DEPARTMENT OF PHYSICS

PROGRAMME: M.Sc. PHYSICS

PROGRAMME OUTCOMES

1 The Master of Science in Physics programme provides the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education, research, or public administration.

2 The work with the Master Thesis gives special expertise within one of the research areas represented by the Department of Physics: Condensed Matter Physics, Thin films, nano particles, computational Physics and Physics Education and Dissemination.

3 To provide an insight into tensors, complex analysis, transforms techniques, Differential equations and Greens function which form the back bone of all higher physics and to apply these techniques to solve Physics problems

4 To introduce the classical formulation approaches like Lagrangian and Hamiltonian dynamics and to study their application in mechanical systems and solving of problems. Also To review the fundamental concepts of relativity ad to create an understanding of their applications

5 To provide an understanding of fundamental principles of quantum mechanics and to introduce to the basic ideas of Dirac formulation, Time-independent perturbation theory and approximation methods in Quantum Mechanics.

6 To provide an exposure to the wide application of integrated circuit logic, Optoelectronics devices, Operational amplifiers, 555timer, Phase Locked Loop and Pulse related communication circuits.

7 To inculcate a flair for scientific research with moral, ethical and social values and also to expose the students to the foundations of various Computational methods and C programming.

PROGRAMME SPECIFIC OUTCOMES

1 Learn the structure of solid materials & their different physical properties along with metallurgy, cryogenics, electronics, & material science.

2 Understand the fundamental theory of nature at small scale & levels of atom & subatomic particles.

3 Demonstrate engagement with current research and developments in the subject.

4 Critically interprets data, write reports and apply the basics of rules of evidence.

5 Select, interpret and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and the internet.

6 Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate techniques to solve them.

7 Demonstrate skills in the use of computers for control, data acquisition and data analysis in experimental investigations. PSO-8 Provide a systemic understanding of core physical concepts, principles and theories along with their applications.

8 Provide a systemic understanding of core physical concepts, principles and theories along with their applications

M. sc. I year (physics)

Sem I

Paper-I

Mathematical Physics

Unit-1 Differential Equations	CO-1. To understand the differential equations. CO-2. To study Bessel functions first and second type. CO-3. To study Legendre, Hermite, Laguerre polynomials CO-4 To study curvilinear coordinate system with specific cases of various coordinate systems like: • Cartesian • Cylindrical • spherical
Unit-2 Integral transformations	CO-1. To study Fourier Integral, Transform and Inverse transform. CO-2 To study Convolution Theorem. CO-3. To study Elementary Laplace transforms and transforms of its derivatives. CO-4. To study Applications to damped Harmonic oscillator.
Unit-3 Green's function	CO-1. To Know Non -Homogeneous boundary value problems. CO-2 To study Green's Function • for 1 D • eigen function expansion • for electrostatic boundary value • eigen function expansion.
Unit-4 Complex Variables	CO-1. To Analyse complex functions. CO-2. To study Cauchy Reimann Equations, Its theorem and integral formula. CO-3. To study Taylor, Maclauian and Laurent series. CO-4. To study Theorem of Residue. CO-5 To study Jordan Lemma integrals involving Branch points CO-6. To Study simple cases of Contour integration.

Paper II

Classical Mechanics

Unit-1	CO-1. To understand Newtonian mechanics in one and many particle systems. CO-2. To study conversation laws, constraints and their classifications. CO-3. To study D'Alembert's principle in generalized coordinates and its applications. CO-4 To study generalised momenta and lagrangian formulation of conservation theorems. CO-5 To study equation of motion and first integrals.
Unit-2	CO-1. To study equations of canonical transformation and generating functions. CO-2 To study Hamiltonian- Jacobi- action and angel variables. CO-3. To study Poisson's Bracket, theorem, and its algebraic properties. CO-4. To study Kepler's problem, Inverse central force field.
Unit-3	CO-1. To Know Theory of small oscillations. CO-2 To study equation of motion. CO-3 To study eigen frequencies and general motions CO-4 To study Applications to coupled pendulum and linear bistable molecule. CO-5 To study Coriolis force and its astronomical applications CO-6 To study Euler's Equation
Unit-4	CO-1. To Study symmetries o under 0f Time and Space. CO-2. To study invariance under Galilean Transformation. CO-3. To study covariant 4 D formulations. CO-. To study Invariance under Lorentz Transformation Relativistic Mechanics. CO-6 To study covariant Lagrangian, covariant Hamiltonian.

Paper III
Quantum mechanics I

Unit-1	CO-1. To understand the basic postulates of quantum mechanics. CO-2. To study equation of continuity CO-3. To study the properties of eigen functions CO-4 To study Ehrenfest Theorem. CO-5 to study solutions of Schrodinger equations in 1 D for various cases.
Unit-2	CO-1. To know about vector spaces and Bra ket notations for state vector. CO-2. To understand concept of Hilbert space. CO-3. To study state vectors and dynamic variables by matrices and unitary transformation. CO-4. To study Heisenberg uncertainty relation through operators (Schwartz inequality) CO-5 To study harmonic oscillator by operator method.
Unit-3	CO-1. To know the solution of Schrodinger equation for • Linear harmonic oscillator • Hydrogen like atom • Square well potential CO-2.to study the applications of above solutions to • Atomic spectra • Molecular spectra • Low Nuclear states(deuteron)
Unit-4	CO-1. To know the Angular momentum in quantum mechanics. CO-2. To study eigen functions and eigen values in terms of spherical harmonics. CO-3. To know interpretation of wave functions. CO-4. To Understand spin Angular momentum and Pauli spin Matrices. CO-5. To study addition of two angular momenta with examples.

Paper IV

Electronic Devices

Unit-1 Transistors	CO-1. To understand working of JFET, BJT, MOSFET and MESFET. CO-2. To study I-V characteristic under different conditions. CO-3. To study Diodes like Gunn Diode, Tunnel Diodes, Impatt diodes And parametric device. CO-4 To study microwave devices and avalanche transit time devices.
Unit-2 Photonic Devices	CO-1. To know about Radiative and non-radiative transitions. CO-2. To understand concept of Thin Film photo conductive devices (LDR). CO-3. To study solar cells, LED, Semiconductors. CO-4. To study Diode Lasers and related concepts.
Unit-3 Memory Devices	CO-1. To know and study ROM and its types like PROM, EPROM, EEPROM etc. CO-2 To know and study RAM and its types like SRAM and DRAM CO-3 To know and study Hybrid memories: CMOS and NMOS etc. CO-4 To study Ferro electric memories< charge couple devices. CO-5 To study various storage devices like FDD, HDD, CO-ROM, CD-R etc.
Unit-4 Electro optic	CO-1. To study Electro optic, Magneto optic and Acoustic optic effects. CO-2. To study electro strictive and magnetostrictive effects. CO-3. To study sensors and actuator devices. CO-5. To study piezoelectric resonators and filters.

SEM II

Paper-I
Quantum Mechanics II

Unit-1	CO-1. To study Approximation method for bound states: Rayleigh- Schrodinger perturbation theory of non-degenerate and degenerate levels CO-2. To study WKB Approximation method. CO-3. To have ideas on potential barrier with applications to theory of alpha decay. CO-4 To study Variation method and its application to ground state helium.
Unit-2	CO-1. To study Time dependent Perturbation theory. CO-2. To study wave equation for a system of charged particle under influence of external E M field. CO-3. To study absorption and induces emission. CO-4. To study Einstein's A and B coefficients and transition probability.
Unit-3	CO-1. To Study theory of scattering and its physical concepts. CO-2 To study Born approximation and Partial Waves. CO-3 To study scattering by perfectly rigid sphere and spherically symmetric potential. CO-4 To study Pauli's spin matrices.
Unit-4	CO-1. To study Klein-Gordan Equation its presence in EM field and its shortcomings. CO-2. To study Dirac matrices. CO-3. To study Dirac relativistic Equation E M field CO-4. To study negative energy states and its interpretation hydrogen atom and hyperfine splitting.

Paper-II
Statistical Physics

Unit-1	CO-1. To study the foundation of Statistical Mechanics. CO-2. To study contact between thermodynamics and statistics. CO-3. To study different kind of Ensembles. CO-4 To study Gibb's Paradox, density of states, phase space CO-5 To Calculate Statistical quantities, energy, and density fluctuation.
Unit-2	CO-1. To study Statistics of ensembles. CO-2 To study Density matrix. CO-3. To study different statistics and their properties: • Maxwell-Boltzmann Statistics • Bose-Einstein Statistics • Fermi-Dirac Statistics CO-4. To study Boltzmann transport equation.
Unit-3	CO-1. To Study Cluster Expansion for a classical gas. CO-2 To study Viral equation of state. CO-3 To study Mean field theory of Ising Model in 3,2 ad 1 dimension
Unit-4	CO-1. To study fluctuation spatial correlation Brownian motion. CO-2. To study Langevin theory. CO-3. To study Fokker plank equation. CO-4. To study Onsager reciprocity relation.

Paper-III
Electrodynamics and Plasma physics

Unit-1	CO-1. To Review the basics of electrostatics and magnetostatics: • Electric Field, Gauss Law and Ampere's law • Poisson and Laplace equations • Biot sawart law • Maxwell's equations in terms of scalar and vector potentials • Lorentz gauge and coulomb gauge CO-2. To study Solutions of Maxwell's equations scalar and vector potentials. CO-3. To study retarded potentials, Lienard Wiechart potentials. CO-4 To study Field of uniform and arbitrarily moving charged particle.
Unit-2	CO-1. To study fields of accelerated charged particles at low velocity and high velocity, CO-2 To study four vector and Lorentz transformation in 4 D spaces. CO-3. To study relativistic transformation properties of E and H fields. CO-4. To study electromagnetic field tensor in 4 D Maxwell's equations. CO-5. To study covariance of electrodynamics. CO-6 To study Langrangian and Hamiltonian for a relativistic charged particle on external EM field and its motion.
Unit-3	CO-1. To Study Elementary concepts of occurrence of plasma in different states. CO-2 To study Plasma production and parameters. CO-3 To study Confinement of plasma, plasma instabilities. CO-4 To study Debye shielding distance. CO-5 To study Plasma Oscillations.
Unit-4	CO-1. To know domain of Magnetohydrodynamics and plasma physics CO-2. To study hydrodynamic waves: magneto sonic and Ailven waves. CO-3. To study experimental study of plasma CO-4. To study theory of single and double probes.

Paper-IV
Atomic and Molecular Physics

Unit-1	CO-1. To study the quantum state of one electron. CO-2. To study atomic orbitals, H- spectra, spectra of alkali metals. CO-3. To study methods of quantum mechanics: • Hartree and Hartree Fock Method • Thomas Fermi statistical model CO-4 To study interaction energy in L-S and J-J coupling CO-5 To its hyperfine structure, line broadening mechanisms.
Unit-2	CO-1. To study Statistics of ensembles. CO-2 To study Density matrix. CO-3. To study Types of molecules: Classification of molecules. CO-4. To study 3Rotational spectra of diatomic molecules as rigid rotator and non-rigid rotator
Unit-3	CO-1. To Study vibrational energy of diatomic molecule. CO-2 To study Diatomic molecule as Simple harmonic oscillator, molecule as vibrating rotator. CO-3 To study Morse potential Curve CO-4 To study Vibrational spectrum diatomic molecules PQR branches, IR Spectroscopy
Unit-4	CO-1. To study UV, visible and Infrared spectroscopy. CO-2. To study Raman Spectroscopy: Pure rotational spectra, Vibrational Spectra. CO-3. To study Photoelectronic spectroscopy. CO-4. To have elementary idea about Photoacoustic spectroscopy and Mossbauer spectroscopy.

COURSE OUTCOME

Semester – 3

Paper 1

CONDENSED MATTER PHYSICS

Unit-1 : Crystal Structure

- To Understand the Bravais Lattice in two and three dimensions
- To Study the Simple Crystal Structures like Hexagonal Close Packed Structure, Diamond structure, Zinc Blende Structure, Sodium Chloride Structure, Cesium Chloride Structure

Unit-2 : Crystal Diffraction by X-Ray

- To Understand the Reciprocal Lattice and about the Reciprocal Lattice of bcc and fcc Lattice.
- To Discuss the Relation between crystal lattice axes and crystal reciprocal lattice axes.
- To study the Bragg Equation
- To Understand the Condition in terms of reciprocal lattice vector and Brillouin Zones.

Unit-3 : Elastic Properties of Solids

- To Study the Stress and Strain components, Elastic Compliance and Stiffness constants
- To study the Elastic energy density, reduction of number of elastic constants and elastic stiffness constants for isotropic body.
- Understanding of elastic constant for cubic isotropic bodies, elastic waves, waves in (100) direction
- To understand experimental determination of elastic constants

Unit-4 : Lattice vibration and phonons

- Understanding of Lattice dynamic of a diatomic linear lattice and Lattice vibrational spectrum.
- Study of the concepts of phonons momentum of phonons and Inelastic Scattering of photons by phonons.
- Study of the Inelastic Scattering of neutrons by phonons and Inelastic scattering of X-Ray.

Unit-5 : Thermal Properties and Band theory of Solids

- To study the Anharmonicity, thermal expansion, thermal conductivity, equation of state of solids and gruneisen constant.
- Understanding of the band theory classification of solids, concepts of effective mass.
- To understand the Fermi surfaces, anomalous skin effect, De Hass van alphen effect, cyclotron resonance and magneto resistance.

COURSE OUTCOME

Semester – 3

Paper 2

NUCLEAR AND PARTICLE PHYSICS

Unit-1 : Nuclear Interaction and Nuclear Reaction

- To Understand the Nuclear forces, exchange and tensor forces, meson theory of nuclear forces, Low energy n-p scattering and spin dependence of n-p forces
- To Study the Direct and compound nuclear reaction mechanism and reciprocity theorem

Unit-2 : Accelerators of charged particles

- To study the Cyclotron, Phase stability, frequency modulated cyclotron, magnetic induction accelerator, Electron synchrotron and linear accelerator

Unit-3 : Nuclear Models

- Understanding the Liquid drop model, Bohr-wheeler's theory of nuclear fission, shell model, spin orbit interaction, magic number, spin and angular momenta of nuclear ground state and nuclear quadrupole moment

Unit-4 : Nuclear decay and elementary particles

- Study of about beta – Decay, general features of beta-ray spectrum, Fermi theory of beta-decay, selection rules, parity in beta-decay, multipole radiation, internal conversion and nuclear isomerism

Unit-5 : Elementary particles

- To study the classification of elementary particles, fundamental interaction, parameters of elementary particles
- Understanding of the Symmetry and conversion laws, symmetry schemes of elementary particles SU(3)

COURSE OUTCOME

Semester – 3

Paper 3

Digital Electronics

Unit-1

- To Study the Number System and conversion between them.
- To Understand the Boolean arithmetic, signed and unsigned binary numbers, 1's complement and 2's complement

Unit-2

- To study the Codes : BCD, Gray, ASCII, EBCDIC, Demorgans theorem
- To study the Gates : OR, AND, NOT, NOR, OR, NAND, XOR, XNOR
- To Study the Boolean algebra, Karnaugh map, adder and subtractor circuit design

Unit-3

- Understand the Multiplexer, demultiplexer, encoder, decoder, parity checker and generator
- To study about the Flip-Flops : R-S, D, J-k, J-k Master slave flip flop, race around condition registers, shift registers

Unit-4

- Study about Counters – Asynchronous counter, synchronous counter, MOD-5 counter and MOD-10 counter, BCD counter, Up-Down counter, Shift Register counter

Unit-5

- Understanding of Digital to analog conversion (R-2R ladder network method, complete DAC structure) and Analog to Digital converters (Staircase or counter method, single slope, equal slope, successive approximation ADC)

COURSE OUTCOME

Semester – 3

Paper 4

ATOMIC AND MOLECULAR PHYSICS

Unit-1 : Nuclear Magnetic Resonance Spectroscopy

- To Understand the concept of Nuclear Magnetic Resonance Spectroscopy and Interaction between Nuclear Spin and Magnetic Field
- To Study the population of energy level, relaxation processes, spin-spin interaction and spin-spin coupling between two and more nuclei.

Unit-2 : Electronic Spectra of Diatomic Molecules

- To study the Franck Condom principles, dissociation and pre-dissociation, dissociation energy.
- To understand Born-Oppenheimer-Approximation, Vibrational coarse structure of electronic spectra.

Unit-3 : Raman Spectra

- To understand the Raman Effect, Molecular polarizability in Raman Effect and Vibrational Raman Spectra, vibration-rotation Raman spectra of diatomic molecules, application of Raman and infrared spectroscopy in the structure determination

Unit-4 : Mossbauer spectroscopy

- Study about Mossbauer Effect, principles of Mossbauer spectroscopy, recoil less emission of gamma emission, line width and resonance absorption, application of Mossbauer Spectroscopy

Unit-5 : Electron Spin Resonance Spectroscopy

- Study about the Elementary idea of ESR, Principle of ESR, ESR spectrometer and splinting of electron energy levels by a magnetic field
- To discuss the G-Values, simple experimental setup of ESR, ESR spectra of free radicals in solution and isotropic system.

COURSE OUTCOME

Semester – 4

Paper 1

CONDENSED MATTER PHYSICS - II

Unit-1 : Super Conductivity

- To Understand the concept of super conducting state, persistent current, critical temperature and Meissner effect.
- To study the thermodynamics of the super conducting transitions, London effect and penetration depth and coherence length.
- Study about the type - I and type – II superconductors and the B.C.S theory of superconductivity.
- Understandinf of AC and DC Josephson effects and Josephson tunneling.

Unit-2 : Magnetism

- To study the Weiss theory of ferromagnetic Heisenberg model and molecular field theory
- Study of Domain and Bloch wall energy, Spin waves and mangnons
- To understand Curie Weiss law for susceptibility, Ferri and anti-ferrimagnetic.

Unit-3 : Imperfection in crystals

- To Study the imperfection in atomic packing, point defects, interstitial Schottky and Frenkel defects
- To discuss about the lattice vacancies colour centres, F centres, F' centres, Coagulation of F centres, production of colour centres and V centres
- Understanding the explanation of experimental facts, line defects, edge and screw dislocation, mechanism of plastic deformation in solids, stress and strain fields of screw and edge dislocation, elastic energy of dislocation
- To study the slip and plastic deformation, shear strength of single crystal, burgers vector stress fields around dislocation

Unit-4 : Thin Film

- Study of surface topography by multiple beam interferometer, conditions for accurate determination of step height and Film thickness
- Discuss Electrical conductivity of thin films, expression for electrical conductivity of thin films, Hall coefficient quantum size effect in thin film.
- Discuss the Preparation of thin film by different physical vapour deposition system.

Unit-5 : Nano Structure

- To study the definition and properties of nano structured material, different method of preparation and characterization of nano material
- To dicuss plasma enchanted chemical vapour deposition, electro deposition and Structure of single wall carbon nano tubes(classification, chiral vector On, Translational vector T, Symmetry vector R, Unit Cell, Brillouin Zone)
- Understanding of Electronic, mechanical, thermal and phonon properties

COURSE OUTCOME

Semester – 4

Paper 2

LASER PHYSICS

Unit-1 : Basic Principles of Laser

- To understand introduction to laser, spontaneous and stimulated emission.
- To study Einstein Coefficients, Idea of light amplification and Population invertion
- Study of laser pumping schemes for two and three level system with threshold condition for laser oscillation.

Unit-2 : Properties of Laser Beams and Resonators

- To discuss the Properties of Laser-Temporal coherence, spatial coherence and directionality
- To study monochromatic of laser beam, resonators, vibrational mode of resonators, laser amplification and open resonator

Unit-3 : Types of lasers

- Understanding of Solid state lasers i.e. Ruby Laser, Nd-Yag Laser, Semiconductor laser
- Understanding of Gas lasers i.e. Carbon dioxide Laser, He-Ne Laser
- To study basic idea about liquid laser, Dye laser and chemical laser i.e. HCL and HF lasers

Unit-4 : Application of lasers

- Understanding of Holography and its principles, theory of holograms, reconstruction of image and characteristics of Holographs
- To study application of lasers in chemistry and optics laser in Industry i.e. laser belding, Hole drilling, laser cutting, application of lasers in medicine.

Unit-5 : Basic idea about non-linear optics

- Study about Harmonic generation, second and third harmonic generation, phase matching, optical mixing, parametric generation of light, self-focusing of light.

COURSE OUTCOME

Semester – 4

Paper 3

NUMERICAL TECHNIQUES BASED ON C++

Unit-1 : Programming in the C++ language

- To study Numeric types, expressions, input and output, conditions, logical expression, and selection control structures

Unit-2 : Loops, Functions and Arrays

- To study, While loop and do-while loop
- To discuss User-defined and library function
- To understand Numeric and character arrays

Unit-3 : Elements of error analysis

- Study of Root finding : Bisection Method, False Position or Regula Falsi Method and Newton-Raphson Method

Unit-4 : Solution of linear Systems AX=B

- Introduction to Gauss Elimination, Jacobi iteration and Gauss-Siedel Method

Unit-5 :

- Study about Curve Fitting : Least Squares Line-fitting
- Study about Interpolation and polynomial approximation : Lagrange Interpolation and Newton Interpolation
- Study about Numerical Integration : Newton-Cotes Integration, Trapezoidal Rule, Simpson's Rule.

COURSE OUTCOME

Semester – 4

Paper 4

ANALOG ELECTRONICS AND MICROPROCESSOR

Unit-1 : OP-AMP

- Understanding of amplifier circuit configurations : dual input balanced output dual input, single input unbalanced output(ac analysis) Only, block diagram of a typical op amp analysis and schematic symbol of op-amp.
- Study of Ideal op-amp parameters : input offset voltage, input offset current, input bias current CMRR, Slew rate, Gain band width product, Output resistance, inverting and non-inverting inputs.

Unit-2 : Application of OP-AMP

- To study the applications like Inverting and Non-inverting amplifier, Summing, Scaling and averaging amplifier, integrator and differentiator.
- To discuss the Oscillator Principles : oscillator types, frequency, stability response, the phase shift oscillator, Wein-bridge oscillator, Le tunable oscillator and square wave generator.

Unit-3 :

- Understanding the Basic architecture of intel 8085 microprocessor, microprocessor and its architecture-data.
- To study about Address and control buses.
- To discuss ALU registers, program counters, Flow chart and assembly language

Unit-4 : Microprocessor and Micro Computers

- To study about Microprocessor and Architecture : Intel 8086.
- To understand Microprocessor architecture : modes of memory addressing 8086/8088, Hardware specification : pin-outs and pin functions.
- To discuss Clock generator(8284 A) Bus buffering and latching, Bus timing, Ready and wait state, Minimum mode versus maximum mode.

Unit-5 :

- Understanding of programming the Microprocessor : Addressing modes : data addressing modes, program memory addressing modes, stack memory-addressing modes.
- Study of the Instruction set : data movement Instructions, Arithmetic and login instruction, Program control instructions.
- Understanding of Programming example : Simple assembly language programs table handling direct table addressing, searching a table and sorting a table using pseudoops.

PROGRAMME: **B.Sc. PHYSICS**

PROGRAMME OUTCOMES

Department of Physics	After successful completion of three year degree program in physics a student should be able to;
Programme Outcomes	**PO-1**. Demonstrate, solve and an understanding of major concepts in all disciplines of physics. **PO-2**. Solve the problem and also think methodically, independently and draw a logical conclusion. **PO-3**. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments. **PO-4**. Create an awareness of the impact of Physics on the society, and development outside the scientific community. **PO-5**. To inculcate the scientific temperament in the students and outside the scientific community. **PO-6**. Use modern techniques, decent equipments and Phonics software's
Programme Specific Outcomes	**PSO-1**. Gain the knowledge of Physics through theory and practical's. **PSO-2**. Understand good laboratory practices and safety. **PSO-3**. Develop research oriented skills. **PSO-4**. Make aware and handle the sophisticated instruments/equipments.
Course Outcomes B. Sc Physics **B. sc □□□□□ □□□□ (Paper I)**	
Course	**Outcomes** After completion of these courses students should be able to;

Unit 1 Mathematical Physics	**CO-1**. Know the Cartesian, spherical polar and cylindrical co-ordinate systems. **CO-2**. Know the vector and scalar product of two and more than two vectors. **CO-3.** Know the scalar and vector fields. **CO-4.** know the line, surface and volume integrals. **CO-5.** Know the gradient of Scalar field, divergence of a Vector field and Curl of a vector field. **CO-6**. Know the Stokes theorem and Green's theorem.
Unit 2 mechanics	**CO-1.** Understand the State of Rest and Motion. **CO-2**. Understand the Distance, displacement, Speed, velocity, acceleration, Force. **CO-3**. Understand Newton's Laws of motion and Kepler's laws and their Applications. **CO-4**. Know gravitational potential energy and gravitational potential of different bodies. **CO-5.** Know about the Pseudo forces (Coriolis force) and its applications. **CO-6.** Know about the centre of mass, Central force and its properties. **CO-7**. Classify elastic and inelastic scattering. **CO-8**. Know the difference between Laboratory and centre of mass system.
Unit 3 Central properties of matter	**CO-1.** Differentiate between elastic and inelastic materials **CO-2**. Understand about the bending and bending moment. **CO-3**. To study the modulus of rigidity, surface tension. **CO-4**. To understand the concepts of viscous force and coefficient of viscocity.
Unit 4 Oscillations	**CO-1.** To understand about vibration, periodic and harmonic motions. **CO-2**. Know the differential equations of simple harmonic oscillator. **CO-3**. Graphical representation of simple harmonic motion. **CO-4**. To know about the rotatory motion of rigid body and Newton's laws in rotational motion.. **CO-5.** Rotational kinetic energy and angular momentum.

	CO-6. To understand the theorems of inertia like parallel axis theorem and perpendicular axis theorem. **CO-7**. Find the moments of inertia of regular bodie.
Unit 5 Relativistic mechanics and earlier development in physics	**CO-1.** Discuss the Galilean and Lorenz Transformations. **CO-2**. Discuss the Michelson- Morley Experiment. **CO-3.** To understand the Special Theory of Relativity **CO-4**. Establish the relation between rest mass and moving mass, mass and energy, length contraction and addition of velocities. **CO-5.** To study the relativistic Transformation of frequency and wave number.

Course Outcomes B. Sc Physics

B. sc □□□□□ □□□□ (Paper IId)

Course	**Outcomes** After completion of these courses students should be able to;
Unit 1 Thermodynamics-I	**CO-1.** To know the terms thermodynamic system, thermodynamic coordinates, equation of state, equilibrium, thermal equilibrium, internal energy. **CO-2**. To study the laws of thermodynamics and its applications. **CO-3.** To study the Reversible and Irreversible Process. **CO-4.** To study the heat engine and its Efficieny. **CO-5.** To study Carnot Cycle and its efficiency. **CO-6**. To study the Clausius-Clapeyperon Latent Heat equation. **CO-7**. To study diesel engine
Unit 2 Thermodynamics-II	**CO-1.** Study the concept of Entropy and disorder. **CO-2**. Second law of thermodynamics in terms of entropy. **CO-3.** To study the Zero point energy. **CO-4.** To study the Kelvin's thermodynamic Scale of temperature.

	CO-5. To study the thermodynamic relations.
Unit 3 Statistical Physics-I	**CO-1**. To study Ensemble, Micro-canonical Ensemble and Grand-canonical Ensemble. **CO-2**. Know the concept of probability in statistical mechanics. **CO-3.** To understand Principle of Equal a Priory Probability. **CO-4.** To understand the concept of Phase Space. **CO-5.** To study the equilibrium between two systems in thermal contact. **CO-6.** To study the Boltzmann Entropy probability relations and Boltzmann Canonical distribution law and its applications. **CO-7.** To study the thermo-dynamical potentials. **CO-8.** To study the Gibbs-Helmholtz Equation.
Unit 4 Statistical Physics-II	**CO-1**.to study phase space and probable distribution of no. of particles. **CO-2** to study boltzman's partition function and its various applications. **CO-3** to study applications of statistics in thermodynamics. **CO-4** To study difference between classical and quantum statistics such as; ● Maxwell's- Boltzman statistics ● Bose- Einstein's statistics ● Fermi-Dirac Statistics **CO-5** To study Fermi levels and Fermi energy.
Unit 5 Contribution of Physicists	**CO-1** To know about achievements of various scientists such as ● S.N. Bose ● Boltzman ● Einstein ● Planck ● Bohr Fermi etc.
Unit-1 Geometrical optics	**CO-1**. To understand the reflection and refraction of light (Fermt's principle) **CO-2**. To know about dispertion and dispersive

		power and study the lens formula. **CO**-3. To study the different types of lenses.
	Unit-2 Interference of light	**CO-1**. To know about the principle of superposition. **CO-2**. To understand about the interference of light. **CO-3**. To study the different sources for coherence conditions. **CO-4**. To study the applications of interference of light such as- Michelson's interferometer, Fabry Perot interferometer, Etalon and Newton's Ring.
	Unit-3 Diffraction of light	**CO-1**. To understand basics of diffraction of light and its classification. **CO-2**. To understand diffraction at slit, circular aperture and circular disc and their mathematical interpretation. **CO-3**. To know the Rayleigh criterion of resolution of images. **CO-4**. To know the diffraction at n parallel slits and intensity distribution (plane diffraction grating). **CO-5**. To know the resolving power of Telescope, microscope, grating and prism. **CO-6**. To compare resolving power of grating with resolving power of Prism and Fabry Parot etalon.
	Unit-4 polarisation	**CO-1**. To know the polarisation of electromagnetic waves, transverse nature of light waves. **CO-2**. To know the production and analysis of plane polarised light. **CO-3**. To know the description of linear, circular and elliptical polarisation. **CO-4**. To Understand the propagation of electromagnetic waves in anisotropic medium. **CO-5. To** know the uni axial and biaxial crystals. **CO-6.** To understand the dielectric tensor. **CO-7.** To know the double refraction, Huygen's principle, ordinary and extra ordinary refractive indices. CO-8. To know the Fresnels's formula, to know the light propagation of uni axial crystal, Nicol Prism.

		CO-9. To know the production of circularly and elliptically polarised light. CO-10. To study the babinet compansator and its applications. CO-11. To know the optical rotation, optical rotation in liquids and its measurement through polarimeter.
	Unit-5 Lasers and Photo sensors	**CO-1.** To know the history of Laser, characteristics of laser light. **CO-2.** To know the Einstein's predictions, relationship between Einstein's coefficients. **CO-3.** To know the pumping schemes, resonators and different types of LASER such as RUBY, He- Ne Lasers and its applications. **CO-4.** To understand the principles of Holografy. **CO-5.** To understand the working of PHOTO-DIOD, PHOTO-TRANSISTORS, and PHOTO-MULTIPLIERS.
	B. sc. Second year (physics) **Paper-II Electrostatics, magneto statics and electrodynamics**	
	Unit-1 **electrostatics**	**CO-1**. To study Coulomb's law. **CO-2**. To study electric field for different charge distributions. **CO-3**. Work done on charge in electric field. **CO-4**. To study the relation between the electric field and electric poteitial. **CO-5. To** study Guass's law and its applications. **CO-6.** To study the various capacitors and its applications. **CO-7.** To know about the Polarisation vector **P,** relation between **D, P and E.** CO-8. Claussius-Mollotti equation.
	Unit-2 magnetostatics	**CO-1**. To study the Lorentz force and its applications. **CO-2**. To study the force on current carrying conductor in uniform magnetic field. **CO-3**. To study the torque on a current loop. **CO-4**. To study the magnetic dipole moment, angular momentum and gyro magnetic ratio.

		CO-5. To study Biotsevert law, and its applications. **CO-6.** To study the Ampere's circuital law and its applications. **CO-7.** To study the field due to magnetic dipoles, free and bound currents, magnetisation current. **CO-8.** To study the relationship between **B, H and J.**
	Unit-3 Current electricity and Bio electricity.	**CO-1**. To study steady and non steady currents and continuity equations. **CO-2**. To study Kirchhoff's laws and its applications. **CO-3**. To study the growth and decay of current in LR, CR and LCR circuits. **CO-4**. To study the different types of AC circuits and its problems. **CO-5.** To study the electricity observed in living organism and origin of bioelectricity.
	Unit-4 Motion of charged particles in electric and magnetic field.	**CO-1**. To Motion of charged particle in electric field and study of electron gun, discharge tube and linear accelerators and CRO. **CO-2**. To study the transverse magnetic field and its applications. **CO-3**. To study the mutually perpendicular and parallel electric and magnetic field and their applications.
	Unit-5 electrodynamics	**CO-1**. To study the electromagnetic induction, Faradays laws, self and mutual induction, transformer. **CO-2**. To study the Maxwell's displacement current. **CO-3**. To study the Maxwell's equations. **CO-4**. To study the electromagnetic field energy density, and Poynting vector. **CO-5. To** study the electromagnetic wave equations in different media. **CO-6.** To study the reflection, refraction, polarisation and total internal reflection of electromagnetic radiation. **CO-7.** To study the reflection and refraction by ionosphere.

Bsc III PhysicsPaper I

QUANTUM MECHANICS AND SPECTROSCOPY

Unit 1 Quantum mechanics 1	● To establish the connection between classical mechanics and quantum mechanicssuch as photoelectric effect and specific heat of solids at low temperature ● Experimental verification between classical and quantum mechanics with the help of division grammar experiment ● To study the schrodinger equation finding the probability of a particle in given conditions Heisenberg uncertainty principle wave particle dualit
Unit 2 Quantum mechanics 2	● To study one dimensional potential well and barrier ● Reflection and transmission coefficient of a rectangular barrier ● To study the quantum phenomenon of tunneling and alpha decay ● To study the one dimensional simple harmonic oscillator problem and to find the eigenvalue from hermit differential ● To study a particle in spherically symmetric potential ● To study the particle in a three dimensional box, angular momentum and properties of Paoli spin matrices

Unit 3 atomic spectroscopy	● To study quantum numbers model and selection rules stern gerlach experiment ● To explain spin as a intrinsic quantum number ● To study orbital angular momentum fine structure total angular momentum and Pauli exclusion principle ● To study the symmetric and antisymmetric wave functions ● To study the atomic shell model ● To study spin orbit coupling LS and JJ coupling ● To study the characteristics of x-rays and mausolus law
Unit 4 molecular spectroscopy	● To study the various types of spectra rotational spectra intensity of spectral lines and the determination of bond distance of diatomic molecules ● To study the isotope effect ● To study the zero point energy ● To study Raman effect stokes and antistokes lines and their intensity difference ● To study the born oppenheimer approximation ● To study the franckcondon principle singlet and triplet States ● To study the fluorescence and phosphorescence ● Introduction to the the laser Raman spectroscopy

	● To study the elementary concept and applications to NMR and EPR
Unit 5 nuclear physics and elementary particles	● To study the basic properties of nucleus such as set size mass and charge of the nucleus ● To study the stability of the nucleus and binding energy ● To study the alpha particle spectra such as velocity and energy of alpha particles geigernuttall law ● To study the nature of the beta spectra the neutrino and its physics ● To study the positron emission and electron capture selection rules beta absorption and range of the beta particles ● To study the nuclear reaction cross section examples of different types of reaction and their characteristics ● to study the compound nucleus postulates of compound nuclear reaction semi empirical mass formula ● To study the different types of models like shell model liquid drop model ● To study the classification of elementary particles and their interactions - conservation laws quark structure of hydra elementary ideas about unification of forces

B sc III Paper II

SOLID STATE PHYSICS AND ELECTRONIC DEVICES

Unit 1 Solid state physics 1	● To study the crystal structure and bonding - crystalline and amorphous solids translational symmetry lattice and bases unit cell reciprocal lattice fundamental types of lattice ● Miller indices lattice planes simple cubic face centred cubic body centred cubic ● To study Laue and Bragg equations ● To determine the crystal structure with x-rays by x-ray spectrometer ● To band theory of solids periodic potential and Blochs theorem ● To study qualitatively the Kronig-Penny model
Unit 2 Solid state physics 2	● Specific heat of solids by Dulong and Petit's law, Einstein's theory and divide theory of specific heat of solids. ● To study the specific heat of electron, wiedemann Franz law ● To study hall effect ● To study the diapera and ferromagnetic substances ● Classical langevin theory of dia and paramagnetic substances ● Weiss theory of ferromagnetism and ferromagnetic domains ● Today’s cuss the Hysteresiss loop ● To study the superconductor of materials at higher temperature, meissner effect etc

Unit 3 Semiconductor devices 1	● To study the pure and impure semiconductor ● To study energy level diagram of p and n type semiconductor ● To study forward biasing and reverse biasing ● To study the different type of diodes like PN junction diode, schottky diode, zener diode, tunnel diode etc ● To study the CB CC and CE mod of NPN and PNP transistors ● To study the characteristics of a transistor
Unit 4 Semiconductor devices 2	● To study the amplifiers of bipolar junction transistors in CB CC and CE configuration ● To study the Q point ● To study the input impedance output impedance, current gain, voltage gain, power gain ● To study the class A, B and C type of amplifiers ● To study RC coupled amplifier, class B push pull amplifier ● To study the feedback amplifiers, voltage feedback and current feedback ● To study the voltage series negative feedback ● To study the oscillators barkhausen criteria of oscillation ● To study the colpitt oscillator, RC phase shift oscillator ● To study the amplitude, phase and frequency modulation
Unit 5 Nano materials	● To introduce the nano materials ● To study Structure and size dependence properties of 3D 2D 1D and 0D materials ● To study the surface and interface effect of nanomaterials ● Modelling of quantum size effect ● To study the synthesis of nanoparticles - bottom up and top down approach ● To study the Wet chemical method ● To study themetal and semiconducting nanomaterials ● To study the essential difference in structural and properties of bulk and nanomateria ● To study the naturally occurring nano materials ●