TEACHING & EXAMINATION SCHEME
For the Examination – 2015
PHYSICS

B.Sc. PART-III

THEORY

			Pd/W (45mts.)	Exam. Hours	Max. Marks 150
Phy.301	Paper I	Solid State Physics	2	3	50
Phy.302	Paper II	Nuclear Physics	2	3	50
Phy.303	Paper III	Relativity and Electrodynamics	2	3	50
PRACTICAL			6	5	75
			TOTAL:		**225**

B. SC. PART-III

PAPER I : SOLID STATE PHYSICS

Note: The question paper for the examination will be divided in three parts i.e., Section – A, Section – B and Section – C.

Section – A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited upto 30 words. Each question will carry 1 mark.

Section – B: Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited upto 250 words. Each question carry 3.5 marks.

Section – C: Will consist of total 05 questions. The paper setter will set one question from each Unit and students will answer any 03 questions and answer of each question shall be limited upto 500 words. Each question will carry 7.5 marks.

UNIT-1 :

Crystal structure : Different terms of crystal structure, Fundamental types of lattices, Two and three dimensional lattice types; Seven system of crystals, Characteristics of sc, bcc, fcc, hcp; Miller indices, orientation of planes in cubic lattices; Distribution of Atoms in atomic planes of cubic lattices. Distance between successive planes; Von-Laue's equations of diffraction of X-rays, Bragg's Law, scattering from

lattice of point-atoms. Scattering factor. Geometrical Scattering factor for sc, bcc, fcc. Reciprocal lattice and its properties.

UNIT-2 :

Crystal binding and lattice vibrations : Inter-atomic forces of solids. Crystal of inert gases, cohesive energy and bulk modulus. Ionic crystals, Madelung energy and bulk modulus. Covalent crystals. Hydrogen bonded crystals, Atomic radii. Concept of phonons Vibration of monatomic lattices, lattice with two atoms per primitive cell. Local phonon modes. Density of states in one dimension, three dimensions, lattice heat capacity for Einstein model, Debye model.

UNIT-3 :

Free Electron theory of metals : Free electron model, Density of states of electron gas, Fermi-Dirac distribution function, effect of temperature on Fermi-Dirac distribution function, Fermi energy at absolute zero temperature and low temperature. Electron heat capacity. Thermionic emission. Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Thermal conductivity, Wiedmann-Franz Law. Hall effect.

UNIT-4 :

Band theory : Formation of bands and origin of energy gap, Bloch theorem, Kronig Penney model, crystal momentum and velocity of an electron. Effective mass of electrons. Electrons and holes. Number of states in a band, insulator, semi-conductor and metal. Construction of Brillouin Zones and Fermi-surfaces. Fermi levels in intrinsic, n-type and p- type semi-conductors, Mass action Law. The static dielectric constants of solids. Local electric field at an atom.

UNIT-5 :

Magnetism : Diamagnetism and Larmor precession, classical theory of diamagnetism, Para-magnetism and its classical theory, free electron theory. Molecular theory of ferromagnetism.

Experimental Survey of Superconductivity : Zero resistance, persistent currents, effect of magnetic fields, flux exclusion, Intermediate state, Entropy effect, frequency effects, Gyromagnetic ratio, Isotope effect. Occurrence of superconductivity. Thermoelectric effects, thermal conductivity. High temperature oxide, superconductors and their properties. BCS theory (elementary idea without mathematical derivation), Magnetic levitation.

Books suggested :

1. Kittel : Introduction to Solid State Physics, Wiley Eastern.
2. A.J. Dekker : Solid State Physics, McMillian India.
3. L. Azaroff : Theory of Solids.

Paper II: NUCLEAR PHYSICS

Note: The question paper for the examination will be divided in three parts i.e., Section – A, Section – B and Section – C.

Section – A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited upto 30 words. Each question will carry 1 mark.

Section – B: Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited upto 250 words. Each question carry 3.5 marks.

Section – C: Will consist of total 05 questions. The paper setter will set one question from each Unit and students will answer any 03 questions and answer of each question shall be limited upto 500 words. Each question will carry 7.5 marks.

UNIT-1 :

Rutherford scattering and Rutherford's nuclear model. Constituents of nucleus, discovery of neutron. Mass of proton and neutron. Measurement of charge radius (i) by Hofstadier experiment, (ii) by electron scattering method, (iii) by Mesonic X-ray Method. Measurement of potential radius (i) from lifetime of α-emitters (ii) from neutron scattering experiment. Variation of nuclear radius with mass number A. Nuclear spin and parity, Magnetic dipole moment of nuclei, Rabi's method for determination of nuclear magnetic moment. Electric quadrupole moment of nucleus.

UNIT-2 :

Mass defect, Mass difference, packing fraction and binding energy of nucleus. Plot of binding energy per nucleon against mass number. Liquid drop model of Nucleus. WEIZSACHER's Semi Empirical Mass formula (Volume, Surface, Coloumb – asymmetry and pairing energy terms). Predication of stability against beta-decay for members of an isobaric family. Stability limits against spontaneous fission. Energetic of Symmetric fission.

UNIT-3 :

The law of radioactive decay, statistical nature of radioactivity. Radio active growth and decay. Ideal equilibrium, transient equilibrium and secular equilibrium Radioactive series.

Types of nuclear reactions (only qualitative statement). The balance of Mass and energy in nuclear reactions. Q equation. Solution of the Q equations, concept of centre of mass in nuclear reaction, view of proton-proton collision and neutron-nucleus collision in CM frame.

UNIT-4 :

Alpha decay: Disintegration Energy, Range of α-particles, Geiger Nuttal's Law. α-spectrum and fine structure. Long range α- particles, α- particles paradox–Barrier penetration, Gamow Theory of α-emission.

Beta Decay: β-ray spectrometer (principle and working). β-ray spectrum ;and its qualitative explanation.

Nuclear Energy: Nuclear induced fission, energy released in fission of U 235. Fission chain reaction, Neutron cycle in a thermal reactor. Four factor formula. Elementary idea of nuclear reactors. Nuclear fusion; fusion in stars, carbon and pp cycle problems of controlled fusion.

UNIT-5 :

Radiation Detectors: Introduction of various Methods used in detection of nuclear radiation. Detailed description of principle and working of following detectors based on detection of free-charge carriers – (i) Ionization Chamber, (ii) Proportional Counter, [iii) Geiger-Muller Counters, dead time, recovery time and paralysis time.

Particle accelerators: Principle and working of Vande-Graff Generators Cyclotron and linear accelerators.

Elementary Particles: Properties of particles, Classification into leptons, mesons and baryons, conservation laws (only qualitative discussion) energy, momentum, angular momentum, charge, Lepton numbers, Iso-spin, Strangeness and Baryon number. Quark model (only qualitative idea).

Books suggested:

1. Alonso & Finn: Fundamental University Physics – Vol. III, Addision Wesley.
2. S.N. Ghoshal : Atomic & Nuclear Physics – Vol. II, S. Chand, New Delhi.

PAPER III: RELATIVITY AND ELECTRODYNAMICS

Note : The question paper for the examination will be divided in three parts i.e., Section – A, Section – B and Section – C.

Section – A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited upto 30 words. Each question will carry 1 mark.

Section – B: Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited upto 250 words. Each question carry 3.5 marks.

Section – C: Will consist of total 05 questions. The paper setter will set one question from each Unit and students will answer any 03 questions and answer of each question shall be limited upto 500 words. Each question will carry 7.5 marks.

UNIT-1. :

Electromagnetic Waves: Displacement current, Maxwell's equations, Electromagnetic wave equation. Poynting theorem. Plane Electromagnetic waves in free space, wave impedance of free space. Propagation of plane Electromagnetic waves in non-conducting and conducting media. Skin depth, propagation of Electromagnetic waves in ionized gases. Polarization of Electromagnetic waves. Scalar and vector potentials, Lorentz condition and D'Alembert's equation.

UNIT-2 :

Reflection and Refraction of Electromagnetic waves: Boundary conditions at the surface of discontinuity, Reflection and refraction of Electromagnetic waves at the interface of non-conducting media. Fresnel's equations and their experimental verification. Reflection and transmission coefficients. Brewster's Law and degree of Polarization. Total internal reflection. Phase difference between parallel and perpendicular components and polarization of the reflected wave. Reflection from a conducting plane. Propagation of Electro-magnetic waves between parallel conducting planes. Cut-off frequency. Phase velocity and group velocity.

UNIT-3 :

Interaction of Electromagnetic waves with matter: Normal and anomalous dispersion of light. Empirical relations. Lorentz theory of dispersion of gases. Experimental demonstration of anomalous dispersion in gases. Scattering of Electromagnetic waves and scattering parameters. Thomson, resonant and Rayleigh's scattering cross-section. Polarization of scattered light. Coherent and incoherent scattered light. Dispersion in liquids and solids, Claussius Mossotti equation and Lorentz-Lorentz formula.

UNIT-4 :

Relativistic Mechanics: Coordinate transformation, contravariant and covariant vectors. Tensors of second and higher rank. Addition, subtraction, contraction, outer and inner product of tensors. Covariance of tensor equations. Minkowski space. Geometrical interpretation of Lorentz transformation, space like and time like intervals, Four vectors, four dimensional gradient, divergence and curl operators. Four-velocity, Four-acceleration, Four-momentum, Four-force. Relativistic classification of particles.

UNIT-5 :

Relativistic Electrodynamics : Invariance of charge. Transformation of surface charge density. Electric field measured in different frames of reference. Transformation of volume-charge density and current density. Equation of continuity in the covariant form. Transformation of Electromagnetic potentials. Electromagnetic field tensor. Covariance of Maxwell's equations. Transformation of Electro-Magnetic fields. Lorentz-force in a covariant form. Electromagnetic field due to a moving charge.

Books suggested :

1. S.P. Puri : Electrodynamics, Tata McGraw Hill.
2. J.D. Jackson : Classical Electro-dynamics.
3. B.B. Laud : Electromagnetic.
4. E.C. Jordan : Electromagnetic waves.
5. Griffiths : Introduction to Electrodynamics, PHI

PRACTICALS

Note: These Practicals are divided into three sections, Lab. A, Lab. B & Lab. C.

1. Lab. A is for all students.
2. Lab. B is for all except those who offer Computer Science as an optional subject.
3. Lab. C is for all except those who offer Electronics as an optional subject.
4. Students not offering Electronics and Computer Science shall perform 50% of experiments from each of Lab. B & Lab. C in addition to those of Lab.A.

Examination Scheme for Laboratory Work:

1. Students with Electronics shall be examined in one experiment of each of Lab. A and Lab. B.
2. Students with Computer Science shall be examined in one experiment of each of Lab. A and Lab. C.
3. Students with Combinations not involving Electronics and Computer Science shall be examined in one experiment of Lab. A and one experiment out of Lab. B and Lab. C

LAB. A: PHYSICS PRACTICALS

1. Determination of Planck's constant by photo cell (retarding potential method using optical filters, preferably five filters).
2. Determination of Planck's constant using solar cell.
3. Determination of Stefan's constant (B-B method).
4. Study of characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.
5. To determine the energy Band gap in a semiconductor using junction diode.
6. To find the magnetic susceptibility of paramagnetic solution using Quinck's method. Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magnetons.
7. Determination of coefficient of rigidity as a function of temperature using torsional oscillator (resonance method).
8. Study of Polarization by reflection from a glass plate with the help of Nicol prism and photo cell and verification of Brewster law and law of Malus.
9. e/m measurement by Helical Method.
10. Measurement of magnetic filed using Ballistic galvanometer and search coil, study of variation of magnetic field of an electromagnet with current.
11. Measurement of electric charge by Millikan's oil drop method.
12. Using Michelson's interferometer find out the wavelength of a given monochromatic source (Sodium light) also determine λ of D_1 and D_2 lines.
13. To study hysteresis loss by B-H curve using CRO.
14. Determination of dielectric constant of solids and liquids using Gang capacitor

LAB. B: COMPUTER APPLICATIONS

The following experiments to be performed in BASIC language:

1. To print out all natural even/odd number between given limits.
2. To find maximum, minimum and range of a given set of numbers.
3. To evaluate sum of finite series.
4. To find the product of two matrices.
5. To find the roots of a quadratic equation.
6. To check if triangle exists and the type of the triangle.
7. To find the sum of the Sine and Cosine series and print out the curve.
8. Fitting a straight line or a simple curve in a given data.
9. Find roots of f(x)=0 by using Newton-Raphson Method.
10. Find roots of f(x)=0 by using Secant Method.
11. Integration by Simpson Rule.
12. To find the value of y at a given value of x by Runge-Kutta Method.

LAB. C: ELECTRONICS

1. Study of Half wave & Full wave rectification and application of L and π section filters.
2. Characteristics of a given transistor PNP/NPN (common emitter, common base and common collector configurations).
3. Study of single stage transistor audio amplifier (variation of gain with frequency).
4. Study of resonance in an LCR circuit (using air core inductance and damping by metal plate) (i) at fixed frequency by varying C and (ii) by varying frequency
5. Study the characteristics of junction diode & Zener diode.
6. Design a Zener regulated power supply land study the regulation with various loads.
7. Study the characteristics of field effect transistor (FET) and design study amplifier of finite gain (10).
8. Study the frequency response of a transistor amplifier, obtain the input and output impedance of the amplifier.
9. Design and study of an R-C Phase shift oscillator and measure output impedance (frequency response with change of component of values R and C).
10. Study voltage multiplier circuit to generate high voltage D.C. from A.C.
11. Using discrete components, study OR, AND, NOT logic gates, compare with TTL integrated circuits (IC's).
12. Application of operational amplifier (OP-AMP).
13. Study of RC circuits as integrating and differentiating systems with Square input.