DEPARTMENT OF PHYSICS
HNB PG COLLEGE KHATIMA

PROGRAM OUTCOMES (POS): The Physics department offers two programs:

1. Physics for B.Sc. students of PCM.
2. M.Sc. Physics.

Both these programs are primarily geared towards cultivating the idea – "***Physics is the study of nature and its laws (till the most fundamental level)***", amongst the students. The Program Specific Outcomes (PSOs) and the Course Outcomes (COs) of the individual programs/courses/papers are more or less spun around this theme and are listed below.

Program Specific Outcomes (PSOs): For the Under-Graduate Physics program (B.Sc. Physics for PCM)

PSO1: Understanding the fundamental concepts of Physics and its basic laws.

PSO2: Acquire the necessary mathematical tools and concepts required for understanding the underlying physics.

PSO3: Acquire theoretical and experimental knowledge/skill related to the physical phenomenon, as well as the ability to connect both (theory & practical).

PS04: Acquire problem solving skills and ability to apply them to real world physical phenomenon.

PSO05: Motivation to pursue higher studies (Postgraduate, Research etc.) in Physics.

Course Outcomes (COs): For the Under-Graduate Physics program (B.Sc. Physics for PCM).

Mechanics and Theory of Waves and Oscillations	Understanding vector analysis (applying concepts for problem solving), the nebula operator (Gradient, Divergence & Curl), Differentiation and Integration of Vectors (fields), Integral Theorems (Gauss, Stokes, Green and corollaries). Understanding - Frame(s) of Reference, Newton's Laws (along with application for point particles as well as system of particle), (conservative) force and potential energy, Work-Energy Theorem, Rocket motion.

	Understanding quantities and ideas related to rotational motion- Angular Velocity, Angular momentum, Torque, Moment of Inertia (calculations and related theorems), Conservation of Angular Momentum. Understanding Newton's law of gravitation, Gravitational Field, Potential & Potential Energy, Central force, Kepler's Laws of Planetary motion, Satellite and Planetary orbits and motions. Understanding material properties such as elasticity, stress, strain, various elastic constants and their relationships, Experimental methods to determine the various elastic properties. Understanding fluids at rest (surface tension, excess pressure) as well as in motion (viscosity, flow through capillary tube, Bernoulli's theorem, Poiseuille's formula), Experimental methods to determine surface tension and viscosity. Understanding Simple Harmonic Motion, the Harmonic Oscillator Equation and solutions, Linearity and Superposition principle, Superposition of Harmonic Oscillations- Collinear(Interference & Beats) and Perpendicular (Lissajous Figures). Understanding waves and wave motion, Waves on a string (travelling and standing), Normal-modes, Group and Phase velocities. Understanding the Fourier Theorem and its applications. Understanding Damped Harmonic Oscillations, Over/Under/Critical damping, Relaxation time, LCR circuit. Understanding Forced Harmonic Oscillations, Transient and Steady state behavior, Resonance and Sharpness, Bandwidth, Quality Factor. Understanding intensity and loudness of sound waves, Decibels, Ultrasonic waves (generation, detection and uses), Building acoustics, Reverberation time and Sabine's formula, (Acoustic) design of buildings.

Electricity and Magnetism	Understand the basic concepts of Electrostatics-Field, Flux, Gauss's Theorem with applications, Potential and relation with Field, Potential Energy. Also concept of conductors, dielectrics and capacitance, The Electric-Vector. Understand the basic concepts of Magnetostatics- Biot-Savart's Law and applicatons, The Lorentz Force law, Div and Curl of magnetic field and the magnetic vector potential, Ampere's circuital law, Magnetism in matter (Magnetization, Permeability, Susceptibility) and Types of Magnetic materials (Dia, Para & Ferro). Understanding inductance (self and mutual and induction), Faraday's Law, Lenz' Law & energy conservation, AC circuits- RC, LC and LCR, Resonance. Realizing that EM is contained in the 4 Maxwell's Equations, Understanding equation of continuity, displacement current, Maxwell's correction to Ampere's circuital law. Gain knowledge on EM waves, propagation and their properties using Maxwell's equations, Polarization of EM Waves.
Practical (B.Sc. !st Year)	The various practicals included in the Physics syllabus of B.Sc. 1 are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers (e.g. ideas about Momentof Inertia, Elastic constants, Simple & Compound pendulums, Current, Voltage, Resistances, Solenoid, LCR circuit, SHM, Normal modes of a string etc.). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to connect theory with experiments.
Heat Thermo dynamics & Statistical Physics	Understanding the basic thermodynamic concepts- State variable, Equilibrium, Heat, Work, Zeroth and First Laws and the concepts of Temperature and Internal Energy, Applications of First Law to various processes (Adiabatc, Isothermal etc.), Mayer's relation. Understanding the need of second law of thermodynamics, Reversible & Irreversible processes, Heat Engine and Refrigerator, Second Law of Thermodynamics (in term of Engines and refrigerators), concept of entropy, the Carnot cycle, second law in terms of entropy change, the Nernst theorem.

	Understanding the four thermodynamic potentials, The Maxwell's relations and applications (response functions, Joule-Thompson cooling, Calusius-Clapeyron equation etc.) Understanding the Kinetic Theory of Gases (towards a microscopic description), Maxwell's velocity distribution law, transport phenomenon, the classical equipartition theorem and its use to determine specific heats of mono-atomic and diatomic gases. Understanding Blackbody radiation (the first step towards quantum mechanics), Spectral emissive power, Energy Density of Cavity Radiation, The Rayleigh-Jeans Law, Planck's law and deducing Wien's displacement law, Wien's distribution laws (1^{st} and 2^{nd}), Stefan-Boltzmann law and Rayleigh-Jeans from it. Understanding Basic postulates of Statistical Physics, Macro and Micro States, Phase Space, Density distribution in phase space, μ space representation and its division, Statistical average values, Condition of equilibrium, Stirling's Approximation, Entropy and Thermodynamic probability, Boltzmann entropy relation. Ensembles, Micro -canonical, Canonical and Grand Canonical ensembles, Statistical definition of temperature and interpretation of second law of thermodynamic, Pressure, Entropy and Chemical potential. Entropy of mixing and Gibb's paradox, Partition function and Physical significances of various statistical quantities. Understanding Maxwell-Boltzmann statistics and Distribution law, Energy distribution function, MaxwellBoltzmann law of velocity distribution (most probable velocity, average velocity, RMS velocity), Limitations of M-B statistics, Elementary idea of quantum statistics.

optics	Understanding Geometrical Optics- Fermat's principle of extremum path and applications, Cardinal points, Combination of Lenses, Lagrange equation of magnification. Understanding optical instruments- Eye pieces (Ramsden's, Huygen's and Gaussian), Aberrations (and types) and their corrections. Understanding the Interference of Light- The superposition principle, Coherence and conditions for interference, Double slit interference, Division of amplitude and division of wavefront, Fresnel's Biprism, Phase change upon reflection, Thin-film interference (Haidenger and Fizeau fringes), Newton's rings (theory and experimental setup), The Michelson Interferometer and its (experimental) use, Fabry-Perot interferometer. Understanding diffraction of light- Fresnel diffraction, Half-period zones and zone-plate, Diffraction pattern of edge, slit and wire, Fraunhofer diffraction (single, double and multiple slits), The diffraction grating as a measurement tool. Understanding polarization of light- Transverse EM Wave, Plane polarized light (production and analysis), Malus Law, Brewster's Law, The Nicol Prism, Circularly and Elliptically polarized light, Optical rotation, The polarimeter (experimental setup also).
Practical (B.Sc. 2nd Year)	The various practicals included in the Physics syllabus of B.Sc. 2 are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers (e.g. ideas about thermal conductivity, blackbody radiation, calorimetry, statistical probabilities, dispersion, interference, gratings, lens combinations, polarization etc). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to connect theory with experiments.

Modern Physics	Understanding the origins of quantum theory- Blackbody radiation and early radiation laws, Planck's (revolutionary) idea (the quantum hypothesis & birth of quantum mechanics), Photoelectric and Compton effects. waves and their wavelength, Davisson-Germer Experiment, Wave-particle duality, The uncertainty principle (position-momentum and Energy-time), Interference experiments with particles. Understanding the Schrodinger's equation (quantum mechanical equation of motion), Time dependent and time-independent versions, Framework of QM (postulates, wavefunction- properties and physical significance), Probability and Conservation, Operators, Eigenfunctions and Eigenvalues, Expectation values, The free particle wavefunction. Learning to solve the Schrodinger's equation, Stationary states, Boundary conditions lead to quantization, Potential Step & Barrier and transmission, Potential well (infinite and finite depths), The one dimensional harmonic oscillator in QM, Zero point energy. Learning to solve the Schrodinger's equation in three dimensions (for spherically symmetric systems), The Schrodinger's equation for the Hydrogen atom and solving it using separation of variables, Angular momentum eigenfunctions (spherical harmonics), Solving the radial equation using Frobenius's method, Emergence of the various quantum numbers (n, l and m). Understanding the various atomic models- Thomson, Rutherford and Bohr, the Bohr model and the hydrogen spectra, Other quantum ideas/experiments- Bohr-Sommerfeld model and quantization condition, the Stern-Gerlach experiment and electron spin, Electron magnetic moment, Bohr magneton, Larmor's precession, The vector atom model, Space quantization. Understanding optical spectra (on the basis of the vector atom model), LS and JJ couplings, Selection and Intensity Rules, The fine structure of sodium D lines, Magnetic interactions and Zeeman effect, X-ray spectra and

	Moseley's Law. Understanding basics of radiation, Absorption and Emission (spontaneous and stimulated), The Einstein's A and B coefficients, Metastable states (long living), Population inversion, Pumping, Lasing action and Laser/Maser. Understanding Franck-Condon Principle, Molecular spectra, Rotational, Vibration and Electronic spectra of diatomic molecules, General features of electronic spectra, Luminescence, Basics of Raman effect. Understanding the atomic nucleus, Constituents of the nucleus, properties, Nature of nuclear force, Binding Energy and BE curve, Stable nuclei, The semi-empirical mass formula, Models of thenucleus (Liquid drop and Shell model), elementary particles and their classification schemes.
Electronics	Understanding Kirchhoff's Laws, Superposition Theorem, Constant voltage source and constant current source, Conversion of voltage source into current source, Thevenin's Theorem and procedure for finding thevenin equivalent circuit, Norton's Theorem and procedure for finding Norton equivalent circuit, Maximum power transfer theorem, Applications of Network Theorems, Four terminal Network and h-parameters. Understanding elementary semiconductors and devices (intrinsic, extrinsic-P & N), the PN diode and its characteristics in forward and reverse bias, Zener diode, Optoelectric devices- LEDs, Photodiode and Solar cell. Understanding diode circuits- The rectifier- Half-wave, Full-wave (Centre tapped and Bridge versions), Ripple factor and Efficiency, Filters (C, L, Pi etc.), Clipping and Clamping circuits using diodes, Voltage multipliers, Zener diode and voltage regulation. Understanding transistors and amplifiers- Bipolar Junction transistors (NPN, PNP), Characteristics (input and output) in various configurations (CE, CB & CC), Current gains alpha and beta and their relation, Load line analysis, Q-point, Active, Cutoff and Saturation regions, Transistor biasings; Transistor Amplifiers- Voltage, Current and Power, Class A, B and C amplifiers; The Field Effect Transistor (FET) and the Uni-Junction

	Transistor (UJT) Understanding Oscillator circuits- Feedback (negative and positive), Birkhausen's criterion, RC (Wein bridge and Phase-Shift) & LC (Collector tuned and Colpitt) oscillators and frequency of oscillation, Crystal oscillators, The Multivibrator and various operation modes (Monostable, Astable and Bistable). Understanding Digital Electronics and Circuits- Number systems (Binary etc.) and conversions, Basic Logic Gates (AND, OR & NOT) and realizations using diodes and transistors, Universal Gates (NAND & NOR), Other gates, Boolean Algebra- De Morgan's Theorem, Simplifying logic circuits, Minterm, Maxterm, SOP and POS, Karnaugh Map, Binary arithmetic (addition, subtraction) using circuits- Half/Full adders, Word (4-bit) binary adder-subtractor
Practical **(B.Sc. 3rd Year)**	The various practicals included in the Physics syllabus of B.Sc. 3 are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers (e.g. ideas about Energy quanta, quantization, diodes, LEDs, rectifiers, power supplies, transistors, amplifiers, oscillators, logic gates, Boolean algebra, logic circuits etc). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to connect theory with experiments.

PROGRAM SPECIFIC OUTCOMES (PSOs): FOR M.SC. PHYSICS

PSO 01: Strengthening and further understanding of the fundamental concepts of Physics and its basic laws (as acquired during the Under-graduate studies) by augmenting mathematical rigor (at the Physicists level) along with Physical interpretations (and clear physical picture(s)) of any theory/process/situation.

PSO 02: Acquire the necessary mathematical-tools (analytic, approximate, numerical, graphical etc.) and concepts required for understanding the underlying physics and use them to solve complex and advanced problems (including those with real world applications).

PSO 03: Gain substantial knowledge in the various (core) branches of Physics- viz. Classical Mechanics, Electrodynamics, Mathematical Methods, Quantum Mechanics, Statistical Mechanics, Condensed Matter Physics, Astrophysics, Electronics, Nuclear Physics, Particle Physics etc.

PSO 04: Acquire theoretical and experimental knowledge/skill related to the physical phenomenon, as well as theability to connect both (theory & practical). Also gradually develop the scientific method by designing and conducting experiments.

PSO 05: To get an exposure to research and research methodology during the dissertation work (theoretical and/or experimental) to be performed during the last semester.

PSO 06: Motivation to pursue a research/academic career in Physics. Aim towards writing and qualifying in various competitive exams- (e.g. CSIR-UGC-NET, GATE, JEST, BARC, DRDO, Entrance exams of premier research institutes (National & International)).

PSO 07: Gain knowledge of the subject along with general competence and analytical skill for employment in other sectors viz. industry, R&D, consultancy, public administration etc.

COURSE OUTCOMES (COS): FOR M.SC. PHYSICS

Mathematical Physics	To learn series solution of differential equations, Legendre, Bessel, Hermite, and Laguerre differential equation and related polynomial, physical integral form of polynomials and their orthogonality relations. Generating Function and recurrence relation. Understanding curvilinear Coordinates and various operators in circular, cylindrical and spherical coordinate systems, classification of Tensors, Rank of a Tensor, covariant and contra-variant tensors, symmetric and anti-symmetric Tensors, Kronecker delta symbol. Contraction of Tensor, metric Tensor and Tensor densities, covariant differentiation and Geodesic equation. Understanding function of complex variable, Cauchy's Riemann differential equation, Cauchy's integral theorem, residues and Cauchy's residues theorem, singularities, evolution of residues and definite integral. Understanding Fourier integral and Fourier Transform, Fourier integral theorem, finite and infinite integral, Laplace transform of elementary function (Dirac delta & Green's function), Solution of simple differential equations.

Classical Mechanics	Understanding mechanics of a system of particles (Constraints and generalized coordinates, D Alembert's principle, Lagrange equations for holonomic and non-holonomic systems and their applications, conservation laws of linear momentum, energy and angular momentum. Understanding Lagrangian and Hamiltonian Formulations with their applications to various conservative systems, Hamilton Jacobi theory. Understanding Dynamics of rigid bodies including Motion of a rigid body, body and space Reference system, angular momentum and Inertia tensor, Principle axes- Principle moments of Inertia, spinning tops, Euler angles, Infinitesimal rotations. Understanding Central force problem including Action and angle variables, phase integral, small oscillations, Kepler's laws of Planetary motion and their deduction, scattering in a Central field, Rutherford scattering cross section.
Quantum mechanics	Understanding that our world in inherently quantum and so the proper framework to understand it is Quantum Mechanics. "Establishing"/Understanding the basic framework of QM(Schrodinger's equation, wavefunctionand probabilistic interpretation,uncertainty relations etc.). Learning to solve the Schrodinger's (time-independent) equation (various one and three dimensional problems). Understanding the various formulations of QM and their equivalence-Schrodinger, Heisnberg (Matrix) and Dirac formulations. Understanding symmetry in QM- Space and Time translation symmetries as well as Rotational symmetry (Angular momentum, Spin, Addition etc.) Understanding the various approximation methods to solve the Schrodinger's equation (Perturbation, Variational method, WKB approximation) and application to different (stationary) state problems. Applying approximation methods to time dependent problems and treatment of radiation (emission and absorption) via such methods

	(Time dependent perturbation theory, Fermi's Golden Rule, the Semiclassical theory of radiation etc.).
Statistical Mechanics	Understanding the (average) microscopic description vs. the macroscopic description (as done in Thermodynamics) for a system with large no. of degrees of freedom. Understanding (and calculating within the framework) the various statistical ensembles and the corresponding (thermodynamic) formulations. Application of the statistical ideas to derive/understand the behavior of gases (ideal as well as real). Understanding the basics of Quantum SM (FD & BE stat) and some simple applications. Understanding blackbody radiation as a gas of photons (i.e statistical treatment- BE statistics).
Atomic & MolecularPhysics	Understanding that optical properties of materials and realizing the fact that it are just an application of Quantum Mechanics to atomic/molecular systems. Understanding the atomic and molecular spectra along with their finer features (Fine structure, Vibrational-Rotational spectra). Understanding the effect of electric and magnetic fields on the various spectra via interactions (or charge and/or spin). Understanding the various theories/formulations/models to understand spectra (Vector atom model, LS, JJ coupling schemes, Raman spectroscopy, Heitler-London and Born-Oppen hiemer treatments etc.) Understanding the quantum theory of radiation (Einstein's coefficients) and basic working principle of Lasers.

Practical (Sem1)	The various practicals included in the Physics syllabus of M.Sc. 1st Semester are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers of various other semesters (e.g. CRO, SCR, Transistors, Diodes, FET, Amplifiers, Oscillators, Antennas, Amplitude modulation/demodulation etc.). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to gradually connect theory with experiments.
General relativity and cosmology	Understanding Christoffels connection as Einstein's connection, Gravitational action, field equations and their general properties, Newtonian limit of Einstein's field equations, Metric in spherically symmetric space-time (Schwarzchild metric), Orbits in the Schwarzschild metric, gravitational collapse of a dust sphere, Schwarzschild black holes. Introduction of Gravitational radiation, Wave equation in linearized theory and plane waves, propagating modes of gravity, gravitational waves in a flat space-time background, propagation of gravitational waves in the curved space-time, Energy and momentum of the gravitational waves, Detection of gravitational waves. Basic Concepts and elementary idea of big-bang and steady state cosmologies, Seagull static models, Cosmological principle, Friedmann space-time, Robertson-Walker line element, Weyl's postulate, expansion of the universe, Hubble's law, dynamical equation of cosmology and their consequences, the primordial fire and the remnant radiation, Big-bang and steady state models of the universe.

Advanced Quantum Mechanics	Understanding, applying and formulating QM at an even deeper level than done earlier (in the QM Course). Applying quantum ideas to understand the scattering of particles. Employing various(approximate) methods- Partial Wave Analysis and the Born approximation. Understanding notion of identical and indistinguishable. Realizing origin of the Pauli's exclusion principle and related notions (Spin-Statistics connection, Permutation symmetry etc.) Formulation (along with the need) of the relativistic version of (NR) quantum mechanics. Working out in detail the two basic relativistic wave equations (Klein-Gordon and Dirac equations) and the various associated phenomenon/notions (Plane wave solutions, Negative Energies and Probabilities, Spin of electron and its magnetic moment, The Hole Concept, Particles and Antiparticles etc.) Understanding the need of relativistic quantum fields (towards Quantum Field Theory), Field formulations for the various wave equations via 2nd quantization.
Nuclear Physics	Understanding the atomic nucleus and its various properties along with the experimental tools and techniques of nuclear investigations. Understanding basic properties of the nucleus and the various nuclear models. Understanding the nature of the nuclear force along with experimental setup(s) to study them. Understanding radioactive decay and its various feature. Understanding nuclear reactions by applying (mainly) quantum ideas to them.

Elementary Particle Physics	Get a basic understanding of the fundamental constituents of our Universe (the "elementary" particles and the four fundamental interactions). Understanding the gauge principle and role of symmetry (along with ideas of unification). Understanding the common (mathematical) origin of (the various) conservation laws as a manifestation of (some) symmetry. A very basic understanding of the unification of the fundamental interactions- Electroweak andGrand Unifications. Understanding (hadronic) matter as composed of quarks and the "construction" schemes (i.e. various direct-product representation of SU(3)). An overview of the various properties of quarks (and also of the composite mesons and baryons).
Condensed Matter Physics	Understanding of the basic (theoretical) ideas involved in the study of Condensed Matter Physics. Understanding the origin of elasticity (and elastic constants) from the properties of the underlying crystal structure. Understanding the interaction of crystals with radiation (X-rays) and the related theoretical framework as well as experimental setup(s) (Diffraction experiments). Understanding the quantum treatment of elastic/sound waves (i.e. the idea of phonons and phonon gas etc.) Understanding the thermal properties of solids on the basis of the phonon picture. Understanding crystal defects, superconductivity, and magnetism.

Practical (Sem2)	The various practicals included in the Physics syllabus of M.Sc. 2nd Semester are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers of various other semesters (e.g. oscillators, electronically regulated power supply, negative feedback amplifiers, FET characteristics, Michelson Interferometer, Fabry Parot Interferometer, four probe method, Fresnel's Law, Magnetic susceptibility, Radiation laws, etc.). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to gradually connect theory with experiments.
Advanced Electronics I	Understanding Integrated Circuit technology, Classification of IC's, Fabrication of IC's & components, Basic monolithic integrated circuit technology, processes used in monolithic technology, active & passive components, metal semiconductor contact, thick & thin film IC's, hybrid IC's, charge coupled devices (CCD), advantages & limitations of integrated circuits. Understanding Operational amplifiers (Linear and Non-linear Analogsystems),

Advanced Electronics II	Understanding Digital communication, Digital signal processing, Image processing (Basic ideas only), Pulse Modulation systems, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse position modulation, Pulse code modulation, Delta modulation Frequency division multiplexing (FDM), Basic idea of digital telemetry. Learning Optical communication, Principle of optical communication, Different modes of propagation of E. M. Wave through optical fibre, Brief concept, classification of fibres and ray path, Advantages of multimode fibres and cladding , Optical Fibre connectors, Optical Fibre communication Receiver, Brief Introduction , Signal path through optical data link, Block diagram of optical Receiver, Advantages of optical communication, Light propagation in cylindrical wave guide. Gaining knowledge of Memory and optoelectronic devices, Bulk and thin films. Photoconductive devices (LDR), Memory devices, static and dynamic random access memories SRAM and DRAM, CMOS and NMOS, nonvolatile-NMOS, magnetic, optical and ferromagnetic memories, charge coupled devices (CCD), LCDS.
Electrodynamics	Realizing the unification of Electricity and Magnetism as a single physical concept- Electromagnetism (or Electrodynamics) and that Maxwell's equations express this fact. Understanding various electromagnetic phenomenon (EM Wave in vacuum, conductors, non-conductors, plasma, bounded media, wave guides). Understanding the potential formulation of ED (and its advantages). Understanding generation and nature of radiation (fields) from moving (accelerated) charges. Formulating ED (and writing and performing calculations) within the relativistic framework i.e. four-vector & Tensor notations. Understanding the role of this relativistic formulation and ability to apply it elsewhere.

Practical (Sem 3)	The various practicals included in the Physics syllabus of M.Sc. 3rd Semester are aimed at understanding (and measuring) the phenomenon/ quantities studied in the theory papers of this semester (Richardson's Law, ESR spectra, Hall effect, multivibrators, transistor amplifiers cum feedback amplifiers, FET and MOSFET, VTVM etc.). The student should use and develop "hand-skills", observation-skills, mathematical tools (analytical, numerical, graphical etc.) to gradually connect theory with experiments.
Advanced Electronics 3	Understanding power supply regulation including Servomechanism, regulation using OA, Zener reference source, The 723 regulator current regulator, short circuit and over load protection, Precision rectifier, IC regulated power supply. Three terminal voltage regulations, dual Polarity regulated power supplies using 78 XX and 79 XX series regulators, Switched mode power supply (SMPS), Active filter , PLL understanding microwave production with basic ideas of Microwave frequencies, Principle of velocity modulation. Reflex klystron. Theory and uses an of cavity magnetron PIN & GUNN Diode, Detection of microwave measurement of power. Understanding Advantages and Disadvantages of Microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on prorogation , Fresnel zone problem, ground reflection, fading sowlles, detectors, components, antennas used in microwave communication system.
Advanced Electronics 4	Understanding Ananlog computation with Solution of ordinary linear differential equations with constant coefficients, Operation modes of analog computers, repetitive operation of computers, Time scaling,

	amplitude scaling, Generation of functions, Simulation of time varying systems. Understanding Boolean algebra, Canonical forms of Boolean, functions, Simplification of Boolean functions (K-map, Tabulation method), don't care conditions. Digital logic families; Adders & Subtractors, Magnitude comparator, Code converters; Parallel adders, Encoders, Decoders, Multiplexers, Demultiplexers, Parity bit generator and checker, Read only memory (PROM, EPROM), P.L. Digital to Analog and Analog to Digital converters. Understanding Sequential logic- Memory element, RS, JK, JKMS, T type and Edge triggered Flip flop; Registers; Shift register; Counters—synchronous and Synchronous; The memory unit; Semiconductor Random Access Memory; Inter-register transfer; Arithmetic; Logic and Shift Micro-operation; Fixed point and floatation point data.
Practical (Sem 4)	Study of regulated power supply (723), operational amplifier (741), Timer (555), A to D and D to A converter, Logic gates (Different types), amplitude and frequency modulations and demodulations, different flip-flop circuits (RS, JK, Dk type, T-type, Master slave), Digital combinational and sequential circuits, Microprocessor (8085), SCR etc.
Dissertation/ Project	The student has to complete a dissertation/project (theoretical and/or experimental) and submit a written report during this last semester. This gives the students some exposure to research and research methodology. Moreover the written report enables the students to write scientific communication. All this is aimed at nurturing them into (possible) future researchers who are capable of- (a) thinking and analyzing critically and clearly (b) adopting the scientific method and (c) working independently.
Elective Courses	

Communication Electronics	Understanding AM and FM (Transmission and reception): Modulation, AM generation, Power consideration, Balanced modulator, SSB transmission, AM detection, AGC, Radio receiver characteristics, signal to noise ratio, FM analysis, noise considerations, generation, direct method and reactance tube method, FM transmitter, AFC, FM Propagation, phase discriminator. To know the propagation of radio waves, Antenna and TV. Study of transmission lines, Voltage and current relations on transmission line, propagation constant, characteristic impedance, impedance matching, quarter wave T/L as impedance transformer, attenuation along coaxial cable, cables of low attenuation, propagation of radio waves between two parallel lines, wave guide modes, TE10 mode and cut off wavelength, cavity resonator, light propagation in cylindrical wave guide, step index and graded index fibers, attenuation and dispersion in fibers.
Plasma Physics	Introduction to Plasma, Elementary concept: Derivation of moment Equation from Boltzmann Equation, Plasma Oscillation, Debye Shielding, Plasma parameter, Magneto plasma, Plasma confinement. Understanding MagnetoHydrodynamics and magneto Plasma To study plasma propagation and fluid plasma, Propagation at finite angle and CMA diagram, Propagation through ionosphere and magnetosphere, Helicon, Faraday rotation, Fluid equations for a plasma, Continuity equation, Momentum balance equation, Equations of state, Two-fluid equations, Plasma resistivity.

Digital Electronics and Computer Architecture	Learning elementary idea of combinational and sequential circuits, Overview of Microcomputer organization and operation, Microprocessor evolution and types, Fundamental knowledge of Microprocessor (8085/8086), Architecture and its operation, Basic idea of logic devices for interfacing 8085/8086. Understanding Computer Organization and Architecture Understanding data communication, Computer and Communications, Need for communication networks, Internet and World Wide Web, communication protocols, Local Area Networks, Interconnecting networks, Future of Network Technology. To study Characteristics of communication channels, Allocation of Channels, Physical Communication media, Public Switched Telephone Network, Cellular Communication Path, ATM networks.
Atmospheric Physics	To gain knowledge about Earth atmosphere, Elementary concept of atmospheric sciences, atmosphere and it composition, Thermal and pressure variation in earth atmosphere, Thermal structure of the troposphere, stratosphere, mesosphere and ionosphere, Hydrostatic equation, spectral distribution of the solar radiation, Green house effect and effective temperature of earth. Meteorological process and different system, local winds, monsoons, fogs, clouds, precipitation, Cyclones and anti-cyclones, thunderstorms, Mountain Meteorology. Understanding Atmospheric Dynamics and Thermodynamics, Environmental pollution and climate change Study of Convectional measurements of pressure, temperature, humidity, wind speed and direction, sunshine duration, radiation clouds, upper air pressure, temperature, humidity and wind measurements, Polit balloons, radiosonde, dropsonde, ozonesonde, GPS sonde. Application

	of radars to study the atmospheric phenomenon, LIDAR, SONAR, RASS (Radio- acoustic sounding system), Observational technique for aerosol.
Introduction to Nanoscience and Nanotechnology	Understanding Emergence of Nanotechnology – Challenges in Nanotechnology, Carbon age–New form of carbon (From Graphene sheet to CNT), Introduction to nanomaterials, evolution of nanoscience, general properties of nanomaterials, role of size in nanomaterials, semiconducting nanoparticles, nanoclusters, quantum wells, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state. Synthesis of nano structured materials, sol-gel processing, Mechanical alloying and mechanical milling, Inert gas condensation technique, Nanopolymers, Bulk and nano composite materials, top down and bottom up approaches. Study of properties of nanomaterials and characterization techniques. Learning about the applications of nanomaterial to Molecular electronics and nanoelectronics, Quantum electronic devices, Carbon Nano Tube based transistor and Field Emission Display, Biological applications, Biochemical sensor, medical applications and Membrane based water purification. Biological systems- DNA and RNA - Lipids.
Self study Courses	
Advances in High Energy Physics	Understanding Gauge Theory and Unification of Fundamentals Forces, Quantum Chromodynamics, Thermal Field Theory and Beyond Standard Model

Advances in Laser Physics	Understanding Laser Raman Spectroscopy and Laser Spectroscopy in Molecular Beams. To gain knowledge of Modern Laser Spectroscopy.
Advances in Solar Physics	Learning about Solar Flares: Magnetohydrodynamic Processes, Solar Cycle: Observations and theory, Sun-Earth Connection.
Bio-Physics	To Know the Basic Concepts of Bio-Physics Understanding Technique For The Study of Biological Structure and Function To study the Radiation Effects on Biological Systems
Computer Application in Physics	Understanding the role of Computers in Physics, Formulation of a problem for solution on a computer, paradigm for solving physics problems for solution . Algorithms and Flowcharts Learning Scientific Programming (FORTRAN and C language), Scientific Word Processing and Modern Software's For Mathematical Computing (LaTeX and MatLab). Study of Computer Applications to Physical Problems(Numerical Methods and Monte Carlo methods).
Medical Physics	To know about the mechanics of human body, Physics of Respiratory and Cardiovascular System. Understanding Electricity in the Body and Sound/Light In Medicine and Diagnostic X-Rays and Nuclear Medicine. To gain knowledge about Medical Precision Equipments and Modern Medicines (MRI, PET, CT scan, ventilators, description, working, analysis and clinical applications of Ultrasonic imaging, ECG, EMG, EEG and ERG. Nanotechnology-based drugs e.g. Abraxane, Doxil, C-

	dots (Cornell dots) and goldnano particle as a diagnostic tool, Anti-cancer polymeric nanomedicines, Use of nano-technology in Photodynamic therapy.