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	CH 113	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** **(2-1-0-6)**
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 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**	0. 1. P. A. Samuelson & W. D. Nordhaus, Economics, McGraw Hill, NY, 1995. 1. 2. A. Koutsoyiannis, Modern Microeconomics, Macmillan, 1975. R. Pindyck and D. L. Rubinfeld, Microeconomics, Macmillan publishing company, NY, 1989. 12. R. J. Gordon, Macroeconomics 4th edition, Little Brown and Co., Boston, 1987. 3. 4. William F. Shughart II, The Organization of Industry, Richard D. Irwin, Illinois, 1990. 4. 5. R.S. Pindyck and D.L. Rubinfeld. Microeconomics Th (7 Edition), Pearson Prentice Hall, New Jersey, 2009. 5. 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**	11. QuantitaIntroduction to genetics 12. Mendelian genetics: Mendel's law and examples, Monohybrid and di- hybrid cross, recessive and dominant mutation, concept of allele 13. Non-Mendelian genetics: incomplete dominance, semi- dominance, and introduction to epigenetics, Cytoplasmic inheritance, infection heredity. 14. Genetic interactions: approach towards generating a network (epistasis, redundancy, synthetic lethality, lethal interactions) 15. Model organisms and studies on molecular and genetic interactions 16. Structure of prokaryotic and eukaryotic cells 17. Introduction of cell biology, classification of living organisms, Prokaryotic cells, eukaryotic cells. 18. Membrane structure and function. 19. Structure and Composition of the Cell Membrane, Membrane Proteins, Transport across the Cell Membrane. 20. 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) 6. Gerald Karp, Cell Biology, WILEY (Feb. 4th, 2013) 7. 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 2. 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**	9. E. V. Anslyn and D. A. Dougherty, *Modern Organic Chemistry*, University Science, 2005. 10. Carey, F. A., Sundberg, R. J. *Advanced Organic Chemistry*, *Part A and B*, Springer, 2007. 11. T. H. Lowry and K. H. Richardson, *Mechanisms and Theory in Organic Chemistry*, Harper and Row, 1976. 12. Isaacs, N. S. *Physical Organic Chemistry*, Prentice Hall, 1996. 13. Deslongchamps, P. *Stereoelectronic Effects in Organic Chemistry*, Elsevier Science, 1983. 14. B. G. Davis & A.J. Farbanks, Carbohydrate Chemistry, 1st Edition, Oxford University Press, 2002 15. S. Doonan, Nucleic Acids, 1st Edition, RSC Publishing House, London, 2000 16. 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**	5. Atkins, P., et al., Shriver and Atkins Inorganic Chemistry, 4th Ed., Oxford University Press, 2006. 6. Lee, J. D., Concise Inorganic Chemistry, 5th Ed., Blackwell Publishing, 2006. 7. Cotton, F. A., Wilkinson, G., Gaus, P. L., Basic Inorganic Chemistry, 3rd Ed., John Wiley and Sons Press, 1995. 8. 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	BB 403	Metabolism and Bioenergetics	2	1	0	6
2	BB 404	Biophysics (1st Half)	3	0	0	3
3	BB 411	Biology Lab I	0	0	3	3
4		Institute Elective – I	3	0	0	6
5		Program Elective-I	3	0	0	6
6		HSS Elective-I	3	0	0	6
		Total Credits				**33**

1	**Title of the course** (L-T-P-C)	**Metabolism and Bioenergetics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	
3	**Course content**	3. Design principles of metabolism 4. Principles of energy release from biological macromolecules. 5. Principles of bioenergetics. 6. Carbohydrate metabolism 7. Alternative oxidation of glucose by Pentose Phosphate pathway (PPP). 8. Krebs /TCA /CAC cycle 9. Strategies in citrate cycle. 10. Oxidative phosphorylation 11. Photosynthesis 12. Fatty acid metabolism 13. Amino acid metabolism 14. Nucleic acid metabolism 15. One carbon metabolism 16. Secondary metabolism 17. Interconvertibility of fuels 18. Molecular chaperones in protein folding, experimental strategies to study protein mis-folding and disease, regulation of metabolism through metabolic networks, metabolic messengers, generation of NO and oxygen radicals.
4	**Texts/References**	1. Rodney F Boyer, Concepts in Biochemistry. John Wiley & Sons; 3rd Edition edition (2 December 2005) 2.Thomas Millar, Biochemistry Explained: A Practical Guide to Learning Biochemistry. CRC Press; 1 edition (30 May 2002) 3.Lubert Stryer et al., Biochemistry. W. H. Freeman; 6th Edition edition (14 July 2006) 4.John E. McMurry and Tadgh Begley. The Organic Chemistry of Biological Pathways. WH Freeman; 2nd edition (11 December 2015) 5.Laurence A Moran, Principles of Biochemistry. Pearson; 5 edition (30 July 2013) 6.David L. Nelson and Michael M. Cox, Lehninger Principles of Biochemistry WH Freeman; 7th ed. 2017 edition (1 January 2017)

1	**Title of the course** (L-T-P-C)	**Biophysics** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	

3	**Course content**	• Diffusion and Brownian motion and Biological applications.
		• Electrostatic interactions
		• Chemical Potential and Chemical reactions
		• Self-assembly, micelles, cell membranes
		• Helix coil transition
		• Stretching of macromolecules
		• Protein folding
		• Unzipping of DNA
		• Machines in membranes
		  ○ Electro-osmotic effects
		  ○ Ion pumping
		• Nerve Impulses
		  ○ Action Potentials
		  ○ Ion Channels
		• Physical Techniques and related biology
		  ○ X-ray diffraction, light and neutron scattering
		  ○ Nuclear magnetic Resonance
		  ○ Fluorescence
		  ○ DNA Microarrays
		  ○ Manipulation of bio-molecules using optical tweezers.
		  ○ Tomography
		  ○ Patch clamps

4	**Texts/References**	1. Physical Biology of the Cell, Second Edition by Rob Phillips, Jane Kondev, Julie Theriot, and Hernan Garcia (Garland Science, 2012). 2. Biological Physics: Energy, Information, Life Student edition by Philip Nelson. (Chiliagon Science)

1	**Title of the course** (L-T-P-C)	**Biology Lab I** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	1. Biological solutions preparation 2. Titration of amino acids, 3. Estimations of reducing non-reducing sugars, proteins, DNA, RNA, lipids, 4. paper chromatography/TLC, 5. SDS-PAGE, isoelectric focusing, 6. DNA melting curves 7. Enzyme assays
4	**Texts/References**	NA

Semester V						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	BB 407	Molecular Biology	2	1	0	6
2	BB 608	Genomics and proteomics (1st Half)	3	0	0	3
3	BB 405	Biostatistics (2nd Half)	3	0	0	3
4	BB 412	Biology Lab II	0	0	3	3
5		Institute Elective – II	3	0	0	6
6		Program Electives				9
		Total Credits				**33**

1	**Title of the course** (L-T-P-C)	**Molecular Biology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	1. **Nucleic acid:** building blocks, nucleotide analogs as drugs 2. **DNA structure**- base pairing and stabilizing forces, different forms of DNA. minor and major grooves, supercoiling, organization into chromosomes, nucleosomes, heterochromatin, euchromatin, genes and organization, unique genes, operons, gene families, repetitive DNA, genome organization, transposons. 3. **Replication:** basic processes in bacteria and eukaryotes, telomeres and telomerase 4. **DNA damage and repair:** 5. Basic steps in gene expression and regulation, transcriptional and post-transcriptional regulation of gene expression 6. **Bacterial translation:** 7. **Eukaryotic translation:** 9. **Epigenetics:** DNA methylation in prokaryotes and eukaryotes, epigenetic gene regulation by DNA methylation in plants and mammals. Methods to detect epigenetic modifications 10. **Protein-nucleic acid interactions** - nucleic acid recognition by proteins binding motifs - techniques to study protein-nucleic acid interactions. 11. **Non-coding RNA:** Biogenesis and its function.
4	**Texts/References**	1. Molecular Biology of the cell by Bruce Alberts et al. 6th edition. 2. Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick. 12th edition (2017) 2. DNA Repair and Mutagenesis (2nd Edition) Friedberg and others. 3. Mehta, A. and Haber J. E. (2014) sources of DNA double strand breaks and Models of Recombination DNA repair Cold Spring Harb Perspect Biol 6: a016428. 4. Anand, R.P, Lovett, S.T. and Haber J.E. (2013) Break Induced DNA Replication. Cold Spring Harb Perspect Biol 5: a010397

1	**Title of the course** (L-T-P-C)	**Genomics and proteomics** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	**Introduction to Genomics and Proteomics:** Organization and structure of genomes. Introduction to Proteomics. **Gene Identification and Expression:** Genome annotation, routes of gene identification, ORF, gene ontology, comparative genomics, determining gene function by sequence comparison and through conserved protein structure, Global expression profiling, applications of genome analysis and genomics. **Analysis of Proteomes I: Analysis of proteomes** – 2D gel electrophoresis, Image analysis of 2-DE gels. **Analysis of Proteomes II**: Mass spectrometry-based methods for protein identification. 2-DE gel electrophoresis coupled with mass spectrometry, **Micro array and RNA-seq techniques** **Applications of Genomics and Proteomics Analysis:** Analysis of Genomes – Human, Mouse, Plasmodium falciparum, Saccharomyces cerevisiae, Mycobacterium tuberculosis. Application of proteome analysis- drug development and toxicology, Pharmaceutical Applications.
4	**Texts/References**	1. Concepts and Techniques in Genomics and Proteomics by N Saraswathy P Ramalingam, first edition, 2011 (Woodhead Publishing). 2. Introduction to Genomics by Arthur M. Lesk. 3rd edition (Oxford university press). 3. Lewin's Genes XII by Elliott S. Goldstein, Jocelyn E. Krebbs, and Stephen T. Kilpatrick. 12th edition (2017) 4. Human Genetics and Genomics by Bruce R. Korf. 4th edition (Blackwell publication). 5. Introduction to Proteomics: Principles and Applications by Nawin C Mishra, Gunter Blobel 1st edition (Wiley publication).

1	**Title of the course** (L-T-P-C)	**Biostatistics** **(3-0-0-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	• **Introduction to statistics for biologists:** importance of statistics, hypothesis testing, overview of statistical tests, variables. • **Summarizing and visualizing data:** types of data, summarizing data, displaying data, descriptive statistics, tools for graphical display. • **Probability & distributions:** basic probability, laws of probability, types of distributions, statistics of distributions, probability distributions. • **Methods of sampling:** populations and samples, sampling & non-sampling errors, various methods of sampling, experimental design. • **Hypothesis testing**: need for statistical testing, acceptable errors, P-values. • **Parametric & non-parametric tests:** concept of parametric & non-parametric statistics, tests for differences. • **ANOVA:** one-way ANOVA, Two-way ANOVA, Three-way ANOVA, Multiway ANOVA, Nested ANOVA, ANCOVA. • **Correlation & regression:** scatter plot, correlation coefficient, partial correlation coefficient, linear regression, non-linearity, non-linearity. • **Survival analysis:** censoring, survival times, summarizing and presentation. • **R for biostatistics:** introduction, performing common statistical tests in R, visualizing data in R, exporting data and analysis.
4	**Texts/References**	1. Michael C. Whitlock and Dolph Schluter, The Analysis of Biological Data, Roberts And Company Publishers, 2015. 2. Steve McKillup, Statistics Explained: An Introductory Guide for Life Scientists, Cambridge University Press, 2006. 3. Calvin Dytham, Choosing and Using Statistics: A Biologist's Guide, Wiley-Blackwell, c2011

1	**Title of the course** (L-T-P-C)	**Biology Lab II** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	1. Methods of describing, observing, counting and estimating the abundance, diversity and behaviour of living organisms. 2. Light Microscopy, sample preparation and examination, identification of microorganisms, 3. Staining techniques (Gram's, acid fast), 4. Bacterial plating, tests for antibiotic resistance, 5. Microbial growth kinetics, bacterial motility assay
4	**Texts/References**	NA

Semester VI						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**

1	CE 301	Environmental Studies	3	0	0	6
2	BB 415	Bioinformatics Lab	0	0	3	3
3		Program Elective	2	1	0	6
4		Institute Elective – III				6
5	BB 413	Biology Lab III	0	0	6	6
		Total Credits				**27**

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)	**Bioinformatics lab** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	1. Biological data & sources - origin and types of biological data, public databases, storing biological data and data security. 2. Data mining - concept of data mining, methods of data mining: text-based, mining tasks, applications. 3. DNA sequence analysis - dot plot, basic concepts of sequence similarity, identity and homology, homologs, orthologs, paralogs, concepts behind scoring matrices, dynamic programming pairwise alignment - Smith-Waterman and Needleman-Wunsch algorithm, FASTA. 4. BLAST & Remote homology search - the BLAST algorithm, parsing BLAST results, advanced BLAST algorithms. 5. Multiple Sequence Alignment - methods of MSA: progressive alignments, consistency-based and structure-based alignment, programs for MSA. 6. Motif finding algorithms - sequence motif concepts, algorithms to detect DNA sequence motifs, Gibbs sampler, MEME. 7. Protein bioinformatics - Protein secondary structure calculation – DSSP, membrane topology prediction, ligand- receptor interactions, composition of active sites in functional proteins, conformational change and activity, allostery, effects of point mutations on proteins structure and function. 8. RNA structure analysis - RNA structure, RNA sequence databases, RNA structure prediction: Nussinov algorithm, EM algorithm. 9. Next generation sequencing and principles of NGS data analysis - introductory concepts, types of NGS data, various platforms of NGS, alignment algorithm - BWA, RNA-Seq, ChIP-Seq, single cell genomics. 10. R for bioinformatics - introduction, basic elements of R, plotting high-dimensional data, statistical analysis, programming.
4	**Texts/References**	1. Bioinformatics, David Mount, CSHL, 2003 2. Bioinformatics & Functional Genomics, Jonathan Pevsner, Wiley 2015 M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, Elsevier, 2010

1	**Title of the course** (L-T-P-C)	**Biology Lab III** **(0-0-6-6)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	Genetic engineering lab will a micro-project-based lab. The micro-project will cover following techniques- 1. DNA isolation 2. Primer Design, 3. PCR, 4. Cloning 5. Transgene expression and validation using PCR and Western Blot, 6. Site-directed Mutagenesis, 7. qRT-PCR
4	**Texts/References**	NA

Semester VII						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	BB 607	Immunology	2	1	0	6
2	BB 414	Biology Lab IV	0	0	3	3
3		Program Elective	3	0	0	6
4		Institute Elective -IV	3	0	0	6
5		HSS Elective-II	3	0	0	6
		Total Credits				**30**

1	**Title of the course** (L-T-P-C)	**Immunology** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Basic Cell biology and Genetics, Microbiology
3	**Course content**	1. Introduction, Organization of the immune system (lymphoid tissues and organs). 2. Immune cell development (hematopoiesis, T and B cell development). 3. Innate and adaptive immunity (including cellular and humoral responses). 4. Antigens and Antibodies (antibody classes, Ag/Ab structure and function). 5. Immune signaling (T cell receptor, TLRs, inflammatory and cytokine responses) and cancer. 6. The MHC and Ag presentation and T cell development. Immunity mechanisms in disease (allergies, autoimmunity, immuno-deficiency).
4	**Texts/References**	1.Judith A. Owen, Jenni Punt, Sharon A. Stranford, Patricia P. Jones., Kuby Immunology, W.H. Freeman and Company, 2013. 2. Kenneth Murphy , Paul Travers , Mark Walport, Janeway's Immunobiology, Garland Science, Taylor & Francis Group, 200

1	**Title of the course** (L-T-P-C)	**Biology Lab IV** **(0-0-3-3)**
2	**Pre-requisite courses(s)**	None
3	**Course content**	Fluorescence microscopy to examine intracellular compartments, Cell fractionation and centrifugation methods, isolation of intracellular compartments by differential centrifugation techniques, nuclei, cytoplasm etc. Basics of cell culture methods: cell counting, culture media preparation. Proliferation and using live cell imaging and MTT assay, Purification and analysis of Immunoglobulins, Immunoprecipitation, Enzyme-linked immunosorbent assay (ELISA), Fluorescence-activated cell sorting (FACS) and analysis of cells Immunostaining and imaging,
4	**Texts/References**	NA

Semester VIII						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1		Program Elective	3	0	0	6
2		Institute Elective -V	3	0	0	6
3		Mnor Project				12
		Total Credits				**24**