Syllabus for B.Sc 1st year (Semester-I)

Subject: Physics

Effective from Academic Session-2015

Mechanics and Relativity

Unit-I

Coordinate Systems: Cartesian, spherical polar coordinates and Cylindrical coordinate systems. Components of velocity and acceleration in spherical polar and Cylindrical coordinate systems. Inertial and non-inertial frames of references, uniformly rotating frame: centripetal acceleration, Corriolis Force and applications; Galilean Transformations. Conservation of Linear and angular momentum in system of particles, principle and equation of rockets.

Unit-II

Inverse Force fields, equation of orbits, Kepler's Laws and their derivation, Gravitational law and Field; Potential and Field due to spherical shell, solid sphere and Disc.
Rigid Body motion, Rotational motion, moments of inertia and their products, Principle moments and axes, Euler's equations with some applications. Idea of moment of inertia tensor.

Unit-III

Harmonic oscillators with examples; Damped harmonic oscillator ; Power Dissipation; Quality Factor; driven harmonic oscillator with and without damping force; Anharmonic Oscillator.
Superposition: Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency; Lissajous figures; case of different frequencies.

Unit-IV

Newtonian relativity; Michelson-Morley experiment; Special theory of relativity; Lorentz Transformations and their consequences (Relativity of simultaneity, Lorentz- FitzGerald length contraction , time dilation); Relativistic addition of velocities; Variation of mass with velocity, mass energy relation; Space-time four-dimensional continuum; Four-vectors

Text Book:

1. An introduction to Mechanics: *Kelppner and Kolenkow (TataMcGraw-Hill).*

References:

1. Kittel, Knight, Ruderman, Helholz, Moyer Second. Ed. "Berkely Physics Course, Vol. 1, Mechanics", McGraw Hill, New Delhi.
2. Theoretical Mechanics: M. Speigel (Schuam's Outline TataMcGraw-Hill)

Syllabus for B.Sc 1st year (Semester-II)

Subject: Physics

Effective from Academic Session-2015

Electricity and Magnetism

Unit-I

Scalar and Vector field. Gradient, Divergence, Curl and their physical significance; Line, surface and volume integrals; Fundamental theorem on gradients; Statement and Proof of Gauss Divergence Theorem, Stoke's Theorem and Green's Theorem. Divergence of r/r^2 ; One and three dimensional Dirac- delta function; Helmholtz theorem. Gauss Law in differantial form. Potential and Field due to Solid sphere, infinite sheet of charge and charged plane disc. Boundary Conditions.

Unit-II

Multipole expansion of charges at rest; Approximate potentials at large distances; Monopole and dipole terms; Origin of coordinates in multipole expansion, Electric field of a dipole. Polarization, Dielectrics; Induced Dipoles and alignment of polar molecules; Field of a polarized object; Bound charges, Physical Interpretation; Field inside a dielectric; Gauss's Law in the presence of Dielectrics, relation between P, E, D. Boundary conditions, Boundary value problems with linear dielectrics.

Unit-III

Review of Biot-savart and Ampere's laws; Magnetic vector potential; Magnetostatic boundary conditions and multipole expansion of the vector potential; Field of a magnetized object; Bound currents and physical interpretation; Ampere's law in magnetized materials; Magnetic susceptibility and permeability. Review of Faraday's law and induced electric field; Energy in magnetic fields.

Unit-IV

Electrodynamics before Maxwell; Maxwell's equations; Magnetic charge; Maxwell's equation in matter; Boundary conditions. Continuity Equation; Poynthing's Theorem; Electromagnetic waves in one dimension; Wave equation; Sinusoidal waves; Boundary conditions; Reflection and transmission; Polarization, Electromagnetic waves in vacuum; Wave equations for E and B, Monochromatic plane waves; Energy and momentum in electromagnetic waves.

Text Book:

Introduction to Electrodynamics by David J. Griffiths, Printice-Hall, India.

References:

1. E.M.Purcell, 'Electricity and Magnetism' Berkley Physics Course Vol.2 McGraw Hill Pub. Ltd. New Delhi.
2. Panofsky and Phillips: Classical electricity and magnetism (India Book House).
3. Feynman Lectures in Physics Vol II, (Pearson Publications)

Syllabus for Physics
Effective from academic session-2016
Semester 3rd
Thermodynamics and Statistical Physics

Semester-III	Max. Marks : 100
Subject Code: PHY15UG03	Internal: 20, External: 80
No. Of Credits: 04	Min. Pass Marks: 40 (08+32)

Unit-I

Molecular collisions; Mean free path and collision cross section; Transport Phenomenon: transport of momentum, mass and energy and their inter-relationship; Brownian motion; Einstein's theory. Deviation from perfect gas behaviour (Liquification of CO_2), van der Waals' equation of state, Nature of van der Waals forces, comparison with experimental results, Critical constants. Joule's expansion of ideal gas and of van der Waals gas; Joule coefficient, Estimates of J-T cooling.

Unit-II

Concept of thermal equilibrium; Internal energy; Carnot theorem; Entropy; Principle of increase of entropy; Thermodynamic scale of temperature and its identity with the perfect gas scale; Third law of thermodynamics. Thermodynamic variables; Extensive and Intensive; Maxwell's general relationship; Equilibrium between phases; Equilibrium condition and Clausius-Clapeyron equation; Phase transformation of a simple substance; Approximate calculation of vapour pressure; Phase transformation and the equation of state.

Unit-III

Thermodynamic potentials and equilibrium of thermodynamical systems; Relation with thermodynamical variables Probability and Thermodynamic probability; Probability distribution. Expressions for average properties; Constraints; Accessible and inaccessible states; Distribution of particles with a given total energy into discrete set of energy states; Microstates and macrostates

Unit-IV

Boltzmann Entropy relation; Statistical interpretation of the second law of thermodynamics; Boltzmann Canonical distribution law ; Partition function, Partition function of an ideal monoatomic gas; The rigorous form of Equipartition of energy;Maxwell-Boltzmann; Fermi-Dirac and Bose-Einstein Statistics (Derivation of distribution laws in each case). Maxwell's velocity distribution, distribution of speeds; Mean values.

Courses of Study B. Sc. (Semester System) 2015-2017
Subject: Physics

Waves and Optics

Semester-IV
Subject Code: PHY15UG04
No. Of Credits: 04

Max. Marks : 100
Internal: 20, External: 80
Min. Pass Marks: 40
(08+32)

Unit-I

The wave equation, general solution of one dimensional wave equation; Harmonic waves; Standing waves on a string of fixed length; Energy of a vibrating string The wave equation for longitudinal waves on a thin cylindrical rod; Energy density and energy transmission in waves; Application to Earthquakes. Standing waves on a stretched rectangular membrane: solution by method of separation of variables; normal modes of vibrations.

Unit-II

General Theory of Image Formation: Cardinal Points of an optical system, general relationships, thick lens formula and lens combination, langrange equation of magnification.
Abberations: Chromatic and monochromatic abberations and their reductions. Corrector plates.

Unit-III

Review of Interference of light; Interference in thin parallel films; Application to Non-reflecting films, Newton rings; Michelson interferometer and its application for precision determination of wavelength; Multiple beam interference; Fabry-Perot interferometer and etalon; Intensity distribution. Fraunhofer diffraction at a slit; the intensity distribution; Two slit diffraction pattern; The intensity distribution.

Unit-IV

Diffraction at N parallel slits; intensity distribution at an N parallel slits. Resolution of images; Rayleigh criterion; Resolving power of a diffraction grating. Frensel half-period zones; The Zone-Plate; Diffraction at a circular aperture; Diffraction by a straight edge (analysis using half-period zones). Polarization by reflection, Malus's law; Double refraction; Refraction in Uniaxial crystals; Optical activity; Rotation of plane of polarization; Origin of optical rotation in liquids and in crystals.

Text Books:

1. H.J. Pain " The Physics of Vibrations and Waves", (John Wiley & Sons Ltd.)
2. Optics by A. K. Ghatak (TataMcgraw-Hill)

References:

1. Jenkins and White, "Fundamental of Optics", (McGraw Hill)
2. Berkley Physics Course, Vol III, "Waves and Oscillations".

Courses of Study B. Sc. (Semester System) 2015-2017
Subject: Physics

Quantum and Nuclear Physics

Semester-V
Subject Code: PHY15UG05
No. Of Credits: 04

Max. Marks : 100
Internal: 20, External: 80
Min. Pass Marks: 40
(08+32)

Unit-I

Black body radiation; Planck's radiation law; Photoelectric effect; Compton Effect.
Pair Production. De-Broglie's matter wave; The concept of wave packets and group velocities; Heisenberg's uncertainty relation for p and x; Its extension to energy and time; Applications of uncertainty principle

Unit II

Schrödinger's wave equation (Time independent form); linearity and superposition; Expectation values; operators; Particle in a box; Finite potential well; Potential Barrier, Tunnel effect. Quantum numbers (n, l, m) for an electron in hydrogen atom; Space quantization; Electron probability density

Unit III

Electron spin; Stern-Gerlach experiment; Pauli's exclusion principle; Symmetric and anti-symmetric wave functions; Atomic structures (shells and sub-shells); Spin-orbit coupling; Total angular momentum **J**, L-S coupling; j-j coupling; Normal and anomalous Zeeman Effect; Lande g-factor. Quantization of rotational energies; Rotational energy levels; Pure rotational spectra; Vibrational energy levels, pure vibrational spectra; Rotation-Vibration spectra of diatomic molecules.

Unit IV

Nuclear composition; Nuclear properties (size, spin, magnetic moment), Stable Nuclei (Nuclear decay, Binding energy), Liquid drop model, Meson theory of nuclear forces. Gammow Theory of Alpha decay (no derivation), Pauli theory of beta-decay , gamma decay, Nuclear Reactions and Cross Section. Interaction and particles; Classification; Leptons and hadrons, Elementary particle quantum numbers; Baryon, lepton and strangeness numbers; Quarks; colour, flavour, Quark confinement.

Text Book:

Concepts of Modern Physics by Arthur Beiser, (Tata McGraw Hill).

References:

1. Introductory Nuclear Physics, Kenneth S. Krane, 3rd Ed. , Wiley.
2. Mani and Mehta, Modern Physics (TatMcgraw-Hill)

Courses of Study B. Sc. (Semester System) 2015-17
Subject: Physics

Solid State Physics and Electronics

Semester-VI
Subject Code: PHY15UG06
No. Of Credits: 04

Max. Marks : 100
Internal: 20, External: 80
Min. Pass Marks: 40
(08+32)

Unit-I

Bravais lattice and seven crystal systems; Reciprocal Lattice. Elastic waves, density of states of continuous medium; Specfic heat; Einstein and Debye models; Lattice waves; One-dimensional monoatomic lattice; Density of states of a lattice; The concept of Phonons, Quantum mechanical free electron gas; Electrical conductivity; Electrical resisitivity versus temperature; Heat capacity of conduction electrons.

Unit-II

The Fermi surface; Electrical conductivity (effects of the Fermi surface); Thermal conductivity in metals. Electrons in one dimensional periodic potential; Kronig-Penney model; Concept of Brillouin zones; Explanation of energy bands on the basis of Brillouin zones; Metals, insulators and semiconductors. Band structure; Intrinsic semiconductors; Temperature dependence of carrier concentration; Impurity states (acceptor and donor);

Unit-III

Extrinsic semiconductors; The electron-hole concentration product; Electrical conductivity; Temperature dependence; The effect of magnetic field on a semiconductor; The Hall effect.
p-n junction: working (on the basis of energy band diagram); Rectification property; Derivation of rectification equation; The junction transistor, Its working (on the basis of energy band diagram), Tunnel diode.

Unit-IV

Transistor load line; Transistor biasing techniques (Voltage divider); bias stability; Thermal runaway. **h**-parameters; h-parameter equivalent circuit for CE configuration; FET and its characteristics, MOSFET; types and characteristics, applications of MOSFET. Transistor amplifiers, Two-stage RC coupled amplifier; Equivalent circuit at mid-frequency, Gain at mid – frequency; Emitter follower.

Text Books:

3. Elementary Solid State Physics: Principle and applications by M. A. Omar (Pearson Education), 2001.
4. Electronic Devices and Circuit Theory by R. Boylestad and L. Nashelsky (Prentice Hall India)

References:

2 Integrated Electronics by Millman and Halkias Tata McGraw Hill.
3 Introduction to Solid State Physics by Charles Kittel, John Wiley & Sons.