Syllabus

for

Bachelor of Science

DEPARTMENT OF PHYSICS

Jananayak Chandrashekhar University, Ballia,(U.P.)

Physics

B.Sc-Part I

Paper I	Mechanics and wave motion
Paper II	Circuit Fundamentals and Basic electronics
Paper III	Optics
Practical	

B.Sc – Part II

Paper I	Electricity and magnetism
Paper II	Thermal Physics and Elementary statistical mechanics
Paper III	Perspectives of modern physics
Practical	

B.Sc – Part III

Paper I	Elements of relativistic and classical mechanics
Paper II	Solid state and nuclear physics
Paper III	Electronics
Practical	

B. Sc. - Part I
PHYSICS
MECHANICS AND WAVE MOTION
PAPER I

Unit I

Inertial and non-inertial reference frames, radial and transverse components of velocity and acceleration using polar coordinates, Newton's laws of motion. Dynamics of particle in rectilinear and circular motion, Conservative and Non-Conservative forces, conservation of energy, linear momentum, and angular momentum. Collision in one and two dimensions, cross section.

Unit II

Rotational energy and rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Simple treatment of the motion of a top. Relations between elastic constants, bending of beam and torsion of cylinder.

Unit III

Central forces, Two body central force problem, Reduced mass and its equation of motion, Centre of mass motion, Newton's law of gravitation; Gravitational binding energy, Equivalence of inertial and gravitational mass, Gravitational field and potential at a point inside and outside a hollow and solid sphere. Kepler's laws, motion of planets and satellites, geo-stationary satellites.

Unit IV

Differential equation of Simple Harmonic Motion (SHM) and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, Principle of superposition of waves, stationary waves, pressure and energy distribution, phase and group velocity.

Reference books:

Unit I-III

1. Berkeley Physics Course Vol I: Mechanics –C. Kittel et al.(McGraw Hill 2017)
2. Feynman Lectures in Physics Vol I – Feynman, Leighton and Sands (Addison– Wesley 2005)
3. Physics Vol I – Resnick, Halliday and Walker (Wiley India Pvt. Ltd. 2007)
4. University Physics – Sears, Zemansky and Young (Pearson 1973)

5.

Unit IV

1. Vibrations and Waves – A. P. French (CRC Press, 1971)
2. Vibrations and Waves in Physics– I. G. Main (Cambridge University Press, 1993)
3. Berkeley Physics Course Vol 3: F.S.Crawford (McGraw Hill 2011)

Learning objectives & outcomes:

1. To understand the difference between conservative and non-conservative forces.
2. To study the response of the classical systems to external forces and their elastic deformation.
3. To understand the dynamics of planetary motion.
4. To understand the different features of Simple harmonic, damped and forced harmonic motion.

B. Sc. - Part I
PHYSICS
CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS
PAPER II

UNIT – I

Diodes: Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator; Tunnel diode; Point contact diode; Light emitting diodes (LEDs); Photodiodes, Thermistors.
Transistors: Equivalent circuit for transistors, Basic model, hybrid model and y-parameter equivalent circuit, input and output impedances, Transistor Power amplifiers: Class A and B operation, maximum power output, effect of temperature, Distortion in amplifiers, cascading of stages.

UNIT – II

Field Effect Transistors: JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS)
Power Devices: Unijunction transistors (UJT), basic construction and working, Silicon controlled rectifier (SCR) construction, working and characteristics, Triac, Diac, IGBT, MESFET, operation and applications.

UNIT – III

Basic Operational Amplifier: Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741). Inverting, Non-inverting, Summming and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. Comparators: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger.

UNIT – IV

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction and multiplication), representation of signed and unsigned numbers, Binary Coded Decimal codes.

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators,

Truth Tables of OR, AND, NOT, Basic postulates and fundamental theorems of Boolean algebra, Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates. Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison.

References:

1. Semiconductor Devices by Kanaan Kano
2. Basic Electronic Devices and Circuits by R. Y. Borse
3. S. M. Sze, Semiconductor Devices: Physics and Technology
4. Digital Principles and Application by Leach & Malvino
5. Digital Electronic Principles by A P Malvino

Learning Objectives and Outcomes-

1. Understanding the basic components of electronic devices
2. To design simple electronic circuits
3. Understanding the applications of various electronic devices

B. Sc.- Part I
PHYSICS
OPTICS
PAPER III

Unit I

Interference of two beams of light, Conditions for interference, Spatial and temporal coherence, classification of interference, Division of Wavefront: Fresnel's Biprism, Lloyd's Mirror. Division of amplitude: Newton's rings, Michelson's Interferometer, Fringes of equal inclination, Fringes of equal thickness, Interference involving multiple reflections, Stokes' treatment, interference in transmitted light, Fabry-Perot interferometer, Edser- Butler interferometer.

Unit II

Fresnel and Fraunhofer Diffraction, Diffraction by a single and double slits. Derivation of equation for intensity, comparison of single-slit and double slit patterns, distinction between interference and diffraction, missing orders. Diffraction grating, formation of spectra by a grating, principal maxima, difference between spectra of prism and grating, production of ruled grating.

Unit III

Rayleigh's criterion of resolution, Resolving power of Grating, Resolving power of a telescope, Fresnel's half period zones, the straight edge, diffraction at a narrow wire, Zone plate. Polarization, polarization by reflection, polarizing angle, Brewster's law, Law of Malus, Polarization by dichroic crystals, birefringence, anisotropic crystals, Nicol prism, Retardation plates, Babinet compensator, Analysis of polarized light.

Unit IV

Optical activity and Fresnel's explanation, Half shade and Biquartz polarimeters, Jones matrix, matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators; Sources of light: Incoherent (Sodium, Neon, Mercury) and coherent (Laser-simple treatment).

Reference books

1. Principles of Optics – Born and Wolf (Pergamon Press 1970)
2. Optics – F.W. Sears (Addison-Wesley 1975)
3. Fundamentals of Optics – Jenkins and White (McGraw Hill Education, 2017))
4. Optics - A. K. Ghatak (McGraw Hill Education 1992)

Learning objectives and outcomes:

1. To be able to understand the behaviour of light in optical systems.
2. To understand the effects of superposition of light and their applications physical systems.
3. To understand the differences between polarised and un-polarised light.

B. Sc.- Part I
PHYSICS
PRACTICALS

1. Determination of 'g' by compound pendulum
2. Determination of the modulus of rigidity of material of a wire by statical method.
3. Determination of the Young's modulus of the material of a beam by flexure method.
4. Determination of the frequency of AC mains using Sonometer.
5. Determination of Surface Tension of water by capillary rise method.
6. Determination of specific rotation of an optically active substance by Polarimeter.
7. Determination of resolving power of a Telescope.
8. Determination of the wavelength of light by Newton's rings.
9. Determination of the wavelength of sodium light by Fresnel biprism.
10. Determination of the diameter of a wire by diffraction.
11. Determination of the wavelength of mercury lines using transmission grating.
12. Verification of Brewster's law.
13. Determination of dispersive power of a prism.
14. Determination of melting point by Thermocouple.
15. Determination of height of a building by sextant.
16. Determination of mechanical equivalent of heat by Callender and Barne's method.

General Skill Development and Training:

- Least count of measuring instruments
- Levelling of optical benches and prism table using sprit level
- Removing optical bench error
- Use of Plumb Bob
- Focusing of spectrometer by Schuster's method

B.Sc. - Part II
PHYSICS
ELECTRICITY AND MAGNETISM
PAPER I

Unit I

Electrostatics: Electric Field and Lines, Electric Field **E** due to a Ring of Charge. Electric Flux; Gauss's law, Gauss's law in Differential form. Applications of Gauss's Law : **E** due to (1) an Infinite Line of Charge, (2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge and Two Parallel Charged Sheets, (4) a Charged Spherical Shell, (5) a Charged Conducting Sphere, (6) a Uniformly Charged Sphere, (7) Two Charged Concentric Spherical Shells and (8) a Charged Conductor. Force on the Surface of a Charged Conductor and Electrostatic Energy in the Medium surrounding a Charged Conductor. Electric Potential: Line Integral of Electric Field. Electric Potential Difference and Electric Potential V (Line integral). Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Potential and Electric Field of (1) a Dipole, (2) Quadrupole (3) a Charged Wire and (4) a Charged Disc. Force and Torque on a Dipole. Conductors in an Electrostatic Field. Description of a System of Charged Conductors. An Isolated Conductor and Capacitance. Electrostatic Energy stored in (1) a Point Charge, (2) a System of Point Charges, (3) a Uniform Sphere, (4) a Capacitor.

Unit -II

Magnetism: Magnetostatics: Magnetic Effect of Currents, Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B**. Magnetic Flux. Biot-Savart's Law : **B** due to (1) a Straight Current Carrying Conductor, (2) Current Loop and (3) Solenoid. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital law (Integral and Differential Forms): **B** due to (1) a Solenoid and (2) a Toroid. Properties of **B**. Curl and Divergence of **B**. Vector Potential. Forces on an Isolated Moving Charge. Magnetic Force on a Current Carrying Wire. Torque on a Current Loop in a Uniform Magnetic Field. Magnetic Properties of Matter: Gauss's law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (**M**). Magnetic Intensity (**H**). Relation between **B**, **M** and **H**. Magnetic Energy stored in Vacuum and Matter. Magnetic Circuit. B-H Curve and Energy Loss in Hysteresis.

Unit –III

Electromagnetic Induction: Faraday's laws of Electromagnetic Induction, Lenz's Law, Self and Mutual Inductance, L of Single Coil, M of Two Coils. Skin effect. Motion of Electron in Changing Magnetic field, Betatron.

Ballistic Galvanometer: Potential Energy of a Current Loop. Ballistic Galvanometer: Current and Charge sensitivity. Electromagnetic Damping. Logarithmic Damping.

Unit –IV

Dielectrics: Electric Field in Matter. Dielectric Constant. Parallel Plate Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector. Electric Susceptibility. Gauss's law in Dielectrics. Displacement Vector **D**. Relations between the three Electric Vectors. Capacitors filled with Dielectrics. Electrostatic equation with dielectrics, Field , Force and Energy in Dielectrics.

Maxwell's equations and Electromagnetic wave propagation: Equation of Continuity of Current, Displacement Current, Magnetic field due to Time varying Electric Field. Maxwell's Equations, Poynting vector, Energy Density in Electromagnetic Field, Electromagnetic Wave Propagation through Vacuum and Isotropic Dielectric Medium, Transverse nature of EM Waves.

Suggested Books:

1. Electricity and Magnetism by Edward M. Purcell (McGraw-Hill Education, 1986)
2. Fundamentals of Electricity and Magnetism by Arthur F. Kip (McGraw-Hill, 1968)
3. Electricity and Magnetism by J H Fewkes & John Yarwood. Vol. I (Oxford Univ. Press, 1991).
4. Electricity and Magnetism. By D C Tayal (Himalaya Publishing House,1988).
5. David J. Griffiths, Introduction to Electrodynamics, 3rd Ed, (Benjamin Cummings,1998).
6. A Student's Guide to Maxwell's Equations by Daniel A. Fleisch, Cambridge University Press 2008.

Learning objectives and outcomes:

1. Better understanding of Electrical and Magnetic phenomenon in daily life.
2. Gaining knowledge about Electromagnetic radiations
3. To understand the working of basic electrical devices
4. To be able to troubleshoot simple problem related to electrical devices.

B.Sc. Part II
PHYSICS
THERMAL PHYSICS AND ELEMENTARY STATISTICAL MECHANICS
PAPER II

Unit I

Thermodynamics: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermo-dynamical Processes, Applications of First Law: General Relation between C_p & C_v, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot 's cycle & theorem, Entropy changes in reversible & irreversible processes. Clausius Inequality, entropy and unavailable energy, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for $(C_P - C_V)$, CP/CV, TdS equations.

Unit II

Kinetic Theory of Gases: RMS speed, Kinetic Interpretation of temperature, Degree of Freedom, Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic Gases. Mean free path, Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Derivation of Maxwell's law of distribution of velocities and its experimental verification.

Unit III

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Concept and derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan-Boltzmann Law and Wien's displacement law from Planck's law. Solar Constant.

Unit IV

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity -Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

Reference books:

1. Thermal Physics - S. Garg, R. Bansal and C. Ghosh (McGraw Hill Education 1993)
2. A Treatise on Heat - Meghnad Saha, and B.N. Srivastava (Indian Press 1969)
3. Heat and Thermodynamics - M.W.Zemasky and R. Dittman (McGraw-Hill College 1996)
4. Thermodynamics, Kinetic theory & Statistical thermodynamics - F.W.Sears & G.L.Salinger (Pearson 1975)

5. Fundamentals of Statistical and Thermal Physics – F. Reif, Waveland Press 2009.
6. Statistical and Thermal Physics - S.Loknathan and R.S.Gambhir (BPB Publications, Delhi)

Learning objectives and outcomes:

1. To understand the dynamics of thermodynamic systems.
2. To understanding concepts of Black body Radiation.
3. To appreciate the concept of entropy.
4. To understand the different statistical behaviour of system of particles.

B.Sc. - Part II
PHYSICS
PERSPECTIVES OF MODERN PHYSICS
PAPER III

Unit I

Inadequacies of classical mechanics, Photoelectric Effect, The Quantum Theory of Light, Continuous and characteristic X-ray, X-ray generation and uses, Compton effect, Gravitational Red Shift, de Broglie waves, de Broglie Wave Function and its Properties, Interpretation of wave function, de Broglie Wave Velocity, Complementary principle, Principle of superposition, Wave and Group Velocity, Motion of Wave Packets Davisson and Germer Experiment-Diffraction of Electrons, Wave-particle duality Experiment.

Unit II

Heisenberg's Uncertainty principle and its applications, Estimating minimum energy of a confined particle using uncertainty principle, Estimate of Hydrogen Ground State Energy; Wave Equation, Wave Equivalent of an unrestricted Particle, Time Dependent Schrödinger wave equation: Eigenvalues and Eigen Functions, Probability Current; Expectation values, Expectation Values of Energy and Momentum Operators, Ehrenfest theorem.

Unit III

Continuity of wave Function, Boundary Condition and Discrete Energy Levels, Steady State Schrödinger Equation, Application of Schrödinger Wave Equation for Particle in an infinitely Rigid Box: Energy and Momentum Quantization, Normalization, Quantum Dot as an example; One Dimensional Step Potential, Rectangular Barrier, Square Well Potential.

Unit IV

Bohr atomic model, de Broglie Waves and Stationary Orbits, Hydrogen Atom Spectrum, Atomic Excitation-Franck Hertz Experiment, Correspondence Principle, Sommerfeld Elliptic Orbits. Electron Angular Momentum, Space Quantization, Electron Spin and Spin Angular Momentum, Spin Magnetic Moment, Stern – Gerlach Experiment, Pauli's Exclusion Principle and Periodic Table. Fine structure, Spin Orbit Coupling, Spectral Notation for Atomic States, Total Angular Momentum, Vector Model, Coupling schemes (LS and jj) for two electron systems. Zeeman Effect for one Electron System.

Reference Books:

6. Concepts of Modern Physics- Arthur Beiser (McGraw-Hill, 2009).
7. Modern Physics- John R. Taylor, Chris D. Zafiratos, Michael A.Dubson (PHI Learning2009).
8. Six Ideas that Shaped Physics: Particles Behave like Waves, Thomas A. Moore, (McGraw Hill, 2009).

4. Modern Physics - R.A. Serway, C.J. Moses, and C.A. Moyer (Third Edition, 2005, Cengage Learning
5. A Text book of Quantum Mechanics- P.M. Mathews & K. Venkatesan (2nd Ed., 2010, McGraw Hill).
6. Quantum Mechanics: Theory and Applications - Ajoy Ghatak, S. Lokanathan.(Macmillan Publishers India Limited).
7. Fundamentals of Modern Physics - R.M. Eisberg (Wiley, New York).
8. Introduction to Atomic Spectra -H.E. White,(McGraw-Hill, New York).

Learning objectives and outcomes:

1. To be able to understand the Physics behind the foundation of micro-world.
2. To understand applications of X-rays in science.
3. To gain knowledge the constituents of an atom.

B. Sc.- Part II
PHYSICS
PRACTICALS

1. To study the time constant in a C.R. Circuit.
2. To study the solid state common power supply.
3. To determine the field along the axis of Helmholtz coil.
4. To measure magnetic field using a ballistic galvanometer.
5. To determine the capacity of condensor by absolute method.
6. To determine the coefficient of mutual induction between two coils.
7. To determine high resistance by leakage method.
8. To study the characteristics of junction and Zener diodes.
9. To Study the Characteristics of p-n-p transistor.
10. To measure 'L' & 'C' by A.C. bridge.
11. To measure 'H' by Earth Inductor.
12. To determine the coefficient of Self Induction.
13. To verify Maximum Power Transfer Theorem
14. To calibrate an oscillator using CRO.

Skill Development and Training:

1. To study colour coding of Resistances and Capacitances and determine their values.
2. To use a multimeter for measuring (i) Resistances (ii) AC and DC voltages & currents (iii) continuity of electrical circuits (checking electrical fuse etc.) (iv) testing of electronic devices e.g. pn junction diode, pnp transistor etc..

B. Sc. – Part III
PHYSICS
ELEMENTS OF RELATIVISTIC AND CLASSICAL MECHANICS
Paper I

Unit I

Frame of reference, Earth as an inertial reference frame, Galilean transformation equations for the position, velocity and acceleration of a particle, Failure of Galilean relativity, Deduction of the law of linear momentum using Galilean invariance, Michelson – Morley experiment and its outcome, Explanation and its interpretation of the negative results with significance, Einstein's postulates of special theory of relativity, Lorentz transformation equations, Inverse Lorentz transformation equations.

Unit II

Length contraction or apparent length contraction, Numerical problems based on length contraction, Twin paradox, Relativistic Doppler effect, Applications of Doppler effect, Time dilation, Experimental verification of time dilation, Concept of simultaneity, Relativistic addition of velocities, Variation of mass with velocity or relativity of mass, Numerical problems based on variation of mass with velocity and mass energy equivalence. Limiting velocity of a material particle, Relativistic momentum and force, Mass energy equivalence and experimental verification, Relativistic relation between energy and momentum, Relativistic relation between kinetic energy and momentum, Gravitational red shift, General theory of relativity.

Unit III

Classical mechanics in Physics and some basic definitions, Mechanics of a system of particles, Constraints and their classification, Examples of constraints, Principle of virtual work, D'Alembert's principle and its applications, Degree of freedom, Generalized coordinates, Lagrangian formulation and Lagrange's equations of motion, Theorem on total energy, Cyclic or ignorable coordinates, Calculus of variation and it's applications, The Hamilton formulation and Hamilton's equation of motion.

Unit IV

Definitions and properties of the central force, Two–body central force problem, reduction to equivalent one body problem, The equation of motion and first integrals, Classification of orbits, Integrable power laws of the central force, Kepler's laws – derivation of equations, Kepler's problem in velocity space; Inadequacy of Classical Mechanics, Virial theorem and its examples.

Reference books:

Unit I and II:

1. Concepts of Modern Physics - Arthur Beiser (Tata McGraw-Hill 2008)
2. Modern Physics - S. K. Gupta and B.S. Agarwal (Publisher: Kedar Nath Ram Nath, 2017)
3. Modern Physics – R. Murugeshan, and K. Sivaprasath (S. Chand Publishing, 2016)

Unit III and IV:

4. Classical Mechanics - H. Goldstein, C. P. Poole, and J. L. Safko (Addison-Wesley 2001)
5. Introduction to Classical Mechanics - P. Puranik, R. Takwale (McGraw Hill Education, 2017)

Learning objectives and outcome:

1. To understand the distinctive features of Galilean, Special Relativistic and General Relativistic approaches.
2. To understand the dynamics of Classical Systems.
3. To improve our understanding of the universe.

B.Sc. – Part III
PHYSICS
SOLID STATE AND NUCLEAR PHYSICS
Paper II

Unit –I

Crystal Structure: Lattice Translation Vectors and Lattice, Basis and Crystal Structure, Primitive and Unit Cells, Two and Three dimensional lattice types, Symmetry operations, Points groups and space groups, Miller indices, Simple crystal structures, NaCl, CsCl, Diamond, Cubic, ZnS and Hexagonal, Glasses.
X-ray Diffraction, Laue Equations, Bragg's Law, Experimental Diffraction Method, Laue Method, Rotating-Crystal Method, Powder Method, Derivation of Scattered Wave Amplitude, Reciprocal Lattice Vectors, Diffraction Conditions, Ewald Method, Brillouin Zones, Reciprocal Lattice to SC, BCC and FCC lattices, Fourier Analysis of the Basis and Atomic and Crystal Structure Factor.

Unit – II

Crystal Bindings: Crystal of Inert Gases, Van der Walls-London Interaction Repulsive Interaction, Equilibrium Lattice Constants, Cohesive Energy, Compressibility and Bulk Modulus of Ionic Crystal, Madelung Energy and Evaluation of Madelung Constant, Covalent Crystals, Metallic Bond, Hydrogen-Bonded Crystals, Atomic Radii.

Elementary Lattice Dynamics: Lattice Vibrations and Phonons, Linear Mono-and Diatomic Chains, Acoustic and Optical Phonons (Qualitative treatment only), Qualitative Description of Phonon in Solids, Dulong and Petit's Law, Einstein Theory of Specific Heat of solids.

Electrical and Thermal Properties of Materials: Free Electron Theory, Fermi Energy, Density of States, Heat Capacity of Electron Gas, Paramagnetic Susceptibility of Conduction Electrons, Hall Effect in Metals. Origin of Band Theory, Qualitative Idea of Bloch Theorem, Kronig-Penney Model, Number of Orbitals in a Band, Effective Mass of Electron, Concept of Holes, Band Gap, Energy Band Diagram and Classification of Solids.

Unit III

Basic Properties of Nuclei: Mass, Radii, Charge, angular Momentum, Spin, Parity, Magnetic Dipole moment, Electric Quadrupole Moment, Binding Energy and Nuclear Stability.

Nuclear Forces: Deuteron ground state properties and basic characteristics of Nuclear force.

Nuclear Models: Liquid drop model, Bethe Weizsacker mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers),basic idea of Collective model.

Natural Radioactivity: Basic ideas about α, β and γ decay. Radioactive growth and decay, ideal, transient, and secular equilibrium.

Unit IV

Nuclear Reactions: Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

Accelerators and detectors: Van de Graaff generator, linear accelerator, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter, principle of Semi-Conductor (SC) detectors.

Elementary Particles: Basic interactions and their mediating quanta, types of particles and their families, Fermions and Bosons, Leptons and Hadrons. Baryon number, Lepton number, particles and antiparticles, idea of resonance states, conservation laws in fundamental interactions, Strangeness, Isospin, concept of Quark model.

Reference Books:

Unit I and II

1 Introduction to Solid State Physics- Charles Kittel (Wiley 2012)

2 Elements of Solid State Physics - J P Srivastava (Prentice-Hall of India, 2006)

3 Introduction to Solids - L V Azaroff (Tata McGraw Hill 1993)

4 Solid State Physics - Aschroft amd Mermin (Cengage Learning 2009)

5 Solid State Physics – A J Dekker (Macmillan 1965)

Unit III and IV

6. Introductory nuclear Physics - Kenneth S. Krane (Wiley 2008)

7. Concepts of Nuclear Physics - Bernard L. Cohen (McGraw Hill Education, 2017)

8. Introduction to the Physics of Nuclei & Particles - R. A. Dunlap (Brooks/Cole 2003)

9. Introduction to Elementary Particles - D. Griffiths (Wiley-VCH, 2008)

10. Basic ideas and concepts in Nuclear Physics - An Introductory Approach - K. Heyde (CRC Press 2004)

Learning objectives and outcomes:

1. To learn applications of crystallography in the study of materials.
2. To understand how crystallography aids in building new materials.
3. To Study the Structure and Stability of Nucleus and thus help understand the Evolution of Universe
4. To learn application of Nuclear Physics in Nuclear Medicine Diagnosis and Treatment as well building safe reactors (Fission/ Fusion Type) to provide clean energy.

B.Sc. – Part III
PHYSICS
PRACTICAL

1. To study the characteristics of Field Effect Transistor.
2. Study of FET as a Voltage Variable Resistor(VVR) and application of FET as a VVR in Voltage Controlled Attenuator (VCA)
3. Study of IC amplifier.
4. Frequency response of RC coupled amplifier.
5. Determination of the velocity of sound by Cathode Ray Oscilloscope.
6. Determination of Stefan's constant.
7. To study resonance in series and parallel LCR circuit.
8. Wavelength of mercury lines by transmission grating up to two orders.
9. Resolving power of grating.
10. Determination of wavelength of sodium light and thickness of mica sheet by Fresnel's biprism.
11. Measurement of variation of Capacitance and Permittivity of air.
12. Rectifier Efficiency and ripple factor of a stabilised power supply.

Skill Development and Training

- To study the waveform and measure (i) voltage (ii) Frequency of a periodic waveform using a Cathode Ray Oscilloscope.
- Designing of Audio Frequency RC Coupled Amplifier for a given Bandwidth.
- Designing a Common Power Supply.