

SEMESTER - I (Common for all B.Tech Courses)

S.No	C. Code	Course	L	T	P	C
1	MA 101	Calculus	3	1	0	8
2	PH 101	Quantum Physics and Applications	2	1	0	6
3	CH 102	Fundamental Concepts and Applications of Chemistry	3	0	0	6
4	BB 103	Introduction to Modern biology	3	0	0	6
5	PH 113	Hands on Science Laboratory - I	0	0	3	3
6	CS 101	Computer Programming	3	0	2	8
7	HS 103	Introduction to Fine Arts	0	0	1	PP/NP
8	HS 106	Design Thinking and Creativity	1	0	0	PP/NP
9	NO107/N O105	NSO/NSS	0	0	2	2
First Semester Total Credits						39

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	<p>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</p> <p>Physical Chemistry: a. Quantum chemistry Schrodinger equation, Origin of quantization, Born interpretation of wave function, Hydrogen atom: solution to \square-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</p>
4	Texts/References	<ol style="list-style-type: none"> 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.

Name of Academic Unit: Mathematics

Level: B. Tech.

Programme: B.Tech.

i	Title of the course	MA 101 Calculus
ii	Credit Structure (L-T-P-C)	(3-1-0-8)
iii	Type of Course	Core course
iv	Semester in which normally to be offered	Autumn
v	Whether Full or Half Semester Course	Full
vi	Pre-requisite(s), if any (For the students) – specify course number(s)	--
vi i	Course Content	Review of limits, continuity, differentiability. Mean value theorem, Taylors Theorem, Maxima and Minima. Riemann integrals, Fundamental theorem of Calculus, Improper integrals, applications to area, volume. Convergence of sequences and series, power series. 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.
vi ii	Texts/References	1. B.V. Limaye and S. Ghorpade, A Course in Calculus and Real Analysis, Springer UTM (2004) 2. B.V. Limaye and S. Ghorpade, A Course in Multivariable Calculus and Analysis, Springer UTM (2010) 3. James Stewart, Calculus (5th Edition), Thomson (2003). 4. T. M. Apostol, Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern (1980). 5. Marsden and Tromba, Vector calculus (First Indian Edition), Springer (2012)

ix	Name(s) of Instructor(s)	BVL
x	Name(s) of other Departments/ Academic Units to whom the course is relevant	NA
xi	Is/Are there any course(s) in the same/ other academic unit(s) which is/ are equivalent to this course? If so, please give details.	No
xi i	Justification/ Need for introducing the course	This is a fundamental mathematics course which is essential for any branch of engineering

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	<ul style="list-style-type: none"> <input type="checkbox"/> Quantum nature of light: Photoelectric Effect and Compton Effect. <input type="checkbox"/> Stability of atoms and Bohr's rules. <input type="checkbox"/> Wave particle duality: De Broglie wavelength, Group and Phase velocity, Uncertainty Principle, Double Slit Experiment. <input type="checkbox"/> Schrödinger Equation. <input type="checkbox"/> Physical interpretation of Wave Function, Elementary Idea of Operators, Eigen-value Problem. <input type="checkbox"/> Solution of Schrödinger equation for simple boundary value problems. <input type="checkbox"/> Reflection and Transmission Coefficients. Tunneling. <input type="checkbox"/> Particle in a three dimensional box, Degenerate states. <input type="checkbox"/> Exposure to Harmonic Oscillator and Hydrogen Atom without deriving the general solution. <input type="checkbox"/> Quantum Statistics: Maxwell Boltzmann, Bose Einstein and Fermi Dirac Statistics by detailed balance arguments. <input type="checkbox"/> Density of states. <input type="checkbox"/> Applications of B-E statistics: Lasers. Bose-Einstein Condensation. <input type="checkbox"/> Applications of F-D statistics: Free electron model of electrons in metals. Concept of Fermi Energy. <input type="checkbox"/> Elementary Ideas of Band Theory of Solids. <input type="checkbox"/> Exposure to Semiconductors, Superconductors, Quantum Communication and Quantum Computing.
4	Texts/References	<ol style="list-style-type: none"> 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 12 th edition, Pearson publication by Lisa Urry, Michael Cain, Steven Wasserman

Name of Academic Unit: Computer Science and Engineering

Level: B. Tech.

Programme: B.Tech.

i	Title of the course	CS 101 Computer Programming
ii	Credit Structure (L-T-P-C)	(3-0-2-8)

iii	Type of Course	Core course
iv	Semester in which normally to be offered	Spring
v	Whether Full or Half Semester Course	Full
vi	Pre-requisite(s), if any (For the students) – <i>specify course number(s)</i>	Nil
vi i	Course Content	<p>This course provides an introduction to problem solving with computers using a modern language such as Java or C/C++.</p> <p>Topics covered will include:</p> <p>Utilization: Developer fundamentals such as editor, integrated programming environment, Unix shell, modules, libraries.</p> <p>Programming features: Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic i/o.</p> <p>Applications: Sample problems in engineering, science, text processing, and numerical methods.</p>
vi ii	Texts/References	<ol style="list-style-type: none"> 1. An Introduction to Programming through C++, 1st edition, by Abhiram G. Ranade, McGraw Hill Education, 2014. 2. C++ Program Design: An introduction to Programming and Object-Oriented Design, 3rd Edition, by Cohoon and Davidson, Tata McGraw Hill, 2003. <p>Other references</p> <ol style="list-style-type: none"> 1. Thinking in C++ 2nd Edition, by Bruce Eckel (available online). 2. How to Solve It by Computer, by G. Dromey, Prentice-Hall, Inc., Upper Saddle River, NJ, 1982. 3. How to Solve _It (2nd ed.), by Polya, G., Doubleday and co, 1957. 4. Let Us C, by Yashwant Kanetkar, Allied Publishers, 1998. 5. The Java Tutorial, Sun Microsystems, Addison- Wesley, 1999.
ix	Name(s) of Instructor(s)	--

x	Name(s) of other Departments/ Academic Units to whom the course is relevant	NA
xi	Is/Are there any course(s) in the same/	No

	other academic unit(s) which is/ are equivalent to this course? If so, please give details.	
xi i	Justification/ Need for introducing the course	Basic course in problem solving using computers.

1	Title of the course (L-T-P-C)	Introduction to Fine Arts: Urban Dance in India: A Brief & Partial Introduction in Theory & Practice
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	<ol style="list-style-type: none"> 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 board 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	<ol style="list-style-type: none"> 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 <p>There are some additional books in this “How it Works” series.</p>

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 111	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 \mathbb{R}^n , notion of linear independence and dependence, linear span of a set of vectors, vector subspaces of \mathbb{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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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)	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 creating and manipulating various data structures and implementation of algorithms.
4	Texts/References	<ol style="list-style-type: none"> 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	<ul style="list-style-type: none"> ▮ 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	<p>(1) Introduction to Electrodynamics (4th ed.), David J. Griffiths, Prentice Hall, 2015.</p> <p>(2) Classical Electromagnetism, J. Franklin, Pearson Education, 2005.</p>

1	Title of the course (L-T-P-C)	Biomolecules (3-0-0-6)
2	Pre-requisite courses(s)	None
3	Course content	<p>Major classes of biological molecules: Comparison of the alphabets and sources of structural diversity of proteins, nucleic acids, carbohydrates and lipids.</p> <p>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.</p> <p>Carbohydrates: Sources of structural diversity; structure- function relationship in glycogen and cellulose, Difficulty associated with sequencing of glycans.</p> <p>Lipids: Structure and properties of storage and membrane lipids. Self-assembly of lipids: packing parameter; Biomembrane organization - sidedness and function; transport phenomena.</p> <p>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.</p> <p>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.</p> <p>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.</p>
4	Texts/References	<ol style="list-style-type: none"> 1. Rodney F Boyer, Concepts in Biochemistry. John Wiley & Sons; 3rd Ed (2 December 2005). 2. Thomas Miliar, 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	<p>The Gaseous State: Gas laws, Equation of state, Concept of temperature, pressure, partial pressure, density, Mole concept.</p> <p>Kinetic Theory of Gases: Maxwells distribution of molecular velocities, Collisions theory. Viscosity of gases. Energy distribution function, Phase rule and equilibria.</p> <p>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.</p> <p>The solid and liquid states and their properties.</p>
4	Texts/References	<ol style="list-style-type: none"> 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	<p>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</p> <p>Epoxidation named reactions: Jacobsen and Sharpless.</p> <p>Olefinations named reactions: Wittig, Julia, Wharton, Peterson, Tebbe.</p> <p>Cross-Coupling named reactions: Buchwald-Hartwig, Negishi, Sonogashira, Suzuki, Wurtz, Ullmann, McMurry, Heck, Stille.</p> <p>Pericyclic reactions: Diels-alder cycloaddition, Ene reaction, Cope rearrangement, Claisen rearrangement (Johnson, Ireland and Eschenmoser).</p> <p>Organic chemistry in industry: Pharmaceuticals, dye, and agrochemicals</p>
4	Texts/References	<ol style="list-style-type: none"> 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		Mathematics Laboratory	0	0	3	3
		Total Credits				35

1	Title of the course (L-T-P-C)	Economics (2-1-0-6)
2	Pre-requisite courses(s)	--
3	Course content	<p>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.</p> <p>Theory of utility and consumer's choice. Theories of demand, supply and market equilibrium. Theories of firm, production and costs. Market structures.</p> <p>Perfect and imperfect competition, oligopoly, monopoly. An overview of macroeconomics, measurement and determination of national income. Consumption, savings, and investments. Commercial and central banking.</p> <p>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.</p>
4	Texts/References	<ul style="list-style-type: none"> . 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. 3. 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	<ol style="list-style-type: none"> 1. Quantitative Introduction 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 <p>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</p>
4	Texts/References	<p>Anthony JF Griffiths et al., An Introduction to Genetic Analysis W.H. Freeman and Co 7th Edition 2000</p> <p>2. Watson et. al., Molecular Biology of the Gene, Pearson, 7th Edition 2013</p> <p>3. Jocelyn E. Krebs et al., Lewin's Gene Jones & Bartlett Learning; 11 edition (December 31, 2012)</p> <p>4. Richard Kowles, Solving Problems in Genetics Springer; 2001 edition (June 21, 2001)</p> <p>4. Gerald Karp, Cell Biology, WILEY (Feb. 4th, 2013)</p> <p>5. Bruce Alberts et al., Essential Cell Biology; Richard Goldsby and Thomas J, &F/Garland, 4th Edition, (2014)</p> <p>Alberts, Bruce.; Molecular Biology of the Cell, Garland Science; 5th edition (2 January 2008)</p>

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	<p>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</p> <p>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</p>
4	Texts/References	<ol style="list-style-type: none"> 1. E. V. Anslyn and D. A. Dougherty, <i>Modern Organic Chemistry</i>, University Science, 2005. 2. Carey, F. A., Sundberg, R. J. <i>Advanced Organic Chemistry, Part A and B</i>, Springer, 2007. 3. T. H. Lowry and K. H. Richardson, <i>Mechanisms and Theory in Organic Chemistry</i>, Harper and Row, 1976. 4. Isaacs, N. S. <i>Physical Organic Chemistry</i>, Prentice Hall, 1996. 5. Deslongchamps, P. <i>Stereoelectronic Effects in Organic Chemistry</i>, Elsevier Science, 1983. 6. B. G. Davis & A.J. Farbanks, <i>Carbohydrate Chemistry</i>, 1st Edition, Oxford University Press, 2002 7. S. Doonan, <i>Nucleic Acids</i>, 1st Edition, RSC Publishing House, London, 2000 8. A. Lehninger, D. L. Nelson, Cox, M. M. <i>Principles of Biochemistry</i>, 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	<p>Concepts and principles of non-transition metal chemistry: An overview of bonding models (ionic & covalent) in inorganic chemistry</p> <p>, Chemical forces, Bent's rule, Application of molecular orbital theory to triatomic linear molecules (localized and delocalized orbitals), Walsh diagrams.</p> <p>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.</p>
4	Texts/References	<ol style="list-style-type: none"> 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	<ul style="list-style-type: none"> <input type="checkbox"/> 1. K. L. Chung and F. AitSahlia, Elementary Probability Theory., 4th Edition, Springer Verlag, 2003 <input type="checkbox"/> R. Ash : Basic Probability Theory, Dover publication, <input type="checkbox"/> W. Feller : Introduction to Probability Theory and its Applications, Volume 1, Wiley-India Edition <input type="checkbox"/> W. Feller : Introduction to Probability Theory and its Applications, Volume 2, Wiley India Edition

Semester - IV

S. No	Course Code	Course Name	L	T	P	C
1	PH 202	Classical Mechanics	2	1	0	6
2	PH 203	Quantum Mechanics - I	2	1	0	6
3	PH 204	Mathematical Physics-I	2	1	0	6
4		Program Elective-I	2	1	0	6
5		HSS Elective-I	3	0	0	6
		Total Credits				30

1	Title of the course (L-T-P-C)	Classical Mechanics (2-1-0-6)
2	Pre-requisite courses(s)	Nil
3	Course content	<p>Review of Newtonian Mechanics - Newton's Laws of Motion and Conservation Laws.</p> <p>Principles of Canonical Mechanics - Constraints and generalized coordinates, Alembert's principle, Lagrange's equation, Hamilton's variational principle, canonical systems, symmetries and conservation laws, Noether's theorem, Liouville's Theorem.</p> <p>Central Force: Equations of motion Virial Theorem, Kepler's Laws, Scattering in a Central Force Field.</p> <p>Rigid Body: Euler angles, Coriolis Effect, Euler equations, moment of inertia tensor, motion of asymmetric top.</p> <p>Small Oscillations: Eigen value problem, frequencies of free vibrations and normal modes, forced vibration, dissipation.</p> <p>Special Theory of Relativity: Newtonian relativity, Michelson-Morley experiment, Special theory of relativity, Lorentz transformations and its consequences, addition of velocities, variation of mass with velocity, mass-energy relation, Minkowski four-dimensional continuum, four vectors.</p> <p>Hamiltonian Equation, Gauge transformation, canonical transformation, Infinitesimal transformation, Poisson brackets, Hamilton-Jacobi equations, Separation of variables.</p> <p>Lagrangian and Hamiltonian formulation of continuous systems.</p>
4	Texts/References	<ol style="list-style-type: none"> 1. Classical Mechanics: H. Goldstein, C. P. Poole, and J. Safko, Pearson 2011. 2. Classical Mechanics: N. C. Rana and P. S. Joag, Tata McGraw Hill, 2017. 3. Introduction to Classical Mechanics: David Morin, Cambridge University Press, 2008. 4. Mechanics: L.D. Landau and E. M. Lifshitz, Butterworth-Heinemann, 3rd edition, 1982. 5. Mechanics: From Newton's Laws to Deterministic Chaos, F. Scheck, Springer, 5th edition, 2010. 6. Introduction to Classical Mechanics, R G Takwale and P S Puranik, Tata McGraw Hill, 2008.

1	Title of the course (L-T-P-C)	Quantum Mechanics - I (3-1-0-8)
2	Pre-requisite courses(s)	PH101 MA101
3	Course content	<p>Review of Wave mechanics, Schrodinger equation, Uncertainty principle, wave packets, group velocity and phase velocity.</p> <p>Postulates of quantum mechanics, probability and probability current density, operators, eigenvalues and eigenfunctions. Bound states, delta-function potential, and harmonic oscillator.</p> <p>Formalism: Hilbert space, Observables, Eigenfunctions of Hermitian operator, Dirac's notation, matrix representations of vectors and operators, parity operation, matrix theory of harmonic oscillator.</p> <p>Theory of Angular Momentum: Spherical harmonics, eigenvalues of L^2 and L_z, addition of angular momentum, commutation relations, degeneracies.</p> <p>Hydrogen atom, quantum numbers, two particle systems.</p>
4	Texts/References	<ol style="list-style-type: none"> 1. Introduction to Quantum Mechanics, D. J. Griffiths and D. F. Schroeter, Cambridge University Press, 3rd edition, 2019. 2. Modern Quantum Mechanics, J. J. Sakurai, Cambridge University Press, 2017. 3. Principles of Quantum Mechanics, R. Shankar, Springer, 2014. 4. Quantum Physics, S. Gasiorowicz, John Wiley, 2000. 5. Quantum Mechanics, L. D. Landau and E.M. Lifshitz, Pergamon press, 1965

Semester V

S.N	Course Code	Course Name	L	T	P	C
1	PH 201	Electrodynamics	2	1	0	6
2	PH 304	Statistical Physics	2	1	0	6
3	PH 302	Quantum Physics-II	2	1	0	6
4		Program Elective-II	2	1	0	6
	PH 212	General Physics Laboratory	0	0	3	3
5	EE 212	Devices and Circuit Lab	0	0	3	3
6		HSS Elective-II	3	0	0	6
		Total Credits				36

1	Title of the course (L-T-P-C)	Electrodynamics (2-1-0-6)
2	Pre-requisite courses(s)	Successful completion of PH102
3	Course content	<p>Review of electrostatics and magnetostatics.</p> <p>Electrodynamics: Differential and integral forms of Maxwell's equations, Scalar and vector potentials, gauge transformations, Coulomb and Lorentz Gauge; Maxwell's equations in terms of potentials. Energy and momentum in electrodynamics.</p> <p>Electromagnetic waves: Electromagnetic waves in non-conducting media: Monochromatic plane waves in vacuum, propagation through linear media; Boundary conditions; Reflection and transmission at interfaces. Fresnel's laws; Electromagnetic waves in conductors: Modified wave equation, monochromatic plane waves in conducting media, Dispersion: Dispersion in non-conductors, free electrons in conductors and plasmas. Guided waves.</p> <p>Retarded potentials, Electric dipole radiation, magnetic dipole radiation. Radiation from a point charge: Lienard-Wiechart potentials, fields of a point charge in motion, power radiated by a point charge.</p> <p>Electrodynamics and Relativity: Review of special theory of relativity, Lorentz transformations, Minkowski four vectors, energy-momentum four vector, covariant formulation of mechanics; Transformation of electric and magnetic fields under Lorentz transformations, field tensor, invariants of electromagnetic field, Covariant formulation of electrodynamics, Lorentz force on a relativistic charged particle.</p> <p>Waveguides, Resonant Cavities and Optical Fibers, Basics of Antennas.</p>
4	Texts/References	<ol style="list-style-type: none"> (1) D. J. Griffith: Introduction to Electrodynamics, 4th edition, Pearson, 2015. (2) J.D. Jackson: Classical Electrodynamics, Wiley student edition, 3rd edition, 2007. (3) Modern Electrodynamics, Andrew Zangwill, Cambridge University Press, 2012. (4) Foundations of Electromagnetic Theory, J. R. Reitz, F. J. Milford, and R. W. Christy, Addison-Wesley, 4th edition, 2008. (5) W K H Panofsky and M Philips: Classical Electricity and Magnetism Addison Wesley, 2nd edition, 1962. (6) W Greiner: Classical Electrodynamics, Springer, 1998. (7) Hayt, William H., Jr., and John A. Buck, "Engineering Electromagnetics", 7th ed. McGraw-Hill, 2006. (8) M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, Saunders, 1983.

1	Title of the course (L-T-P-C)	Statistical Physics (2-1-0-6)
2	Pre-requisite courses(s)	None
3	Course content	<p>Thermodynamics: Thermal equilibrium, the laws of thermodynamics; temperature, energy, entropy, and other functions of state.</p> <p>Probability Theory: Probability densities, cumulants and correlations; central limit theorem; laws of large numbers.</p> <p>Kinetic Theory: Phase space densities; Liouville's theorem, the Boltzmann equation; transport phenomena.</p> <p>Classical Statistical Mechanics: Postulates; microcanonical, canonical and grand canonical ensembles; Gibb's paradox, non-interacting examples. Maxwell Boltzmann distribution, ideal gas.</p> <p>Quantum Statistical Mechanics: Indistinguishability, Bose-Einstein and Fermi- Dirac distributions and Applications</p> <p>Interacting Systems: Virial and cluster expansions; van der Waals theory; liquid- vapor condensation.</p> <p>Quantization effects in molecular gases; phonons, photons; density matrix formulation.</p> <p>□ Identical Particles: Degenerate quantum gases; Fermi liquids; Bose condensation; superfluidity..</p>
4	Texts/References	<ol style="list-style-type: none"> 1. Huang, Kerson. Statistical Mechanics. 2nd ed. Wiley, 1987. 2. Baierlein, Thermal Physics (Cambridge University Press, 1999). 3. Pathria, R. K. Statistical Mechanics. Pergamon Press, 1972. 4. Ma, Shang-keng. Statistical Mechanics. Translated by M. K. Fung. World Scientific Publishing Company, 1985. 5. J. K. Bhattacharjee, Statistical Physics: Equilibrium and Non-Equilibrium Aspects, Allied Publishes, 2000 6. F. Reif, Fundamentals of Statistical and Thermal Physics Statistical Physics :Amit and Verbin, Word Scientific, 1999

1	Title of the course (L-T-P-C)	Devices and circuits Lab (0-0-3-3)
2	Pre-requisite courses(s)	--
3	Course content	<p>This lab will reinforce concepts thought in Electronic devices and analog circuits. It will have experiments on Device characterization and circuits design and characterization. The following is the tentative list of experiments for this lab:</p> <ol style="list-style-type: none"> 1. LED and Photodiode characterization 2. BJT biasing and CE amplifier 3. Solar cell characterization 4. Diode Temperature characteristics 5. NMOS characterization and CS amplifier 6. MOS differential amplifier 7. basic opamp circuits 8. Active filters 9. Multivibrators 10. Audio amplifiers
4	Texts/References	<p>J.V.Wait, L.P.Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.</p> <p>J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.</p> <p>Behzad Razavi, Fundamentals of microelectronics, Wiley Publications</p> <p>A.S.Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, Edition IV, 2017.</p> <p>Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000.</p>

Semester VI

S.No	Course Code	Course Name	L	T	P	C
1	CE 301	Environmental Studies	3	0	0	6
		Program Elective-III	2	1	0	6
		Institute Elective – 1	2	1	0	6
		Institute Elective – 2 / Minor Project	0	0	6	6
	PH 311	Advanced Physics Lab	0	0	3	3
		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	<p>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</p> <p>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.</p> <p>Module C: Water Treatment Discussion of water quality constituents and introduction to the design and operation of water and wastewater treatment processes.</p> <p>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.</p> <p>Module E: Sociology/Environmentalism Description: Environmentalism in sociological tradition, Sustainability, North-South divide, Political economy approaches in environmental studies, Debates over environmental issues</p> <p>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</p> <p>Module G: Philosophy Environmental ethics, Deep ecology, Practical ecology, Religion and attitude towards environmental ethics, Ecofeminism and its evolution.</p> <p>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.</p>
4	Texts/References	<ol style="list-style-type: none"> 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

Semester VII

S.No	Course Code	Course Name	L	T	P	C
1		Program Elective-IV	2	1	0	6
2		Seminar – I	0	0	3	3
3		Institute Elective – 3	2	1	0	6
4		Institute Elective – 4	2	1	0	6
5		Institute Elective – 5 / Minor Project	0	0	6	6

Semester VIII

S.No	Course Code	Course Name	L	T	P	C
1		Program Elective-V	2	1	0	6
		Institute Elective – 6	2	1	0	6
		Institute Elective – 7/ Minor Project				6
		Institute Elective – 8/ MinorProject				6
		Seminar – II	0	0	3	3
		Total Credits				27

Semester IX & X			
		Independent Project	60
		Total Credits	60