Presidency University
Kolkata

Syllabus for

Three Year Honours Degree Course
And
Extra-Departmental Course of Studies
(Semester System)

Subject: PHYSICS

May, 2011

HONOURS (Six Semesters)

Semester-1: **Physics Major-1(50 marks)**
Unit-A (25 Marks): Mathematical Methods-I
Unit-B (25 Marks): Classical Mechanics-I
Physics Major Practical-1(50 Marks)

Semester-2: **Physics Major-2(50 marks)**
Unit-A (25 Marks): Mathematical Methods-II
Unit-B (15 Marks): Thermal Physics-I
Unit-C (10 Marks): Geometrical Optics
Physics Major Practical-2(50 Marks)

Semester-3: **Physics Major-3(50 marks)**
Unit-A (25 Marks): Electronics-I
Unit-B (25 Marks): Mathematical Methods-III
Physics Major-4(50 marks)
Unit-A (25 Marks): Electrostatics
Unit-B (25 Marks):Magnetostatics
Physics Major Practical-3(50 Marks)

Semester-4: **Physics Major-5(50 marks)**
Unit-A (25 Marks): Electronics-II
Unit-B (25 Marks): Waves & Optics
Physics Major-6(50 marks)
Unit-A (25 Marks): Electromagnetic Theory
Unit-B (25 Marks): Thermal Physics-II
Physics Major Practical-4(50 Marks)

Semester-5: **Physics Major-7(50 marks)**
Unit-A (25 Marks): Quantum Mechanics-I
Unit-B (25 Marks): Atomic & Molecular Physics
Physics Major-8(50 marks)
Unit-A (25 Marks): Classical Mechanics-II
Unit-B (25 Marks): Special Theory of Relativity
Physics Major-9(50 marks)
Unit-A (25 Marks): Solid State Physics-I
Unit-B (25 Marks): Nuclear & Particle Physics-I
Physics Major Practical-5(50 Marks)
Physics Major Practical-6(50 Marks)

Semester-6: **Physics Major-10(50 marks)**
Unit-A (25 Marks): Quantum Mechanics-II
Unit-B (25 Marks): Statistical Mechanics
Physics Major-11(50 marks)
Unit-A (25 Marks): Electronics-III
Unit-B (25 Marks): Continuum mechanics and non-linear dynamics
Physics Major-12(50 marks)
Unit-A (25 Marks): Solid State Physics-II
Unit-B (25 Marks): Nuclear and Particle Physics-II
Physics Major Practical-7(50 Marks)
Physics Major Practical-8(50 Marks)

THEORY

SEMESTER-I
Physics Major-1
Unit- A: Mathematical Methods-I **Lectures:25+7(Tutorial)**

Calculus of Several variables: **[5]**
Continuity, derivative, Taylor's expansion, multiple integral, maxima & minima.

Transformation Properties of vectors: **[2]**
Co-ordinate transformations, definition of vectors & Tensors, Product of vectors.

Vector Calculus: **[10]**
Differentiation and integration of vectors with respect to a parameter, Vector fields, line integrals, conservative fields and potential, surface integrals, volume integrals, integral forms for gradient, divergence and curl, the divergence theorem, Stokes' theorem, Green's theorem with simple applications to physical problems. Orthogonal curvilinear co-ordinate systems: co-ordinate curves, scale factors, gradient, divergence & curl in curvilinear co-ordinates: Velocity & acceleration.

Matrices & linear vector spaces: **[8]**
Vector spaces – basis vectors, inner product & some useful inequalities. Linear operators, Matrices, Complex & Hermitian conjugate of a matrix, some special types of matrix – diagonal, triangular, symmetric and anti-symmetric, orthogonal, Hermitian & anti-Hermitian, unitary & normal, Eigenvectors and Eigenvalues. Change of basis and similarity transformations, Diagonalization of matrices. Quadratic and Hermitian forms.

Unit- B: Classical Mechanics-I **Lectures:25+7(Tutorial)**

Mechanics of single Particle **[9]**

Kinematics in 3D, velocity and acceleration of a particle in plane polar coordinates - radial and cross-radial components, Simple applications, Conservative forces & concept of potential; Conservation principles, Variable mass problems.

Mechanics of a system of Particles **[6]**

Linear momentum, angular momentum and energy, Centre of mass decomposition; Equations of motion, conservation principles, Two body system, Collision problems.

Rotational Motion **[10]**

Rotational motions of rigid bodies, Energy and angular momentum of rotating rigid bodies, Ellipsoid of inertia and inertia tensor, Moment of inertia, Calculation for simple symmetric bodies. Parallel and perpendicular axes theorems, setting up of principal axes in simple symmetric cases.

SEMESTER-II

Physics Major-2

Unit-A: Mathematical Methods-II **Lectures:25+7(Tutorial)**

Infinite sequences and series: **[5]**

convergence and divergence, conditional and absolute convergence, ratio test for convergence, Integral test.

Ordinary Differential equation: **[20]**

Differential equations of first order & first degree, Linear First order ODE, Inexact equation, Integrating factor, higher order ODE. Homogeneous linear equation with constant coefficients – application to an oscillating pendulum. Non-homogeneous linear differential equations with constants coefficients – applications to LCR circuits & other mechanical systems. Resonance phenomena. Series solution of ODE – the power series method, ordinary points and singular points of differential equation. Series solutions about an ordinary point – Legendre's equation. Series solutions about a regular singular point. Bessel equation.

Unit-B: Thermal Physics-I **Lectures:15+4(Tutorial)**

Kinetic Theory **[7]**

Basic assumptions of kinetic theory, Ideal gas approximation, deduction of perfect gas laws.Virial theorem and deduction of equation of state of ideal gas. Maxwell’s distribution law, Root mean square and most probable velocities. Finite size of molecules: Collision probability, Distribution of free paths and mean free path from Maxwell’s distribution. Degrees of freedom, Equipartition of energy and its applications.

Transport Phenomena **[4]**

Viscosity, thermal conduction and diffusion in gases. Random walk. Brownian Motion: Fluctuation – dissipation phenomena. Langevin equation. Einstein-Smoluchowski equation, Perrin's experiment:

Real Gases **[4]**

Nature of intermolecular interaction: isotherms of real gases. Van der-Waals equation of state. Critical constants of a gas, law of corresponding states; Virial Coefficients, Boyle temperature.

Unit-C: Geometrical Optics **Lectures:10+3(Tutorial)**

Fermat Principle **[2]**

Fermat's principle and its application to plane and curved surfaces.

Matrix Method **[6]**

Vergence. Paraxial approximation, introduction to matrix methods in paraxial optics – simple application.Two thin lenses separated by a distance, equivalent lens, Thick lens: different types of magnification, Helmholtz - Lagrange equations, Cardinal points of an optical system.

Seidel & chromatic aberrations. **[2]**

Elementary discussions.

SEMESTER-III

Physics Major- 3:

Unit-A: Electronics-I **Lectures:25+7(Tutorial)**

Basic Network Analysis **[5]**

Thevenin's Theorem, Norton's theorem, principle of superposition principle, T and Π network (star and delta), maximum power transfer theorem.

Semiconductor Diodes **[5]**

Semiconductors: intrinsic and extrinsic, p-type and n-type semiconductors, p-n junction, energy band diagram, forward and reverse bias, current-voltage characteristics, Zener breakdown, avalanche breakdown, Zener diode and its applications. Rectifier circuits: half wave and full wave, peak inverse voltage, dc and rms voltage and current, ripple factor, efficiency, idea of regulation.

Bipolar junction transistor **[5]**

p-n-p and n-p-n structures; α and β and their interrelation, input and output characteristics, cut-off, active and saturation regions, biasing and bias stability, load line and Q-point, low frequency model. Introduction to high frequency model, common-base, common-emitter and common-collector amplifiers, introduction to h parameters.

Field Effect Transistors **[5]**

Types of FET, construction of junction FET, output characteristics, biasing, operating region, pinch-off voltage, MOSFET: enhancement and depletion type, construction, principle of operation and characteristics, common-source amplifier, elementary idea on CMOS, MOS inverter.

Digital electronics **[5]**

Decimal, binary and hexadecimal numbers, binary arithmetic, Boolean algebra, logic gates: OR, AND, NOT, NAND, NOR and exclusive-OR, universal gate, de-Morgan's theorems, 1's and 2's complement, Boolean simplifications, sum-of-product and product-of-sum form, Karnaugh map.

Unit-B: Mathematical Methods-III **Lectures:25+7(Tutorial)**

Fourier Series: **[5]**

Fourier series as eigenfunction expansions, sine & cosine series. Complex Fourier series and the Dirac δ function.

Fourier Transform: **[5]**

FT & PDE – the case of a diffusion equation.

Partial Differential Equations: **[15]**

Classification of PDEs, Some examples of PDEs, Solution of PDEs with separation of variables and eigenfunction expansions. Boundary and initial conditions – vibrations of a string. Laplace's equation and its solution in cartesian, spherical polar with axially symmetric coordinate system and cylindrical polar with infinite cylinder coordinate system. Solution 1D & 2D wave equations, Solution of heat conduction equations in 1D.

Physics Major- 4:

Unit-A: Electrostatics **Lectures:25+7(Tutorial)**

Field, Potential, Gauss' Law **[8]**

Coulomb's law, Superposition principle, Intensity & potential. Potential and field due to different charge distribution. Gauss law and its application. Earnshaw's theorem.

Multipole Expansion **[4]**

Potential.and field due to a dipole, Force & torque on a dipole in an external field. Dipole-dipole interaction, Multipole Expansion for bounded charge distribution.

Dielectrics **[6]**

Polarization and charge density. Molecular polarizablility. Electric displacement vector. Electric field in cavities of dielectrics. Electrostatic energy.

Laplace equation & Electrical Images **[7]**

Possion and Laplace equation, Boundary conditions, Uniqueness Theorem. Boundary value problems with the help of Electrical images.

Unit-B: Magnetostatics **Lectures:25+7(Tutorial)**

Magnetic effect of steady current, Vector Potential **[12]**

Equation of continuity and steady current. Lorentz force and concept of magnetic induction; force on linear current element; Biot-Savart's law, Ampere's circuital law. Magnetic vector potential; calculation of vector potential and magnetic induction in simple cases. Vector potential due to closed current loop - magnetic dipole term; Field due to a dipole; Concept of magnetic shell; Magnetic dipole moment for rotating charge bodies, Gyro-magnetic ratio, Force & torque on a magnetic dipole.

Field and magnetic materials **[7]**

Free current and bound current; surface and volume density of current distribution; magnetisation; non-uniform magnetisation of matter; Introduction of **H**; Magnetostatic boundary conditions. Magnetic scalar potential; Field due to uniformly magnetized sphere. Hysteresis and iron loss.

Electromagnetic Induction **[6]**

Faraday's and Lenz's law. Motional e.m.f.-simple problems. Calculation of self and mutual inductance in simple cases. Energy stored in magnetic field. Energy of a magnetic dipole.

SEMESTER-IV

Physics Major- 5

Unit-A: Electronics-II **Lectures:25+7(Tutorial)**

Amplifiers and Oscillators **[10]**

Voltage and current amplifiers, principle of feedback, positive and negative feedback, advantages of negative feedback, multistage amplifier, R-C coupled amplifier: frequency response, gain and bandwidth, class A, class B and class C amplifiers, tuned amplifier, push-pull amplifier, power amplifier. Barkhausen criterion for sustained oscillation, Hartley and Colpitts oscillators, Wien bridge oscillator, crystal oscillator, relaxation oscillators: astable, monostable and bistable multivibrators.

Operational Amplifier **[5]**

Properties of ideal operational amplifier, differential amplifier, common-mode rejection ratio, inverting amplifier (voltage shunt feedback) and non-inverting amplifier (voltage series feedback), voltage follower, performing mathematical operations: adder, subtractor, multiplier, integrator, differentiator, comparator, Schmitt trigger.

Combinational and Sequential Logic Circuits **[10]**

Half adder, full adder, digital comparator, multiplexer, demultiplexer, decoder, encoder, diode ROM, flip-flops: RS, D, JK, JK master-slave, use of clock pulse, shift register, counter, digital-to-analog and analog-to-digital converters.

Unit-B: Waves & Optics **Lectures:25+7(Tutorial)**

Interference of Light **[10]**

Young's experiment, spatial and temporal coherence, intensity distribution. Fresnel's biprism. Lloyd's mirror. Interference in thin film, fringes of equal inclination and equal thickness, Newton's ring, Michelson's interferometer. Multiple beam interference – reflected and transmitted pattern, Fabry-Perot interferometer.

Diffraction of Light **[8]**

Fresnel and Fraunhoffer class, Fresnel's half period zones, explanation of rectilinear propagation of light, circular aperture, zone plate. Fraunhofer diffraction due to a single slit, double slit, Transmission grating. Rayleigh criterion of resolution, Resolving power of optical system.

Polarization of Light & Anisotropic Medium **[7]**

Different states of polarisation; double refraction, Huygen's construction for uniaxial crystals; Production and analysis of plane, circularly and elliptically polarised light by retardation plates and rotatory polarisation and optical activity; Fresnel's explanation of optical activity.

Physics Major- 6

Unit-A: Electromagnetic Theory **Lectures:25+7(Tutorial)**

Maxwell's Equations & Electromagnetic Waves **[10]**

Displacement Current, Maxwell's Equations in vacuum in presence of source charges and currents, plane wave solutions, energy & momentum relations in electromagnetic field - Poynting's theorem, Scalar & vector potentials, gauge transformation, Maxwell's Equations in linear isotropic media, Wave equation, transverse nature, boundary conditions. Wave equation in conducting medium.

Reflection and refraction at plane boundary **[9]**

Reflection and transmission coefficients, Fresnel's formula, change of phase on reflection, polarization on reflection and Brewster's law, total internal reflection.

Reflection and transmission at metallic surface –skin effect and skin depth, propagation of E-M waves between parallel and conducting plates – wave guides (rectangular only).

Dispersion & Scattering **[6]**

Equation of motion of an electron in a radiation field : Lorentz theory of dispersion – normal and anomalous; Sellmeier's and Cauchy's formulae, absorptive and dispersive mode, half power frequency, band width.

Scattering of radiation by a bound charge. Rayleigh's scattering & blueness of the sky.

Unit-B: Thermal Physics-II **Lectures:25+7(Tutorial)**

Laws of Thermodynamics **[9]**

Thermodynamic descriptions of a system, concept of equilibrium and its temporal nature, isolated systems, internal energy, zeroth law and its importance, heat, first law and its consequences, reversible and irreversible process, Carnot engine, second law of

thermodynamics, Heat engine & refrigerator principles, Clausius inequality, entropy, thermodynamic scale of temperature, entropy principle, calculation of entropy change in simple cases, entropy change in mixing of gases.

Thermodynamics Functions **[8]**

Enthalpy, Helmholtz and Gibbs free energy, Maxwell relations and their uses, Radiation as a thermodynamic system, conditions of equilibrium, energy minimum and entropy maximum principle, stability of thermodynamics systems, conditions on thermodynamic potentials, physical consequences of stability.

Change of phases **[8]**

First order phase transition in a single component system, thermodynamic potential with multiple minima, variation of Gibbs function and its discontinuity, Clapeyron's equation, unstable isotherms and Maxwell's construction, multi-component systems and phase rule (qualitative only), critical phenomenon, order parameter and critical exponents.
Third law of thermodynamics and its consequences.

SEMESTER-V

Physics Major- 7

Unit-A: Quantum Mechanics-I **Lectures:25+7(Tutorial)**

Historical development of Quantum Mechanics **[5]**

Planck's formula of black-body radiation. Compton effect, de Broglie hypothesis. Electron double-slit experiment, Davisson-Germer experiment, Heisenberg's uncertainty principle (statement) with illustrations, Photon polarization.

Basics of quantum mechanics **[10]**

Concept of wave function as describing the dynamical state of a system, wave packets, Group and phase velocities, classical velocity of a particle and the group velocity of the wave representing the particle. Principle of superposition, Schrodinger equation. Probabilistic interpretation; equation of continuity, probability current density. Boundary conditions on the wave function, Properties of the solutions of Schrodinger equation, time dependent and time independent Schrodinger equation, stationary states, spreading of wave packet.

Postulates of quantum mechanics **[10]**

Dynamical variables as linear hermitian operators, properties of hermitian operators, eigenvalue equations, Momentum, energy and angular momentum operators. Measurement of observables, expectation values. Ehrenfest theorem, Commutation relations between operators. Compatible observables and simultaneous measurements, Eigenfunction expansion, free particle & Infinite square well potential problem.

Unit-B: Atomic & Molecular Physics **Lectures:25+7(Tutorial)**

Atomic Spectra **[5]**

Spectrum of light, Bohr model for hydrogen like ions, experimental evidences, Rydberg atoms, Franck-Hertz experiment and its improvements, Bohr-Sommerfeld quantization, spectra of alkali atoms.

Vector Atom Model **[8]**

Magnetic moment of an electron for orbital motion, space quantization, Stern-Gerlach experiment, electron spin, vector model, Lande g factor, interpretation of Stern-Gerlach experiment, doublet lines of alkali spectra, spin-orbit interaction, Zeeman effect (normal & anomalous), Paschen-Back effect.

Many Electron Atoms **[4]**

Helium spectra, LS and JJ coupling, Pauli exclusion principle, Hund's rules, equivalent and non-equivalent electrons.

Molecular spectra **[5]**

Diatomic molecules-rotational and vibrational levels, basic ideas about molecular spectra, Raman Spectra.

Laser Physics **[3]**

Population inversion, Einstein's A, B coefficients, feedback of energy in a resonator, three level and four level systems.

Physics Major- 8

Unit-A: Classical Mechanics-II **Lectures:25+7(Tutorial)**

Central Force **[5]**

Motion under a central force, Nature of orbits – detailed discussion for the case of attractive inverse-squared force field, Stability of orbits, Kepler's laws of planetary motion.

Non-inertial frames of reference **[5]**

Non-inertial frames of reference - Coriolis and centrifugal forces, simple examples, Foucault's Pendulum, Euler's equation of motion for a rigid body, simple applications.

Lagrangian and Hamiltonian formulation of Classical Mechanics **[15]**

Generalised coordinates, Constraints and degrees of freedom, D'Alembert's principle, Derivation of Lagrange's equation for conservative, holonomic systems from D'Alembert's principle and from the variational principle, Generalised momentum, cyclic coordinate and conservation principle, Definition of Hamiltonian, Hamilton's equation and its application to simple cases, Canonical transformations and Poisson brackets.

Unit-B: Special Theory of Relativity **Lectures:25+7(Tutorial)**

Basic Development & Principle of Relativity **[11]**

Inertial frame, Galilean covariance of Newton's second law, inconsistency with electro magnetic theory, interpretation of null results of Michelson-Morley experiment.

Postulates of special theory of Relativity, definition of interval, Minkowski space-time diagram, Lorentz transformation in (1+1) and (3+1) dimension for standard configuration, basic features: simultaneity, time dilation, space contraction. Transformation of velocity and acceleration. Fizeau's experiment.

4-Vector formulism **[14]**

Lorentz 4-vector notation, invariance of metric, Boost and rotation, light cone, time-like, space-like & light-like interval.

4-velocity, energy & momentum of a particle, 4-momentum for massive & massless particle, aberration & Doppler Effect.

Physics Major-9

Unit-A:Solid State Physics-I **Lectures:25+7(Tutorial)**

Crystal Structure of Solids **[8]**

Crystalline periodicity, crystal symmetry, Bravais lattices, position, directions and planes in crystals. Simple lattice, Close-packed structures & Reciprocal lattice.

The Bragg diffraction law, Laue condition of X-ray diffraction, determination of crystal structure with X-rays.

Bonding in Solids **[2]**

Different types of bonding – ionic, covalent, metallic, van der Waals & hydrogen type.

Energy band Structure **[9]**

Periodic potential in a crystalline solid, Bloch theorem, Kroning-Penny model and the formation of energy allowed and forbidden energy gaps, number of electrons in a band, reciprocal effective mass tensor of electrons. Electrons and holes. Metals, insulators and semiconductors.

Free Electron Theory of Metals **[6]**

Relaxation time, mean free path, mobility and thermal conductivity. Drude model – electrical conductivity. Wiedemann-Franz-Lorentz relation. Hall effect in metals.

Unit-B: Nuclear & Particle Physics-I **Lectures:25+7(Tutorial)**

Nuclear Structure & Properties **[15]**

Nuclear mass, charge, size, shape, binding energy, spin and electric/magnetic moment. Neutron and proton-rich nuclei.

N-Z chart of nuclei, Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model and the Bethe-Weizsacker mass formula, application to stability considerations, extreme single particle shell model (qualitative discussion with emphasis on phenomenology with examples), Magic numbers. Prediction of spin-parity.

Unstable Nuclei: α, β & γ - decay **[10]**

(a) Rutherford Scattering, Geiger-Nuttal law, alpha particle spectra – fine structure, long range alpha particle, straggling, alpha decay problem.

(b) Nature of beta ray spectra, the neutrino, energy levels and decay schemes, positron emission and electron capture, Q-values, selection rules (Fermi & Gamow –Teller), Kurie plot.

(c) Gamma ray spectra and nuclear energy levels, isomeric states. Gamma absorption in matter.

SEMESTER-VI
Physics Major-10
Unit-A: Quantum Mechanics-II **Lectures:25+7(Tutorial)**

Simple Applications of Quantum Mechanics [8]
Finite potential well, potential step, Delta function potential, rectangular barrier.

Linear Harmonic Oscillator [4]
Quantised states, Quantisation by operator method.

Hydrogen Atom Problem [10]
Central force problem in quantum mechanics, reduction to one dimensional problem. Angular momentum-Eigen values and Eigen functions, Concept of spin, bound states of hydrogen atom, concept of scattering states.

Symmetry and Conservation Principle [3]
Energy, linear & angular momentum, parity.

Unit-B:Statistical Mechanics **Lectures:25+7(Tutorial)**

Statistical description of thermodynamic systems [5]
Basic thermodynamics and its limitations. Microstates & Macrostates, Concepts of statistical equilibrium, Statistical definitions of temperature & entropy. Isolated system, equal a priori probability.

Statistical ensembles [3]
Microcanonical ensembles, Applications of equal a priori probability, Thermal equilibrium and canonical ensembles, Gibbs distribution, Partition function as a generating function of all thermodynamic quantities.

Developments & Applications of Classical Statistical mechanics [7]
Equipartition of energy, examples. Applications of Gibbs distribution in noninteracting spin systems. Ideal gas, equation of state, energy, specific heat. Maxwell-Boltzmann distribution. Entropy of ideal gas. Gibbs paradox.

Developments & Applications of Quantum Statistical mechanics [10]
Spin dependent Quantum states of system of particles, Fermi-Dirac statistics, Fermi energy, average energy at T=0. Electronic specific heat at nonzero finite (low) temperature. Simple applications in spin paramagnetism, electrical conductivity, thermo-ionic emission. Bose-Einstein statistics, Black body radiation, Bose-Einstein condensation.

Physics Major-11

Unit-A: Electronics-III **Lectures:25+7(Tutorial)**

Communication Principles **[6]**

Modulation and demodulation: elementary theory of amplitude modulation, frequency modulation and phase modulation, demodulation of amplitude-modulated wave (diode detector) and frequency modulated wave (slope detector).

Instrumentation **[5]**

Cathode ray oscilloscope (CRO): cathode ray tube, electron emission mechanism, deflection system, fluorescent screen, vertical and horizontal amplifiers, time base, display of the waveform, measurement of voltage, frequency and phase with CRO, Lissajous figures, principle of digital multimeter.

Fibre Optics **[5]**

Optical fibre - core and cladding, step index and graded index fibres, communication through optical fibres, Dispersion, energy loss, bandwidth and channel capacity.

Basics of IC Technology **[3]**

Advantages and limitations of IC, introduction to bulk and epitaxial crystal growth, photolithography, diffusion and ion implantation techniques for doping.

Introduction to Microprocessor **[6]**

Arithmetic logic unit, block diagram of 8085, registers, data and address bus, types of instructions, op-code, addressing modes, timing and control signals, memory interfacing, brief idea on microprocessor programming.

Unit-B:Continuum mechanics and non-linear dynamics Lectures:25+7(Tutorial)

Small Oscillations **[7]**

Lagrangian of oscillating systems. Secular equation and its solution, normal coordinates and modes.

Continnum mechanics **[18]**

Stress and strain tensors, conditions of equilibrium, Hooke’s law & strain energy function, generalized Hooke’s law, isotropic solid, simple cases of strain, stress & equation of motion, dynamics of elastic bodies, Propagation of wave in a elastic medium, Newtonian and non-Newtonian fluids, perfect fluid, Euler's equation of fluid motion, Bernoulli's theorem and its applications, uniplanar motion of incompressible fluid, vorticity, conservation equation, Imperfect fluids, Navier-Stokes equation, Derivation of Poiseuille’s equation.

Physics Major-12

Unit-A: Solid State Physics-II **Lectures:25+7(Tutorial)**

Dielectric Properties of Solids: **[6]**

Static dielectric constant of solids, dipole moment and polarization, types of polarization – electronic, ionic and orientational polarizations. Internal fields of solids. Clausius-Mosotti relation.

Magnetic Properties of Solids: **[12]**

Magnetic susceptibility, Diamagnetism of core electrons. Paramagnetism. Langevin equations for dia & paramagnetism. Curie's law. Quantum theory of paramagnetism (for S=1/2 system). Spontaneous magnetization and ferromagnetic properties of solids. Temperature variation of spontaneous magnetization, Curie-Weiss law. Domain structure & hysteresis in ferromagnets.

Lattice Vibration & Specific heat of solids: **[7]**

One-dimensional monatomic lattice, periodic boundary condition & vibrational modes of the 1-D lattice, Classical calculation of lattice specific heat- Einstein's and Debye's theories of specific heat.

Unit-B: Nuclear and Particle Physics-II **Lectures:25+7(Tutorial)**

Nuclear Reactions **[5]**

Conservation principles in nuclear reactions. Q-values and thresholds (relativistic formulation preferred), nuclear reaction cross-sections, examples of different types of reactions and their characteristics. Direct reactions, Bohr's postulate of compound nuclear reaction, Ghoshal's experiment.

Nuclear Fission **[3]**

Discovery and characteristics of nuclear fission, Energy and Mass distribution of fission fragments, explanation in terms of liquid drop model, spontaneous and induced fission. Chain reaction and basic principle of nuclear reactors.

Nuclear Fusion **[3]**

Energetics in terms of liquid drop model, Fusion as a source of energy production in Stars. Synthesis of nuclei under primordial and explosive condition (qualitative discussion).

Elementary particles **[8]**

Four basic interactions in nature and their relative strengths, Quantum numbers – mass, charge, spin, isotopic spin, strangeness, intrinsic parity, hypercharge. Charge conjugation. Conservation laws. Classifications of elementary particles – hadrons and leptons, baryons and mesons, elementary ideas about quark structure of hadrons.

Particle Accelerators **[6]**

Cyclotron–basic theory, synchrotron, linear accelerator.

PRACTICAL

SEMESTER-I & II

Major Practical-1: General, Electrical & Thermal Physics Total Classes = 96

1. Determination of Young's modulus of a metallic bar by the method of flexure.
2. Determination of the rigidity modulus of a metallic wire by dynamical method.
3. Determination of the thermal conductivity of a bad conductor in the form of a disk by the Lees & Chorlton method.
4. Determination of the time period of oscillation of a bar magnet using vibrating magnetometer & distribution of errors.
5. Design of different logic gates and realization of truth table.
6. Construction of a One-Ohm coil using a Carey Foster bridge.

Major Practical-2: Electricity & Magnetism Total Classes = 96

1. Investigation on LCR resonance circuits.
2. Study of network theorems.
3. Determination of Mutual inductance between a pair of coils using a BG.
4. Determination of thermoelectric power using thermocouples.
5. Boiling point of a given liquid by Platinum Resistance thermometer.
6. Regulation characteristic of the Bridge Rectifier with C & π filters.

SEMESTER-III & IV

Major Practical-3: Optics & Basic Electronics Total Classes = 96

1. Study of Newton's Ring using various plano-convex lenses.
2. Plotting of D-λ calibration curve of a spectrometer with a given prism and determination of wavelengths of some unknown spectral lines.
3. Verification of Cauchy relation using a spectrometer.
4. Determination of the strength of an unknown optically active substance using polarimeter.
5. I-V characteristics of a typical Zener Diode and study of regulation properties.
6. (i) Determination of I/O characteristics of a transistor and determination of h-parameters (dc). (ii) Determination of h-parameters of a CE transistor with ac source.

Major Practical-4: Optics Total Classes = 96

1. Determination of the value of Planck’s constant using visible photoelectric effect.
2. Study of a plane transmission grating & determination of wavelength of unknown spectral lines.
3. Studying of the diffraction pattern of a Double Slit with variable slit width.
4. Verification of Fresnel's equations for reflection of EM waves.
5. Determination of the wavelength of a monochromatic light by Fresnel's biprism.
6. Determination of the wavelength of a monochromatic light by Michelson interferometer.

SEMESTER-V

Major Practical-5: Electronics, Laser & Electrical Transport Total Classes = 96

1. Determination of the concentration of majority carriers of a semiconductor using Hall effect experiment.
2. Study of polarization with laser source, polarizer, analyzer, half & quarter wave plate.
3. Determination of band gap of a semiconductor by four-probe method.
4. B-H loop.
5. Tracing of the characteristics of a JFET, determination of trans-conductance & studying the performance of a JFET amplifier.
6. Design and construction of a regulated power supply using OP-AMP, Zener Diode & transistor.

Major Practical-6: Microprocessor (Intel-8085) Total Classes = 96

Software experiments with microprocessor related to the storing/ transferring/clearing of data in the memory addresses, increment of stored data, addition of binary numbers, finding of the largest/ negative/ positive numbers in a given series of data, sorting etc.

SEMESTER-VI

Major Practical-7: Electronics Total Classes = 96

1. Design and study of the output waveform of an astable multivibrator using transistor/555 timer IC/Op-Amp.
2. Study the waveform of a Wien-Bridge oscillator and its calibration using CRO.
3. Design and verification of operation of RS, D & JK flip-flop.
4. Determination of Fourier spectra of square, triangle and half-sinusoidal waveforms by CRO.
5. Design and test of the circuits of inverting/non-inverting amplifier, adder, differential amplifier, differentiators, integrator, comparator, Schmitt trigger using an OP-AMP.
6. Design of a CE amplifier using transistor (single stage/double stage).

Major Practical-8: Computer Programming Total Classes = 96

Programming related to the solution of algebraic equation, curve fitting, sorting, numerical differentiation & integration.

RECOMMENDED BOOKS (B.SC. PHYSICS MAJOR)

Mathematical Methods (Major-1A, Major-2A, Major-3B)

1 Vector Analysis - M. R. Spiegel, (Schaum's Outline Series) (TMH)
2 Mathematical methods for Physical Sciences – M.L.Boas. (J Willey)
3 Mathematical methods for Physicist and Engineers – Rilley, Hobson & Bence (Cam.U P)
4 Differential & Integral Calculus (vol. I & II) – N.Piskunov.
5 Differential Equation – G.F.Simmons (TMH).
6 Mathematical methods for Physicist – Arfken & Weber (Viva Books).
7 Mathematical methods for Physicist & Engineers – E.Kresyzig (J Willey)

Classical Mechanics (Major-1B, Major- 8A & Major – 11B)

1 Berkeley Physics Course, Vol – I (Mechanics) (Mc Graw Hill).
2 An introduction to mechanics – D. Morin (Cam. UP).
3 An Introduction to Mechanics – D. Kleppner and R.J. Kolenkow (Tata McGraw-Hill).
4 Classical Mechanics – H. Goldstein, C.Poole & S.Safko (Pearson).
5 Classical Mechanics – A. K. Raychaudhuri (O. U. P., Calcutta).
6 Classical Mechanics – Landau & Lifshitz (Butterworth & Heinemann).
7 Theory of Elasticity - Landau & Lifshitz (Butterworth & Heinemann).
8 Fluid Mechanics - Landau & Lifshitz (Butterworth & Heinemann).
9 Classical Mechanics – T.W.B.Kibble (Imperial College press).
10 Mechanics - K. R. Symon (Addison-Wesley).
11 Nonlinear dynamics & chaos – S.Strogatz (Levant Books)

Thermal Physics (Major - 2B & Major – 6B)

1 Heat and thermodynamics - Zemansky and Dittman (5th/6th eds.)(Mc Graw Hill).
2 Thermodynamics & introduction to Thermostatistics– H.B.Callen (2^{nd} eds.) (J.Willey).
3 Thermodynamics, Statistical Physics & Kinetics – Sears & Sallinger (TMH).
4 Thermodynamics – F. Fermi (Dover).
5 A Treatise on Heat - Saha and Srivastava (The Indian Press Ltd).
6 An introduction to Thermal Physics – D.V.Schroeder (Pearson).
7 Kinetic theory of gases - Loeb (Radha Publ. House).

Geometrical Optics (Major – 2C)

1 Matrix Methods in Optics – Gerard & Burch (Dover).
2 Classical & Modern Optics – R Mayer-Arendt (TMH)

Electronics (Major - 3A, Major - 5A & Major – 11A)

1 Integrated Electronics – J. Millman and C. Halkias (Mc Graw Hill).
2 Microelectronics – J.Millman ((Mc Graw Hill).
3 Electronics Fundamentals and Applications – J. D. Ryder (PHI Pvt. Ltd).
4 Electronic Device and Circuit Theory – R. Boylestad and L. Nashelsky (Prentice – Hall).
5 Operational Amplifier & Linear IC – Gayakwad (TMH)
6 Digital Principles & Applications – Malvino and Leach (TMH)
7 Digital Electronics – D. RayChaudhuri (Platinum Publishers)
8 Electronics Principles – A.P.Malvino (TMH).
9 Electronic Principle & Applications – A. Mottershed (PHI).
10 Communication Systems – Kennedy & Davis (TMH).
11 Microprocessor – B.Ram (TMH).

Electrostatics & Electrodynamics (Major - 4A, Major - 4B & Major – 6A)

1 Introduction to Electrodynamics – D. J. Griffith, (Prentice Hall, India Pvt. Ltd).
2 Berkeley Physics Vol II (Electricity and Magnetism) E.M. Purcell (Tata McGraw-Hill).
3 The Feynman Lectures on Physics – Vol. II (Addison – Wesley).
4 Foundations of electromagnetic theory – Reitz, Milford & Christy (Narosa).
5 Introduction to Electrodynamics – V.Barger & M.G.Olsson (Little Brown).
6 Electromagnetic Theory – Corson & Lorraine (W.H.Freeman).

Waves and Optics (Major – 5B)

1 Berkeley Physics Vol III (Waves) - J R Crawford (Tata McGraw Hill)
2 Fundamentals of Optics - F. A. Jenkins and H. E. White (Mc Graw Hill, Kogakusha).
3 Geometrical and Physical Optics - B. S. Longhurst (Orient Longman).
4 Optics – Klein & Furtak (J Willey).
5 Optics – Hecht and Zajac (Addison-Wesley)
6 Optics – M.Born & E Wolf (Pergamon).

Quantum Mechanics (Major - 7A & Major – 10A)

1 Quantum Mechanics – J. L. Powell and B. Crasemann, (Oxford, Delhi).
2 Quantum Mechanics – F. Schwabl (Narosa).
3 Quantum Mechanics – S.Gasiorowicz (J.Willey).
4 Introductory Quantum Mechanics - D.Griffith (Pearson).
5 A Textbook of Quantum Mechanics – P. M. Mathews and K. Venkatesan (TMH).
6 Quantum Mechanics – L.Schiff (McGraw Hill).
7 Quantum Mechanics – P.T.Mathews (McGraw Hill).

Atomic & Molecular Physics (Major – 7B)

1 Laser Principles and Applications – A. K. Ghatak and K. Tyagrajan (TMH).
2 Introduction to Atomic & Nuclear Physics – H.Semat and J.R.Albright (RW).
3 Atomic & Nuclear Physics – Yang and Hamilton (McGraw Hill).
4 Atomic & Nuclear Physics – S. K. Sharma (Pearson Education).
5 Atomic & Nuclear Physics (vol.I) – S.N.Ghoshal (S.Chand).
6 Quantum Physics – Eisberg & Resnick (J.Wiley).

Nuclear and Particle Physics (Major – 9B, Major – 12B)

1 Nuclear Physics – Cottingham and Greenwood (Cambridge University Press).
2 Particle Physics - Cottingham and Greenwood (Cambridge University Press).
3 Concepts of Nuclear Physics – B.L.Cohen (Tata-Mc Graw Hill).
4 Atomic and Nuclear Physics (vol.II) – S. N. Ghoshal (S. Chand).
5 Nuclear Physics – I. Kaplan (Addison-Wesley).

Solid State Physics (Major - 9A, Major – 12A)

1 Introduction to Solid State Physics, C. Kittel (Wiley Eastern).
2 Solid State Physics – A. J. Dekker (Mc. Millan).
3 An Introduction to Solid State Physics and Application – R.J. Elliot and A.F. Gibson (McMillan).

Statistical Mechanics (Major – 10B)

1 Statistical Mechanics - K. Huang (Wiley Eastern).
2 Fundamentals of Statistical and Thermal Physics - F. Reif (MGH).
3 Statistical Mechanics – F. Mandl (ELBS).
4 Statistical Mechanics – R.K.Pathria (Elsevier).
5 Statistical Mechanics – Palash Baran Pal (Narosa).

Special Theory of Relativity (Major – 8B)

1 Introduction to Special Theory of Relativity -R. Resnick (Wiley Eastern).
2 Special Theory of Relativity - A. P. French (ELBS).
3 Introduction to Electrodynamics – D.Griffiths (TMH).
4 Classical Theory of Fields – Landau & Lifshitz (Butterworth & Heinemann).

EXTRA-DEPARTMENTAL COURSE STRUCTURE

Semester-1

Physics EL-1 (Marks:35)

Unit- I(25 Marks): Classical Mechanics and Gravitation
Unit-II(10 Marks): Waves and Vibrations
Physics Practical -1(15 Marks)

Physics EL-2 (Marks:35)

Unit- I (20 Marks): General Properties of Matter
Unit-II (15 Marks): Geometrical Optics
Physics Practical-2 (15 Marks)

Semester-2

Physics EL-3 (Marks:35)

Unit- I(25 Marks): Heat and Thermodynamics
Unit-II(10 Marks): Electricity & Magnetism-I
Physics Practical -3(15 Marks)

Physics EL-4 (Marks:35)

Electricity and Magnetism - II
Physics Practical -4(15 Marks)

Semester-3

Physics EL-5 (Marks:35)

Unit- I(25 Marks): Physical Optics
Unit-II(10 Marks): Modern Physics
Physics Practical -5(15 Marks)

Physics EL-6 (Marks:35)

Unit- I(25 Marks): Electronics
Unit-II(10 Marks): Communications
Physics Practical -6(15 Marks)

THEORY

FIRST SEMESTER

Physics EL - 1 Lectures:34

Unit I: Classical Mechanics and Gravitation (Lectures 24)

1 *Dimensions of Physical Quantities :* Principle of dimensional homogeneity

2 *Vectors :* Axial and polar vectors, dot product and cross product, scalar triple product and vector triple product. Scalar and vector fields --- gradient, divergence and curl, statement of divergence theorem, statement of Stokes' theorem.

3 *Mechanics of a Particle :* (a) Newton's laws of motion, principle of conservation of linear momentum, time and path integral of force, conservative force field, concept of potential, conservation of total energy, equation of motion of a system with variable mass.

(b) Rotational motion, angular velocity, angular acceleration, angular momentum, torque, fundamental equation of rotational motion, principle of conservation of angular momentum, radial and cross-radial acceleration.

4 *Dynamics of Rigid Bodies :* Moment of inertia and radius of gyration - their physical significance, theorems of parallel and perpendicular axes, rotational kinetic energy, calculation of moment of inertia for some simple symmetric systems. Physical significance of MI.

5 *Gravitation :* Gravitational potential and intensity due to thin uniform spherical shell and solid sphere of uniform density, escape velocity.

Unit II : Waves and Vibrations (Lectures 10)

1 *Simple Harmonic Motion :* Differential equation and its solution.

2 *Superposition of Simple Harmonic Motion :* Analytical treatment, Lissajous figures, natural, damped and forced vibration, resonance, sharpness of resonance.

3 *Differential Equation of Wave Motion :* Plane progressive wave - energy and intensity. Bel, decibel and phon. Superposition of waves, beats. Velocity of longitudinal wave in solid and in gas, velocity of transverse wave in string, Doppler effect.

Physics EL – 2 Lectures:34

Unit I : General Properties of Matter (Lectures 20)

1 *Elasticity :* Elastic moduli and their interrelations, torsion of a cylinder, bending moment, cantilever, simply supported beam with concentrated load at the centre, strain energy.

2 *Viscosity :* Streamline and turbulent motion, Poiseuille's formula, critical velocity, Reynolds number, Bernoulli's theorem, Stokes' law (statement only).

3 *Surface Tension :* Surface tension and surface energy, molecular theory, angle of contact, elevation and depression of liquid columns in a capillary tube, excess pressure in a spherical bubble and spherical drop.

Unit II : Geometrical Optics (Lectures 14)

1 *Reflection and refraction :* Fermat's Principle, laws of reflection and refraction at a plane

surface, refraction at a spherical surface, lens formula. Combination of thin lenses - equivalent focal length.

2 *Optical instruments :* Dispersion and dispersive power, chromatic aberration and its remedy, different types of Siedel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power.

SECOND SEMESTER

Physics EL – 3 Lectures:34

Unit I: Heat and Thermodynamics (Lectures 24)

1 *Kinetic Theory of Gases :* Perfect gas, pressure exerted by it, Maxwell's law of distribution of molecular velocities (statement only) - rms, mean and most probable velocities, degrees of freedom, principle of equipartition of energy - application in simple cases. Equation of state - defects of ideal gas equation, van der Waals equation (qualitative study), critical constants.

2 *Thermal Conductivity :* Steady state and variable state, thermal and thermometric conductivity, Fourier equation for one-dimensional heat flow and its solution, Ingen Hausz's experiment, cylindrical flow of heat.

3 *Thermodynamics :* Basic concepts (equilibrium state, state function, exact and inexact differential), internal energy as state function. First law of thermodynamics and its application. Isothermal and adiabatic changes - relations, indicator diagrams. Reversible and irreversible processes, second law of thermodynamics, Carnot cycle and its efficiency, entropy and its physical interpretation.

4 *Radiation :* Nature of radiant heat, emissive and absorptive power, Kirchhoff's law, black body radiation, Stefan's law, Newton's law of cooling, Planck's distribution law (only statement), Wien's displacement law, pyrometer - principle.

Unit II: Electricity and Magnetism - I (Lectures 10)

1 *Electrostatics :* Quantisation of charge and Millikan's oil-drop experiment, Coulomb's law, intensity and potential ---example of point charge, Gauss' theorem ---simple applications, potential and field due to an electric dipole, mechanical force on the surface of a charged conductor. Dielectric medium, polarization, electric displacement.

2 *Capacitor :* Parallel-plates and cylindrical, energy stored in parallel plate capacitor.

Physics EL - 4 Lectures:34

Electricity and Magnetism - II (Lectures 34)

1 *Steady Current :* Network analysis --- Kirchoff's laws, Thevnin and Norton's theorem, Wheatstone bridge, potentiometer.

2 *Thermoelectricity :* Seebeck, Peltier, and Thomson effects, laws of thermoelectricity, thermoelectric curve --- neutral and inversion temperature, thermoelectric power.

3 *Magnetic effect of current :* Biot and Savart's law, ampere's circuital law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop --- concept of magnetic dipole, Ampere's equivalence theorem.

4 *Lorentz force :* Force on a moving charge in simultaneous electric and magnetic fields, force on a current carrying conductor in a magnetic field.

5 *Magnetic materials :* Intensity of magnetization, relation between **B**, **H**, and **M** --- illustration in the case of bar magnet, magnetic susceptibility --- dia, para and ferromagnetic materials, statement of Curie's law. Hysteresis in a ferromagnetic material, hysteresis loss.

6 *Electromagnetic induction :* Self and mutual inductances in simple cases, energy stored in

inductance.

7 *Varying currents :* growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit.

8 *Alternating current :* Mean and r.m.s. values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit --- power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer.

THIRD SEMESTER

Physics EL - 5 Lectures:34

Unit I: Physical Optics [14]

1 *Light as an electromagnetic wave :* Full electromagnetic spectrum, properties of electromagnetic waves, Huygens' principle --- explanation of the laws of reflection and refraction.

2 *Interference of light :* Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring.

3 *Diffraction :* Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory), resolving power.

4 *Polarisation :* Different states of polarisation, Brewster's law, double refraction, retardation plate, polaroid, optical activity.

Unit II: Modern Physics [20]

1 *Special Theory of Relativity :* Postulates of STR, formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence.

2 *Quantum theory of radiation :* Planck's concept --- radiation formula (statement only) --qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect.

3 *Basic Quantum Mechanics :* Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger equation, particle in a one-dimensional infinite well --- energy eigenvalues, wavefunction and its probabilistic interpretation. Bohr's theory of hydrogen spectra --- concept of quantum number, Pauli exclusion principle.

4 *Solid State Physics :* Crystalline nature of solid, diffraction of X-ray, Bragg's law; Moseley's law -- explanation from Bohr's theory.

5 *Nuclear Physics :* Binding energy of nucleus, binding energy curve and stability; Radioactivity, successive disintegration, radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation, fission and fusion, nuclear reactor.

Physics EL - 6 Lectures:34

Unit I: Electronics [24]

1 *Diodes and Transistors :* P-N junction diode, bridge rectifier, capacitance input filter, Zener diode, voltage regulator, Transistors --- α and β and their interrelations; output characteristics in CE mode, single stage CE amplifier --- approximate expressions of current and voltage gain with the help of 'Load Line'.

2 *Digital circuits :* binary systems, binary numbers. Decimal to binary and reverse conversions; binary addition and subtraction.

3 *Logic gates :* OR, AND, NOT gates --- truth tables. Statement of de Morgan's theorems, NOR and NAND universal gates.

4 *Feedback :* Basic principle, positive and negative feedback, Barkhausen criterion, oscillator, OPAMP : characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac.

5 *Digital electronics :* combinational circuits --- adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits --- flip-flop, D and J-K, registers and counters.

Unit II: Communications [10]

1 Propagation of electromagnetic waves in atmosphere, various layers of atmosphere, ground and sky waves.

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 of FM waves, signal-to-noise ratio.

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

PRACTICAL

FIRST SEMESTER

Physics EL Practical - 1

Full Marks: 15 Total Class = 30

1 Determination of modulus of rigidity of the material of a wire by dynamical method.

2 Determination of moment of inertia of a metallic cylinder / rectangular bar about an axis passing through its c.g.

3 Determination of the pressure coefficient of air.

4 Determination of the refractive index of the material of a lens and that of a liquid using a convex lens and a plane mirror.

5 Determination of the focal length of a concave lens by auxiliary lens method or by combination method.

Physics EL Practical - 2

Full Marks: 15 Total Class = 30

1 Determination of the frequency of a tuning fork with the help of a sonometer (Either by using the relevant formula or by using the n-l curve).

2 Determination of the resistance of a suspended coil galvanometer by the method of half deflection and to calculate the figure of merit of the galvanometer (using the same data)

3 To draw the I-V characteristic of i) resistor and ii) a P-N junction diode in forward bias condition. (Plot both the characteristic curves on the same graph paper.) Estimate from the graphs i) the resistance of the resistor and ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

4 Determination of (i) an unknown resistance and (ii) resistance per unit length of a wire by

Carey Foster method.

5 Measurement of current flowing through a resistor by using a potentiometer. Verify the result with the help of a milli-ammeter.

SECOND SEMESTER

Physics EL Practical - 3

Full Marks: 15 **Total Class = 30**

1 Determination of Young's modulus of the material of a beam by the method of flexure (single length only).

2 Determination of the coefficient of viscosity of water by Poiseuille's method (The diameter of the capillary tube to be measured by travelling vernier microscope).

3 Determination of the surface tension of water by capillary rise method.

4 Determination of the refractive index of the material of a prism by drawing the i-δ curve using spectrometer.

5 To calibrate a polarimeter and hence to determine the concentration of sugar solution.

Physics EL Practical- 4

Full Marks: 15 **Total Class = 30**

1 Determination of refractive index of a liquid by traveling microscope.

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

3 To draw the reverse characteristics of a Zener diode & to study its voltage regulation characteristics using a variable load. (Breakdown region to be identified on the graph and Percentage voltage regulation to be calculated for two load currents.)

4 To draw the output characteristics of a transistor in C-E configuration (for at least 5 base currents) and hence to determine the A.C. current gain from the active region of the characteristics.

5 To verify the truth tables of OR and AND logic gates using diodes and construction of AND, OR and NOT gates using NOR / NAND IC gates on breadboard.

THIRD SEMESTER

Physics EL Practical - 5

Full Marks: 15 **Total Class = 30**

1 To draw the resonance curve of a series LCR circuit and hence to determine the Quality-factor of the circuit.

2 To determine the wavelength of a monochromatic light by Newton's ring method.

3 Determination of the horizontal component of earth's magnetic field using a deflection and an oscillation magnetometer.

4 Determination of the coefficient of linear expansion of a metallic rod using an optical lever.

5 Determination of the temperature coefficient of the material of a coil using a Carey-Foster bridge (3 sets of readings for both temperatures to be taken, also the resistance per unit length of the wire to be measured).

Physics EL Practical - 6

Full Marks: 15 Total Class = 30

1 To draw the I-V characteristics of a bridge rectifier (4-diode) (i) without using any filter and (ii) using a capacitive filter. (Percentage voltage regulation to be calculated for each case at a specified load current.)

2 To construct an adjustable voltage power supply using appropriate IC and to study its regulation.

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

4 To use OP AMP 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.