B.Sc. Physics Syllabus for General Course for the session 2006-2009

Semester – I

(A) Mathematical methods and Mechanics (35)

1) Scalars and vectors, laws of vector algebra, dot and cross products, scalar triple product, vector triple product. Scalar and vector fields – gradient, divergence and curl. Statements of Stoke's and Divergence theorem, polar coordinates.

2) Principle of dimensional homogeneity, Newton's laws of motion, principles of conservation of linear momentum, time and path integral of forces, Central forces, conservative force field (gravitational field and calculations of field intensity in simple cases), concept of potential, conservation of total energy, equation of motion of a system with variable mass.

3a) Rotational kinematics and dynamics, equations of rotational motion, kinetic energy of a rotating body, conservation of angular momentum, radial and cross radial acceleration.

3b) Moment of inertia – its physical significance, radius of gyration, parallel and perpendicular axes theorem, calculation of moment of inertia for simple cases (thin uniform rod, rectangular lamina, thin circular disc, flat ring, cylindrical shell, solid cylinder, solid sphere, spherical shell, thin spherical shell), rotational kinetic energy, acceleration of a rolling body down an inclined plane.

(B) General properties of matter (15)

1) Elasticity – Introduction (elastic properties of matter, stress, strain, Hooke's law, different types of modulii of elasticity for isotropic homogeneous bodies), interrelations of elastic moduli, torsion of a

cylinder, internal bending moment, cantilever, bending of beams(beam supported at ends with a concentrated load at the centre), Calculation of strain energy.

2) Surface Tension ─ Introduction (origin of surface tension forces and applications), surface tension and surface energy, molecular theory (property of surface layer), Neumann's triangle, angle of contact, excess pressure over a curved surface, capillarity, Jurin's law, factors affecting surface tension of a liquid.

3) Dynamics of fluids ─ Streamline and turbulent motion, equation of continuity, coefficient of viscosity, critical velocity, Reynold's number, Poiseuille's equation, Stokes law (only statement), terminal velocity, Bernoulli's theorem and applications, Newtonian and non-Newtonian fluids─ an elementary idea.

(C) Heat – I **(12)**

1a) Kinetic theory of gases ─ Introduction, Maxwell's law of velocity distribution (no deduction), most probable speed, rms speed and mean speed. Degrees of freedom, principles of equipartition of energy, application in simple cases.

1b) Equation of State ─ Defects of ideal gas equation, Boyle temperature, Amagat's experiment, Andrew's experiment, critical constants of a gas, Van der Waals equation (no derivation), interrelations between Van der Waals' constants, critical and Boyle temperature, limitations of Van der Waals equation,law of corresponding state, reduced equation of state.

2) Thermal conductivity ─ Introduction to heat transport, steady and variable state ─ approach to equilibrium, Fourier's equation for one dimensional heat flow and its solution.

Semester – II

(A) Optics – I (Geometrical optics) (15)

1) Fermat's principle and its application to simple optical systems. Refraction of light at curved surface, Lens-maker's formula, Cardinal points (basic idea), combination of thin lenses, equivalent focal length.

2) Dispersion and dispersive power, Cauchy's relation, achromatic combination of prisms, prism combination producing dispersion without deviation.
Seidel aberration (qualitative) and its types. Chromatic aberration – longitudinal and lateral chromatic aberration, achromatic combination of lenses, achromatic doublet.

3) Eyepieces – Ramsden's and Huygen's eyepieces.

(B) Heat – II (20)

1) Thermodynamics – Introduction, first law of thermodynamics and its applications, specific heats of a gas, isothermal, adiabatic, isochoric and isobaric processes, indicator diagrams, adiabatic relations for a perfect gas, reversible and irreversible processes, cyclic process. Work done by a perfect gas during isothermal and adiabatic process, Second law of thermodynamics – Clausius and Kelvin statements and their equivalence, Carnot's engine – its operation and calculation of efficiency, Carnot's theorem, thermodynamic scale of temperature, Clausius inequality, entropy, entropy of a perfect gas.

2) Radiation – Introduction, Kirchoff's laws of black body radiation, Stefan's law, Newton's law of cooling. Wein's displacement law, Rayleigh-Jean's law, Planck's law of black body radiation (only statements of the last three laws), Solar constant.

(C) Electrostatics and Electricity – I (28)

1) Quantization of charge, Coulomb's law, potential and field intensity for discrete and continuous charge distribution including electric dipole. Torque on a dipole.

2) Gauss's theorem and its applications (for charged spherical shell, charged solid sphere, charged rod, cylinder, thick conducting plate), field due to electric dipole, mechanical force on surface of a charged conductor.

3) Dielectric medium, polarization, electric displacement. Capacitors ─ parallel plate, spherical and cylindrical capacitors, energy stored by a charged capacitor (parallel plate), force between parallel plates, effect between dielectric in a capacitor.

4) Steady current ─ Network analysis, Kirchhoffs laws, Thevenin, Norton and Maximum power transfer theorems (statements only), applications to simple circuits, current through a galvanometer in an unbalanced Wheatstone's bridge, Meter bridge, Potentiometer.

5)Magnetic effect of current : Biot Savart's law, application for simple cases ─ [straight conductor, circular coil, helmholtz coil, solenoid], Ampere's theorem, Ampere's circuital law (statement only), applications of circuital law [long straight conductor, solid cylinder, circular loop, solenoid, toroid].

Semester – III

(A) Optics II – Physical optics (20)

1) Huygen's principle ─ light as e.m. wave.

2) Interference ─ Concept of spatial and temporal coherence, Young's Double slit experiment, intensity distribution, shapes

of fringes, displacement of fringes due to thin plate, biprism, thin films, Newton's rings.

3) Diffraction ─ Fresnel and Fraunhofer class, Fresnel's half period zones, Zone-plate, diffraction by a circular aperture and disc. Fraunhofer diffraction, Single slit diffraction, plane transmission grating [rotating vector method], absent spectra. Resolving power, Rayleigh's criterion, resolving power of telescope and diffraction grating.

4) Polarisation ─ states of polarization, Brewster's law, double refraction, retardation plate, Polaroid, optical activity, polarimeter.

(B) Electricity II (28)

1) Force on a current carrying conductor in a magnetic field, Lorentz force, action of current on current, torque on a rectangular current loop in a uniform magnetic field, suspended coil galvanometer (dead beat and ballistic mode of operation)

2) Magnetic materials ─ Intensity of magnetization, field due to a magnetic dipole, relation between B,H and M. Magnetic susceptibility, Dia-, para- and ferromagnets, Curie's law (only statement). Hysteresis, hysteresis loss.

3) Electromagnetic induction ─ Introduction, Self and Mutual inductances in simple cases [circular coil,long solenoid, coaxial cylinders, two long parallel wires,toroid]. Non-inductive windings,combination of inductors,energy stored in inductors.

4) Varying currents ─ Growth and decay of currents in L-R circuit, charging and discharging of capacitor in C-R circuit

5) Alternating current ─ Mean and rms values of emf and current with sinusoidal waveform, L-R, C-R and L-C-R series circuits, resonance, Q factor, impedances, reactances, phase angles, power dissipation in a.c. circuits, power factor, vector diagrams. Transformer ─ coupling coefficient, energy loss.

(C) Modern Physics─I **(10)**

1) Basic idea about crystal structures, diffraction of x-rays, Bragg's law, Moseley's law ─ explanation from Bohr's theory.

2) Recapitulation of basic idea in nuclear physics, significance of binding energy curve, preliminary idea of models of nucleus, nuclear reaction, fission and fusion, nuclear reactor.

Semester ─ IV

(A) Vibration and Waves **(16)**

1) Simple harmonic motion ─ Superposition of simple harmonic motion, analytical treatment, Lissajous figures, analytical solution for natural, damped and forced vibration, resonance, sharpness of resonance.

2a) Differential equation of wave motion ─ plane progressive wave, energy and intensity of plane wave.

2b) Superposition of waves ─ stationary waves, beats.

3)Velocity of longitudinal waves in gases, velocity of transverse vibration in stretched strings, sonometer. Doppler effect.

(B) Electronics **(18)**

1) Semiconductor diodes ─ Introduction, depletion region, junction capacitance, biasing, bridge rectifier, filters. Zener diode ─ characteristics and voltage regulation.

2) Transistor ─ Modes of operation, output characteristics of CE mode, α and ß, single stage CE amplifier.

3) FET, MOSFET and IC ─ elementary idea about basic features.

4a) Binary number system ─ a recapitulation

4b) Logic gates ─ AND, OR, NOT gates using diodes/transistor, De-Morgan's laws, NOR, NAND,XOR gates.

(C) Modern Physics ─ II **(18)**

1) Special theory of relativity ─ Postulates, Lorentz transformation (no deduction), length contraction, time dilation, velocity addition, mass variation, mass-energy equivalence.

2)Planck's theory of radiation (only statement), review of photoelectric effect, Compton, Zeeman and Raman effects. Wave particle duality, De-Broglie's wave, Heisenberg's uncertainty principle.

3) Schrödinger's equation, particle in one dimensional infinite well, energy eigenvalues, wave function, probabilistic interpretations.

B.Sc. Physics (General) Syllabus for 3 rd. year

Semester – V & VI

Theory : Marks – 70
Practical : Marks - 30

(A) Electronics **(31)**

1) Loadline analysis of transistor & transistor biasing. Feedback -negative and positive feedback, Barkhausan criterion, oscillator, OPAMP – characteristics, uses of OPAMP as amplifier, oscillator and filter,
Light emitting diodes, seven segment display. (18)

2) Digital electronics : Combinational circuits - adder, subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits - Flip-flops D and J-K, registers and counters. (8)

3) Instruments : Cathode ray Oscilloscope. Digital multimeter, L and C measurements. (5)

(B) Computer **(25)**

1) Computer hardware : basic building blocks, central processing units; memory-hard disc, RAM, ROM, floppy, CD-ROM; memory units – bits and bytes, input-output devices. Computer software : Operating systems (OS), DOS, UNIX, Windows. (7)

2) Programming in C : basic structure, character set, keywords, identifiers, constants, variables, type declaration, operators – arithmetic, rational, logical, assignment, increment, decrement, operator precedence and associativity, arithmetic expression, evaluation and type conversion character I/O, escape sequence and formatted I/O, branching and looping, if , if-else, while, do-while, for, arrays – one and two dimensional. (8)

OR

Programming in FORTRAN : constants, variables, arrays; DIMENSION-type statements ; arithmetic expressions, input and output statements; control statements – jumping, branching and looping. (8)

3) Tutorial classes on Programming in C or FORTRAN. (10)

(C) Thermodynamics (8)

Heat engines, thermal efficiency, indicated Horse-power, Break Horse-power, Otto cycle, Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison. (8)

(D) Energy sources (16)

1) Conventional energy sources : Thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro electric power plant – basic principle. (8)

2) Non-conventional energy sources : Solar, wind, tidal, geothermal & bio-gas sources, elementary ideas of production and uses. (8)

(E) Communication (20)

1) Propagation of electromagnetic waves in atmosphere, various layers of atmosphere – ground and sky waves. (4)

2) Transmission of electromagnetic waves – amplitude and frequency modulation, calculation of power in amplitude modulation, sideband generation in frequency modulated wave; demodulation – linear diode detector, detection in FM waves, signal to noise ratio. (10)

3) Transmission through media : coaxial cables, optical fibre cladding, energy loss, band width and channel capacity, information carrying capacity of light waves (qualitative); satellite communication, microwave link, modem and internet. (6)

Practical Paper : Experiment - 20
Project report – 5
Viva – 5

Experiments :

1) To convert a given ammeter to a voltmeter and a given voltmeter to an ammeter. To calibrate the instrument and to measure the internal resistance of it in each case.

2) To construct an adjustable voltage power supply using IC and to study its regulations.

3) To measure the internal resistance of an analog voltmeter and to increase its internal resistance by using an OPAMP.

4) To use OPAMP as inverting, non-inverting, differential amplifier and as an adder.

5) To calibrate a given temperature sensor and to use the sensor to control the temperature of a heat bath.

6) To develop a photosensor using a phototransistor followed by an amplifier and to use the same to control the switching of a bulb.

7) To familiarize with the operating system and to solve simple problems by programming in C or FORTRAN as per theoretical syllabus.

8) To use database package and word processor.