Interaction between Economic Development and the Environment Module G: Philosophy Environmental ethics, Deep ecology, Practical ecology, Religion and attitude towards environmental ethics, Ecofeminism and its evolution. Module H: Field work and project: visit to a local area to document environmental assets, case studies of a simple ecosystem and group discussions on current environmental issues.
4	**Texts/References**	1) Cunningham W.P. and Cunningham M.A. (2002), Principles of Environmental Science, Tata McGraw-Hill Publishing Company, New Delhi. 2) Dasgupta, P. and Maler, G. (eds.), (1997), The Environment and Emerging Development Issues, Vol. I, Oxford University Press, New Delhi. 3) Jackson, A.R.W. and Jackson, J.M. (1996), Environmental Sciences: The Environment and Human Impact, Longman Publishers. 4) Nathanson, J.A., (2002), Basic Environmental Technology, Prentice Hall of India, New Delhi. 5) Redclift, M. and Woodgate, G. (eds.), (1997), International Handbook of Environmental Sociology. 6)Srivastava, K.P. (2002), An Introduction to Environmental Study, Kalyani Publishers, Ludhiana. 7) Review articles from literature

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. 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. 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 "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.

Semester VII

S.No	Course Code	Course Name	L	T	P	C
1		Program ElectiveVII/ Minor Project	2	1	0	6
2		HSS Elective-I	3	0	0	6
3		Institute Elective -II	2	1	0	6
4		Institute Elective – III	2	1	0	6
5	CH 313	Chemistry laboratory-IV	0	0	3	3
		Total Credits				**27**

Semester VIII

S.No	Course Code	Course Name	L	T	P	C
1		Program ElectiveVIII/ Minor Project	2	1	0	6
2		HSS Elective-II	3	0	0	6
3		Institute Elective – IV	2	1	0	6
4		Institute Elective – V	2	1	0	6
		Total Credits				**24**