B.Sc. (P) Physical Science

PAPER NAME	COURSE LEARNING OUTCOME
	PHYSICS
CC-1A: Mechanics	Upon completion of this course, students are expected to understand the following concepts: Understand the role of vectors and coordinate systems in Physics, solve Ordinary Differential Equations, laws of motion and their application to various dynamical situations. Learn the concept of Inertial reference frames their transformations. Also, the concept of conservation of energy, momentum, angular momentum and apply them to basic problems. Understand the phenomena of elastic and in-elastic collisions, phenomenon of simple harmonic motion, understand angular momentum of a system of particle, understand concept of Geosynchronous orbits Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object. In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, Vernier calipers, travelling microscope) student shall embark on verifying various principles and associated measurable parameters.
CC-2A: Electricity, Magnetism & EMT	At the end of this course, students will be able to • Have basic knowledge of Vector Calculus • Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges. • Apply Gauss's law of electrostatics to solve a variety of problems. Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential. • Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws) • Have brief idea of magnetic materials, understand the concepts of induction, solveproblems using Faraday's and Lenz's laws • In the Lab course, students will be able to measure resistance (high and low), Voltage, Current, self and mutual inductance, capacitor, strength of magnetic field and its variation, study different circuits RC, LCR etc.
CC-3A: Thermal Physics and Statistical Mechanics	At the end of this course, students will • Learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations.

	• Know the fundamentals of the kinetic theory of gases, Maxwell-Boltzman distribution law, equipartition of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion. • Learn about the black body radiations, Stefan- Boltzmann's law, Rayleigh-Jean's law and Planck's law and their significances. • Learn the quantum statistical distributions, viz., the Bose-Einstein statistics and the Fermi-Dirac statistics. • In the laboratory course, the students are expected to: Measure of Planck's constant using black body radiation, determine Stefan's Constant, coefficient of thermal conductivity of a bad conductor and a good conductor, determine the temperature co- efficient of resistance, study variation of thermo emf across two junctions of a thermocouple with temperature etc.
CC-4A: Waves and Optics	On successfully completing the requirements of this course, the students will have the skill and knowledge to: • Understand Simple harmonic oscillation and superposition principle. • Understand the importance of classical wave equation in transverse and longitudinal waves and solving a range of physical systems on its basis. • Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations. • Understand Interference as superposition of waves from coherent sources derived from same parent source. Demonstrate understanding of Interference experiments: Young's Double Slit, Fresnel's biprism, Llyod's Mirror, Newton's Rings. • Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from apertures. Understand Fraunhoffer Diffraction from a slit. • Concept of Polarization • In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt first hand. • The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.
SEC: Physics Workshop Skills	After completing this course, student will be able to: • Use measuring devices like Vernier alipers, Screw gauge, travelling microscope and Sextant for measuring various length scales. • Acquire skills in the usage of multimeter, soldering iron, oscilloscopes, power supplies and relays. • Develop mechanical skills such as casting, foundry, machining,

	forming and welding and will become familiar with common machine tools like lathe, shaper, drill, milling machine, surface machines and cutting tools. • Get acquainted with prime movers: mechanism, gear system, wheel, fixing of gears with motor axle, lever mechanism, lifting of heavy weight using lever, braking systems, pulleys.
SEC: Computational Physics Skills	Students will be able to • Use computers for solving problems in Physics. • Prepare algorithms and flowcharts for solving a problem. • Use Linux commands on terminal • Use an unformatted editor to write sources codes. • Learn "Scientific Word Processing", in particular, using LaTeX for preparing articles, papers etc. which include mathematical equations, picture and tables. • Learn the basic commands of Gnuplot.
Electrical circuits and Network Skills	At the end of this course, students will be able to • Demonstrate good comprehension of basic principles of electricity including ideas about voltage, current and resistance. • Develop the capacity to analyze and evaluate schematics of power efficient electrical circuits while demonstrating insight into tracking of interconnections within elements while identifying current flow and voltage drop. • Gain knowledge about generators, transformers and electric motors. The knowledge would include interfacing aspects and consumer defined control of speed and power. • Acquire capacity to work theoretically and practically with solid-state devices. • Delve into practical aspects related to electrical wiring like various types of conductors and cables, wiring-Star and delta connections, voltage drop and losses. • Measure current, voltage, power in DC and AC circuits, acquire proficiency infabrication of regulated power supply. • Develop capacity to identify and suggest types and sizes of solid and stranded cables, conduit lengths, cable trays, splices, crimps, terminal blocks and solder.
SEC: Basic Instrumentation Skills	At the end of this course the students will learn the following: • The student is expected to have the necessary working knowledge on accuracy, precision, resolution, range and errors/uncertainty in measurements.

	• Course learning begins with the basic understanding of the measurement and errors in measurement. It then familiarizes about each and every specification of a multimeter, multimeters, multivibrators, rectifiers, amplifiers, oscillators and high voltage probes and their significance with hands on mode. • Explanation of the specifications of CRO and their significance. Complete explanation ofCRT. • Students learn the use of CRO for the measurement of voltage (DC and AC), frequency and time period. Covers the Digital Storage Oscilloscope and its principle of working. • Students learn principles of voltage measurement. Students should be able to understand the advantages of electronic voltmeter over conventional multimeter in terms of sensitivity etc. Types of AC millivoltmeter should be covered. • Covers the explanation and specifications of Signal and pulse Generators: low frequency signal generator and pulse generator. Students should be familiarized with testing and specifications. • Students learn about the working principles and specifications of basic LCR bridge. • Hands on ability to use analog and digital instruments like digital multimeter and frequency counter.
SEC: Renewable Energy and Energy harvesting	At the end of this course, students will be able to achieve the following learning outcomes: • Knowledge of various sources of energy for harvesting • Understand the need of energy conversion and the various methods of energy storage • A good understanding of various renewable energy systems, and its components. • Knowledge about renewable energy technologies, different storage technologies, distribution grid, smart grid including sensors, regulation and their control. • Design the model for sending the wind energy or solar energy plant. • The students will gain hand on experience of: (i) different kinds of alternative energy sources, (ii) conversion of vibration into voltage using piezoelectric materials, (iii) conversion of thermal energy into voltage using thermoelectric modules.
SEC: Engineering Design and Prototyping/Technical	This course will enable the student to be proficient in:

Drawing	• Understanding the concept of a sectional view – visualizing a space after being cut by a plane. How The student will be able to draw and learn proper techniques for drawing an aligned section. • Understanding the use of spatial visualization by constructing an orthographic multi viewdrawing. • Drawing simple curves like ellipse, cycloid and spiral, Orthographic projections of points, lines and of solids like cylinders, cones, prisms and pyramids etc. • Using Computer Aided Design (CAD) software and AutoCAD techniques.
SEC : Radiation Safety	This course will help students in the following ways: • Awareness and understanding the hazards of radiation and the safety measures to guard against these hazards. • Learning the basic aspects of the atomic and nuclear Physics, specially the radiations that originate from the atom and the nucleus. • Having a comprehensive knowledge about the nature of interaction of matter with radiations like gamma, beta, alpha rays, neutrons etc. and radiation shielding by appropriate materials. • Knowing about the units of radiations and their safety limits, the devises to detect and measure radiation. • Learning radiation safety management, biological effects of ionizing radiation, operational limits and basics of radiation hazards evaluation and control, radiation protection standards, 'International Commission on Radiological Protection' (ICRP) its principles, justification, optimization, limitation, introduction of safety and risk management of radiation. nuclear waste and disposal management, brief idea about 'Accelerator driven Sub-Critical System' (ADS) for waste management. • Learning about the devices which apply radiations in medical sciences, such as MRI, PET. • Understanding and performing experiments like Study the background radiation levels using Radiation detectors, Determination of gamma ray linear and mass absorption coefficient of a given material for radiation shielding application.
SEC: Applied Optics	Students will be able to : • Understand basic lasing mechanism qualitatively, types of lasers, characteristics of laser light and its application in developing

	LED, Holography. • Gain concepts of Fourier optics and Fourier transform spectroscopy. • Understand basic principle and theory of Holography. • Grasp the idea of total internal reflection and learn the characteristics of optical fibers.
SEC: Weather Forecasting	The student will gain the following: • Acquire basic knowledge of the elements of the atmosphere, its composition at various heights, variation of pressure and temperature with height. • Learn basic techniques to measure temperature and its relation with cyclones and anti- cyclones. • Knowledge of simple techniques to measure wind speed and its directions, humidity and rainfall. • Understanding of absorption, emission and scattering of radiations in atmosphere; Radiation laws. • Knowledge of global wind systems, jet streams, local thunderstorms, tropical cyclones, tornadoes and hurricanes. • Knowledge of climate and its classification. Understanding various causes of climate change like global warming, air pollution, aerosols, ozone depletion, acid rain. • Develop skills needed for weather forecasting, mathematical simulations, weather forecasting methods, types of weather forecasting, role of satellite observations in weather forecasting, weather maps etc. Uncertainties in predicting weather based on statistical analysis. • Develop ability to do weather forecasts using input data. • In the laboratory course, students should be able to learn: Principle of the working of a weather Station, Study of Synoptic charts and weather reports, Processing and analysis of weather data, Reading of Pressure charts, Surface charts, Wind charts and theiranalysis.
SEC : Introduction to Physical Computing	The student will be able to • Understand the evolution of the CPU from microprocessor to microcontroller and embedded computers from a historical

	perspective. • Operate basic electronic components and analog and digital electronics building blocksincluding power supply and batteries. • Use basic laboratory equipment for measurement and instrumentation. • Understand the Arduino ecosystem and write simple Arduino programs (sketches) • Understand sensor characteristics and select a suitable sensor for various applications. • Read digital and analog data and produce digital and analog outputs from an embeddedcomputer. • Understand how to interface an embedded computer to the physical environment. • Visualize the needs of a standalone embedded computer and implement a simple systemusing Arduino.
SEC: Numerical Analysis	**Theory:** After completing this course, student will be able to: • Approximate single and multi-variable function by Taylor's Theorem. • Solve first order differential equations and apply it to physics problems. • solve linear second order homogeneous and non-homogeneous differential equationswith constant coefficients. • Calculate partial derivatives of function of several variables • Understand the concept of gradient of scalar field and divergence and curl of vector fields. perform line, surface and volume integration • Use Green's, Stokes' and Gauss's Theorems to compute integrals **Practical:** After completing this course, student will be able to : • Design, code and test simple programs in C++ learn Monte Carlo techniques, • fit a given data to linear function using method of least squares find roots of a given non-linear function • Use above computational techniques to solve physics problems
DSE-1A: Elements of Modern Physics	This course will prepare the students to appreciate and comprehend the following aspects: • Understand historical basis of quantum mechanics. • Explain how quantum mechanical concepts answer some of

	unanswered questions of Classical mechanics such as photoelectric effect, Compton scattering etc. • Explain inadequacy of Rutherford model, discrete atomic spectra from hydrogen like atoms and its explanation on quantum mechanical basis. • Demonstrate ability to apply wave-particle duality and uncertainty principle to solvephysics problems. • Explain two slit interference experiment with photons, atoms and particles establishingnon-deterministic nature of QM. • Set up Schrodinger equation for behavior of a particle in a field of force for simple potential and find wave solutions establishing wave-like nature of particles. • Demonstrate ability to solve 1-D quantum problems including the quantum particle in a box, a well and the transmission and reflection of waves. • Explain nuclear structure, binding energy, nuclear models and impossibility of anelectron being in the nucleus as a consequence of the uncertainty principle. • Understand radioactivity, radioactive decays, apply radioactive laws to solve relatedphysics problems and Pauli's prediction of neutrino, and the subsequent discovery.
DSE-1A: Digital, Analog and Instrumentation	• Differentiating the Analog and Digital circuits, the concepts of number systems like Binary, BCD, Octal and hexadecimal are developed to elaborate and focus on the digital systems. • Characteristics and working of pn junction. • Two terminal devices: Rectifier diodes, Zener diode, photodiode etc. • NPN and PNP transistors: Characteristics of different configurations, biasing,stabilization and their applications. • CE and two stage RC coupled transistor amplifier using h-parameter model of thetransistor. • Designing of different types of oscillators and their stabilities. • Ideal and practical op-amps: Characteristics and applications. • Timer circuits using IC 555 providing clock pulses to sequential circuits and developmultivibrators. • Also impart understanding of working of CRO and its usage in measurements of voltage, current, frequency and phase measurement. • In the laboratory students will learn to construct both combinational and sequential circuits by employing NAND as building blocks. They will be able to study characteristics of various diodes and BJT. They will also be able to design

	amplifiers (using BJT and Op-Amp), oscillators and multivibrators. They will also learn working ofCRO.
DSE-1A: Mathematical Physics	At the end of this course, the students will be able to • Find extrema of functions of several variables. • Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc. • Obtain power series solution of differential equation of second order with variablecoefficient using Frobenius method. • Understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations and apply these to various physical problems such as in quantum mechanics. • Learn about gamma and beta functions and their applications. • Solve linear partial differential equations of second order with separation of variablemethod. • Understand the basic concepts of complex analysis and integration. • In the laboratory course, the students will be able to design, code and test simpleprograms in C++ in the process of solving various problems.
DSE-1A: Nano Materials and Applications	On successful completion of the module students should be able to • Understand the basic concepts of Quantum Mechanics and solve Schrodinger waveequation for simple problems. • Explain the difference between nanomaterials and bulk materials and their properties. • Explain the role of confinement on the density of state function and so on the various properties exhibited by nanomaterials compared to bulk materials. • Explain various methods for the synthesis/growth of nanomaterials including top downand bottom up approaches. • Analyze the data obtained from the various characterization techniques. • Explain various applications of nano particles, quantum dots, nano wires etc. • Explain why nanomaterials exhibit properties which are sometimes very opposite, like magnetic, to their bulk counterparts. • In the Lab course students will synthesize nanoparticles by different chemical routes andcharacterize them in the laboratory using the different techniques, learnt in the theory.

	• They will also carry out thin film preparation and prepare capacitors and evaluate its performance. They will fabricate a PN diode and study its I-V characteristics.
DSE-1A: Communication System	At the end of this course, students will be able to • Understand of fundamentals of electronic communication system and electromagnetic communication spectrum with an idea of frequency allocation for radio communication system in India. • Gain an insight on the use of different modulation and demodulation techniques used in analog communication • Learn the generation and detection of a signal through pulse and digital modulation techniques and multiplexing. • Gain an in-depth understanding of different concepts used in a satellite communication system. • Study the concept of Mobile radio propagation, cellular system design and understand mobile technologies like GSM and CDMA. • Understand evolution of mobile communication generations 2G, 3G, and 4G with their characteristics and limitations. • In the laboratory course, students will apply the theoretical concepts to gain hands on experience in building modulation and demodulation circuits; Transmitters and Receivers for AM and FM. Also to construct TDM, PAM, PWM, PPM and ASK, PSK and FSK modulator and verify their results.
DSE-1A: Verilog and FPGA Based System Design	At the end of this course, students will be able to • Understand the steps and processes for design of logic circuits and systems. • Differentiate between combinational and sequential circuits. • Design various types of state machines.. • Understand various types of programmable logic building blocks such as CPLDs andFPGAs and their tradeoffs. • Write synthesizable Verilog code. • Write a Verilog test bench to test various Verilog code modules. • Design, program and test logic systems on a programmable logic device (CPLD orFPGA) using Verilog.
DSE-1A: Medical Physics	This course will enable the student to

	• Focus on the application of Physics to clinical medicine. • Gain a broad and fundamental understanding of Physics while developing particularexpertise in medical applications. • Learn about the human body, its anatomy, physiology and BioPhysics, exploring itsperformance as a physical machine. • Learn diagnostic and therapeutic applications like the ECG, Radiation Physics, X-ray technology, ultrasound and magnetic resonance imaging. • Gain knowledge with reference to working of various diagnostic tools, medicalimaging techniques • Understand interaction of ionizing radiation with matter - its effects on living organisms and its uses as a therapeutic technique and also radiation safety practices. • Gain functional knowledge regarding need for radiological protection and the sources of an approximate level of radiation exposure for treatment purposes. • In the laboratory course, the student will be exposed to the workings of various medicaldevices and getting familiarized with various detectors used in medical imaging, medical diagnostics. The hands-on experience will be very useful for the students from job perspective.
DSE-1A: Applied Dynamics	Upon successful course completion, a student will be able to: • Demonstrate understanding of the concepts that underlay the study of dynamical systems. • Understand fractals as self-similar structures. • Learn various forms of dynamics and different routes to chaos. • Understand basic Physics of fluids and its dynamics theoretically and experimentally and by computational simulations • In the Lab course, students will be able to perform Simulations/Lab experiments on: coupled Oscillators, Simulation of Simple Population , Predator-Prey Dynamics, Simple genetic circuits, rate equations for some simple chemical reactions, Fractal Formation in Deterministic Fractals, Fluid Flow Models.
DSE: 2A: Solid State Physics	On successful completion of the module students should be able to • Elucidate the concept of lattice, crystals and symmetry operations. • Understand the elementary lattice dynamics and its influence on the properties ofmaterials. • Describe the main features of the physics of electrons in solids: origin of energy bands,and their influence electronic behavior. • Explain the origin of dia-, para-, and ferro-magnetic properties of solids. • Explain the origin of the dielectric properties exhibited by solids and the concept ofpolarizability. • Learn the properties of superconductivity in solid. • In the laboratory students will carry out experiments based on the

	theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.
DSE-2A: Embedded System: Introduction to microcontroller	At the end of this course, students will be able to: • Know the major components that constitute an embedded system. • Understand what is a microcontroller, microcomputer embedded system. • Describe the architecture of 8051 microcontroller. • Write simple programs for 8051 microcontrollers in C language. • Understand key concepts of 8051 microcontroller systems like I/O operations,interrupts, programming of timers and counters. • Interface 8051 microcontroller with peripherals • Understand and explain concepts and architecture of embedded systems • Implement small programs to solve well-defined problems on an embedded platform. • Develop familiarity with tools used to develop an embedded environment • Learn to use the Arduino Uno (an open source microcontroller board) in simpleapplications. • In the laboratory, students will program 8051 microcontroller and Arduino to performvarious experiments.
DSE-2A: Nuclear and Particle Physics	• To be able to understand the basic properties of nuclei as well as knowledge of experimental determination of the same, the concept of binding energy, its various dependent parameters, N-Z curves and their significance • To appreciate the formulations and contrasts between different nuclear models such as Liquid drop model, Fermi gas model and Shell Model and evidences in support. • Knowledge of radioactivity and decay laws. A detailed analysis, comparison and energy kinematics of alpha, beta and gamma decays. • Familiarization with different types of nuclear reactions, Q-values, compound and directreactions. • To know about energy losses due to ionizing radiations, energy losses of electrons, gamma ray interactions through matter and neutron interaction with matter. Through the section on accelerators students will acquire knowledge about Accelerator facilities in India along with a comparative study of a range of detectors and accelerators which are building blocks of modern day science. • It will acquaint students with the nature and magnitude of different

	forces, particle interactions, families of sub- atomic particles with the different conservation laws, concept of quark model. • The acquired knowledge can be applied in the areas of nuclear medicine, medical physics, archaeology, geology and other interdisciplinary fields of Physics and Chemistry. It will enhance the special skills required for these fields.
DSE-2A: Quantum Mechanics	The Students will be able to learn the following from this course: • Methods to solve time-dependent and time-independent Schrodinger equation. • Quantum mechanics of simple harmonic oscillator. • Non-relativistic hydrogen atom: spectrum and Eigen functions. • Angular momentum: Orbital angular momentum and spin angular momentum. • Bosons and fermions - symmetric and anti-symmetric wave functions. • Application to atomic systems • In the laboratory course, with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one-dimensional and three dimensional potentials.
DSE-2A: Digital Signal processing	At the end of this course, students will be able to • Learn basic discrete-time signal and system types, convolution sum, impulse and frequency response concepts for linear time-invariant (LTI) systems. • Understand use of different transforms and analyze the discrete time signals andsystems. • Realize the use of LTI filters for filtering different real world signals. The concept oftransfer • Learn to solve Difference Equations. • Develop an ability to analyze DSP systems like linear-phase, FIR, IIR, All-pass, averaging and notch Filter etc. • Understand the discrete Fourier transform (DFT) and realize its implementation using FFT techniques. • Design and understand different types of digital filters such as finite & infinite impulse response filters for various applications. • In the Lab course, the students will realize various concepts using Scilab simulations like Digital Filters and their classifications based on the response, design and algorithm, Fluency in using Fast Fourier Transform, Signal generation, realization of systems and finding their transfer function, characterization using pole-zero plots and designing digital filters.

DSE-2A: Astronomy and Astrophysics	Students completing this course will gain an understanding of • Different types of telescopes, diurnal and yearly motion of astronomical objects, and astronomical coordinate systems and their transformations. • Brightness scale for stars, types of stars, their structure and evolution on HR diagram. • Components of Solar System and its evolution • The large scale structure of the Universe and its history • Distribution of chemical compounds in the interstellar medium and astrophysical conditions necessary for the emergence and existence of life.
DSE-2A: Atmospheric Physics	At the end of this course, students will be able to: • Learn and understand structure of temperature profiles and fine scale features in thetroposphere using observations. • Understand Atmospheric waves: surface water waves, atmospheric gravity waves,acoustic waves etc. • Learn remote sensing techniques such as radar, LIDAR, and satellite to exploreatmospheric processes. • Understand properties of aerosols, their radiative and health effects.
DSE-2A: Physics of the Earth	At the end of this course student will be able to • Have an overview of structure of the earth as well as various dynamical processesoccurring on it. • Develop an understanding of evolution of the earth. • Apply physical principles of elasticity and elastic wave propagation to understand modern global seismology as a probe of the Earth's internal structure. • Understand the origin of magnetic field, Geodynamics of earthquakes and the description of seismic sources; a simple but fundamental theory of thermal convection; the distinctive rheological behavior of the upper mantle and its top. • Explore various roles played by water cycle, carbon cycle, nitrogen cycles in maintaining steady state of earth leading to better understanding of the contemporary dilemmas (climate change, bio diversity loss, population growth, etc.) disturbing the Earth • In the tutorial section, through literature survey on the various aspects of health of Earth, project work / seminar presentation,

CHEMISTRY	
Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	By the end of the course, the students will be able to: • Solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii, ionization energy and electron affinity of elements. • Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules). • Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt. • Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved. • Learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.
Chemical Energetics, Equilibria and Functional Group Organic Chemistry-I	By the end of this course, students will be able to: • Understand the laws of thermodynamics, thermochemistry and equilibria. • Understand concept of pH and its effect on the various physical and chemical properties of the compounds. • Use the concepts learnt to predict feasibility of chemical reactions and to study the behaviour of reactions in equilibrium. • Understand the fundamentals of functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism. • Use concepts learnt to understand stereochemistry of a reaction and predict the reaction outcome • Design newer synthetic routes for various organic compounds.

Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II	By the end of the course, the students will be able to: • Explain the concepts of different types of binary solutions-miscible, partially miscible and immiscible along with their applications. • Explain the thermodynamic aspects of equilibria between phases and draw phase diagrams of simple one component and two component systems. • Explain the factors that affect conductance, migration of ions and application of conductance measurement. • Understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements. • Understand and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses. • Design newer synthetic routes for various organic compounds.
SEC I: Chemistry of Cosmetics and Perfumes	By the end of this course, the students will be able to: • Learn basic of cosmetics, various cosmetic formulation, ingredients and their roles in cosmetic products. • Learn the use of safe, economic and body-friendly cosmetics • Prepare new innovative formulations.
Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics	By the end of the course, the students will be able to: • Understand the chemistry and applications of s- and p-block elements. • Derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behaviour. • Explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases. • Explain the properties of liquids especially surface tension and viscosity. • Explain symmetry elements, crystal structure specially NaCl, KCl and CsCl • Define rate of reactions and the factors that affect the rates of reaction. • Understand the concept of rate laws e.g., order, molecularity, half-life and their determination • Learn about various theories of reaction rates and how these account for experimental observations.
SEC II: Basic Analytical Chemistry	By the end of this course, students will be able to: • Handle analytical data • Determine composition and pH of soil, which can be useful in agriculture • Do quantitative analysis of metal ions in water • Separate mixtures using separation techniques • Estimate macro nutrients using Flame photometry

DSE I: Chemistry of d-block elements, Quantum Chemistry and Spectroscopy	By the end of the course, the students will be able to: • Understand chemistry of d and f block elements, Latimer diagrams, properties of coordination compounds and VBT and CFT for bonding in coordination compounds • Understand basic principles of quantum mechanics: operators, eigen values, averages, probability distributions. • Understand and use basic concepts of microwave, IR and UV-VIS spectroscopy for interpretation of spectra. • Explain Lambert-Beer's law, quantum efficiency and photochemical processes.
SEC III: Green Methods in Chemistry	By the end of this course, students will be able to: • Get idea of toxicology, environmental law, energy and the environment • Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry. • Think of chemical methods for recovering metals from used electronics materials. • Get ideas of innovative approaches to environmental and societal challenges. • Know how chemicals can have an adverse/potentially damaging effect on human and vegetation. • Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols. • Convert biomass into valuable chemicals through green technologies.
DSE II: Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy	By the end of the course, the students will be able to: • Understand the chemistry and applications of 3d elements including their oxidation states and important properties of the familiar compounds potassium dichromate, potassium permanganate and potassium ferrocyanide • Use IR data to explain the extent of back bonding in carbonyl complexes • Get a general idea of toxicity of metal ions through the study of Hg(II) and Cd(II) in the physiological system • Understand the fundamentals of functional group chemistry, polynuclear hydrocarbons and heterocyclic compounds through the study of methods of preparation, properties and chemical reactions with underlying mechanism. • Gain insight into the basic fundamental principles of IR and UV-Vis spectroscopic techniques. • Use basic theoretical principles underlying UV-visible and IR spectroscopy as a tool for functional group identification in organic molecules.

SEC IV: Pharmaceutical Chemistry	By the end of this course, students will be able to: • Gain insight into retro-synthesis approach in relation to drug design and drug discovery. • Learn synthetic pathways of major drug classes. • Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.
MATHEMATICS	
Calculus and Matrices	This course will enable the students to: • Define and use fundamental concepts of calculus including limits, continuity and differentiability. • Solve systems of linear equations and find eigenvalues and corresponding eigenvectors for a square matrix, and check for its diagonalizability. • Perform operations with various forms of complex numbers to solve equations
Calculus and Geometry	This course will enable the students to: • Sketch curves in a plane using its mathematical properties in the different coordinate systems of reference. • Compute area of surfaces of revolution and the volume of solids by integrating over cross- sectional areas. • Be well-versed with conics and quadric surfaces so that they should able to relate the shape of real-life objects with the curves/conics.
Algebra	●Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups etc. Explain the significance of the notion of cosets, normal subgroups, and factor groups. ● Understand the fundamental concepts of rings, fields and integral domains. ● Know about vector spaces over a field, and linear transformations.
Real Analysis	On completion of this course, the student will be able to: • Understand basic properties of the field of real numbers. • Test the convergence of sequence and series of real numbers. • Understand the concepts of pointwise and uniform convergence. • Understand Riemann Integrability of continuous and monotone functions.
Differential Equations (with Practical)	• Solve the exact, linear and Bernoulli equations and find orthogonal trajectories. • Apply the method of variation of parameters to solve linear differential equations. • Formulate and solve various types of first and second order partial differential equations.

Numerical Methods (with Practical)	The course will enable the students to do the following: • Find the consequences of finite precision and the inherent limits of Numerical Methods. • Appropriate Numerical Methods to solve algebraic and transcendental equations. • Solve first order initial value problems of ODE's numerically using Euler Methods.
Computer Algebra System (SEC)	This course will enable the students to: • Use CAS as a calculator and for plotting functions. • Understand the role of CAS finding roots of polynomials and solving general equations. • Employ CAS for computing limits, derivatives, and computing definite and indefinite integrals. • Use CAS to understand matrix operations and to find eigenvalues of matrices.
Mathematical Typesetting System: Latex (SEC)	This course will enable the students to: • Learn to create and typeset a LaTeX document. • Typeset a mathematical document using LaTeX. • Learn about pictures and graphic in LaTeX. • Create Beamer Presentations.
Transportation and Network Flow Problems (SEC)	On completion of this course, the student will be able to: • Formulate and Solve Transportation Problem • Learn to Solve Assignment Problem • Solve Travelling Salesman problem • Learn about Network Models and various Network Flow Problems • Learn about Project Planning Techniques namely PERT and CPM
Statistical Software: R (SEC)	On completion of this course, the student will be able to: • Be familiar with R software and using **R** as calculator. • Understand the concepts of objects, vectors and data types. • Know about summary commands and summary tables in **R**. • Visualize distribution of data in **R**. • Learn about Normality test. • Plot various graphs and charts in **R.**