UNIVERSITY OF KALYANI

REVISED SYLLABUS

FOR THREE YEARS B.Sc. DEGREE COURSE

(HONOURS AND GENERAL)

IN

PHYSICS

According to the New Examination Pattern
Part – I, Part- II & Part- III

WITH EFFECT FROM THE SESSION
2009 – 2010

UNIVERSITY OF KALYANI
KALYANI NADIA
COUNCIL FOR UNDER GRADUATE STUDIES
PROCEEDINGS OF THE 21ST MEETING OF THE (PREVIOUS) COUNCIL FOR UG STUDIES HELD ON 13/09/2005

Revised Structure and Distribution of Marks for Practical Based Subjects at UG Level w.e.f. Academic Session 2005-2006

BACHELOR OF SCIENCE (GENERAL)	PART-I	PART-II	PART-III
Compulsory English : One half paper : 50 Marks Modern Indian Language : One half paper : 50 Marks	50 Marks 50 Marks	– –	– –
Environmental Studies : One full paper* : 100 Marks*	100 Marks*	–	–
Elective Subjects : **Three** : Four full papers : 3x4x100 each =1200 Marks	3x1x100 =300 Marks	3x2x100 =600 Marks { Th: 3x1x100 = 300 Marks; Pr: 3x1x100 = 300 Marks }	3x1x100 =300 Marks { Th : 3x1x 60 = 180 Marks; Pr : 3x1x40 = 120 Marks }
AGGREGATE MARKS : 1400	**500 Marks**	**600 Marks**	**300 Marks**

BACHELOR OF SCIENCE (HONOURS)	PART-I	PART-II	PART-III
Compulsory English : One half paper : 50 Marks Modern Indian Language : One half paper : 50 Marks	50 Marks 50 Marks	- -	- -
Environmental Studies : One full paper* : 100 Marks*	100 Marks*	-	-
Elective subjects : **Two** : Three full papers : 2x3x100 each = 600 Marks	2x1x100 Marks =200 Marks	2x2x100 =400 Marks { Th: 2x1x100 =200 Marks; Pr: 2x1x100 =200 Marks }	- -
One Honours Subject = 800 Marks Theory: Seven Papers = 540 Marks Practical: Four Papers = 260 Marks	200 Marks (Th: 2 x 75 Marks) (Pr : 1 x 50 Marks)	200 Marks (Th: 2 x 75 Marks) (Pr : 1 x 50 Marks)	400 Marks (Th: 3 x 80 Marks) (Pr : 2 x 80 Marks)
For Computer Science Honours	For Computer Science Honours		
Theory : Seven Papers = 440 Marks Practical : Four Papers = 280 Marks Project : One Paper = 80 Marks	200 Marks (Th: 2 x 50 Marks) (Pr: 1 x 100 Marks)	200 Marks (Th: 2 x 50 Marks) (Pr: 1 x 100 Marks)	400 Marks (Th: 3 x 80 Marks) (Pr : 1 x 80 Marks) (Project : 1 x 80 Marks)
AGGREGATE MARKS : 1600	**600 Marks**	**600 Marks**	**400 Marks**

* ***With effect from the session 2009-2010.***

07/08/2009
Secretary, Faculty Councils (U.G.)
University of Kalyani
Kalyani, Nadia

University of Kalyani

Revised Syllabus for B.Sc. (Honours) Course in

PHYSICS

(w.e.f. the session 2009-2010)

According to the New Examination Pattern
Part – I, Part – II & Part – III

Details of the Physics Honours Course

& Contents

Examination	Paper	Subjects	No. of Lectures	Marks	Page Number	Total marks & Lectures
B.Sc. Part-I	Paper-I (Theory)	Group A : Mathematical Methods	25	15	H-1	75 marks 95 lectures
		Group B : Mechanics	40	30	H-2	
		Group C : General Properties of Matter	30	30	H-3	
	Paper-II (Theory)	Group A : Waves, Oscillations and Acoustics	45	45	H-4	75 marks 80 lectures
		Group B : Geometrical Optics	35	30	H-6	
	Paper-III	Practical		50	H-7	50 marks
B.Sc.Part-II	Paper-IV	Group A : Heat and Kinetic Theory	35	30	H-9	75 marks 80 lectures
		Group B : Thermodynamics	45	45	H-10	
	Paper-V (Theory)	Electricity and Magnetism	100	75	H-11	75 Marks 100 lectures
	Paper-VI	Practical		50	H-14	50 marks
B.Sc.Part-III	Paper-VII (Theory)	Group A : Physical Optics	60	40	H-16	80 marks 120 lectures
		Group B : EM Theory & Relativity	60	40	H-17	
	Paper-VIII (Theory)	Group A : Classical Mechanics	25	24	H-19	80 marks
		Group B : Statistical Mechanics	35	24	H-20	115 lectures
		Group C : Quantum Physics	55	32	H-21	
	Paper IX (Theory)	Group A : Structure of Matter	65	40	H-23	80 marks
		Group B : Electronics	75	40	H-26	140 lectures
	Paper-X (Practical)	Optics experiments		80	H-28	80 marks
	Paper-XI (Practical)	Electricity & Electronics experiments		80	H-29	80 marks

PART-I

Paper-I

Full Marks : 75

Total No. of Lectures : 95

Group-A (No. of Lectures : 25)

Mathematical Methods of Physics – 15 marks

(2 questions to be set, 1 to be answered)

1(a) Vectors : Scalar and vector products vector triple and multiple products; application to plane geometry (up to 3 dimensions); scalar and vector functions; vector dependence on one or more parameters; derivative of a vector with respect to a parameter.

Directional derivative of a scalar field; gradient, divergence and curl; Laplacian; integration; line, surface and volume integrals; Gauss's theorem, Green's theorem and Stoke's theorem; applications. (8)

(b) Orthogonal Curvilinear Coordinates : Unit vectors; arc length, volume element, ∇ and ∇^2 in rectangular Cartesian, spherical polar and cylindrical coordinates; the Jacobian. (4)

2. Fourier series : Dirichlet's condition, waveforms with Fourier series, Fourier Transforms (3)

3. Matrices : Hermitian, adjoint and inverse of a matrix, Hermi tian and unitary matrices, Diagonalisation of real symmetric matrices with non -degenerate eigen valves. (4)

4. Differential Equations : Ordinary second order linear differential equations with constant coefficients, partial differential equations : solution by the method of separation of variables, solution of Laplace's equation (6)

Reference Books :

1. Introduction to Mathematical Physics, C. Harper (Prentice Hall of India).
2. Vector Analysis – M.R. Spiegel (Schaum's Outline Seri es) (Tata McGraw Hill)
3. Mathematical Methods – M.C. Potter and J. Goldberg (Prentice Hall of India).

Group-B (No. of Lectures : 40)

Mechanics – 30 marks

(3 question to be set, 2 to be answered)

1. Kinetics : Velocity and acceleration in rectangular Cartesian, spherical and cylindrical coordinates; radial and transverse, tangential and normal components of velocity and acceleration; motion with uniform velocity and uniform acceleration, relative velocity; angular velocity and angular acceleration; linear momentum, angular momentum and their components. (5)

2 Frames of reference and Laws of Motion :

   (a) Inertial Frames : Galilean invariance and Galilean transformation : Newton's laws of motion; force; energy – kinetic and potential; torque. (3)

   (b) Application of Laws of Motion : (i) One-dimensional motion of particles; time integral of force – impulsive forces; systems with variable mass. (ii) Motion on a plane; projectiles – range and nature of path; three dimensional motion (iii) Dissipative forces; friction; motion in a viscous medium – terminal velocity (Emphasis should be on problem solving) (6)

   (c) Non-inertial frames and fictitious forces; rotating frames, centrifugal force and centripetal acceleration; coriolis force, Foucault's pendulum. (4)

3. System of Particles : Centre of mass; reduced mass and relative coordinates; scattering and scattering cross-section: centre of mass and laboratory frames of reference. (3)

4. Conservation Principles : Conservative and non-conservative forces, path integral of force, conservation of energy; collision of particles – conservation of momentum : elastic and inelastic collisions – conservation of kinetic energy : coefficient of restitution : conservation of angular momentum. (Again the emphasis should be on the application of conservation principles to problem solving) (6)

5. Rigid Bodies : Translation and rotation of rigid bodies : kinetic energy and angular momentum of rotation; moment of inertia and products of inertia; parallel and perpendicular axes theorems; calculation of moment of inertia for simple symmetric systems; principal axes – setting these up in simple symmetric cases; Euler's equations and application to simple cases. (6)

6. Central Force :

   a) Definition; general characteristics of central forces and conserved quantities (1)

   b) Motion under Inverse Square law of force : Bound State – Kepler problem; Kepler's laws; planetary motion; artificial satellite; escape velocity. Scattering – Rutherford scattering. (6)

Reference Books :

1. Kittel, Knight and Ruderman : Mechanics – Berkeley Physics Course, Vol.I – McGraww Hill, Kogakusha.
2. Symon : Mechanics – Addison Wesley.
3. Synge and Griffith : Mechanics – McGraw Hill Kogakusha
4. Feynman, Leighton and Sands : Feynman Lecture Notes on Physics, Vol.I - Narosa.

Group-C : (No. of Lectures : 30)

General Properties of Matter – 30 marks

(3 questions to be set, 2 to be answered)

1. Gravitation :

   (a) Gravitational and inertial masses, G by Poynting's methods (principle only)

   (b) Kater's pendulums

   (c) Gravitational intensities and potentials for bodies with simple geometric shapes; Gauss's and Poisson's equations for gravitational fields. (5)

2. Mechanics of Deformable Bodies : Strain and stress tensors; generalized Hooke's law; interrelations between different elastic constants of an isotropic solid; Poisson's ratio; bending moments and shearing forces; cantilever; beam supported at both ends; torsion of a cylinder; some standard methods of measurement of elastic constants (principles only – to be taught as a background for practical classes) (10)

3. Mechanics of Continuous Media :

   (a) *Surface Tension* : Surface energy and surface tension; equilibrium of liquid surface; surface waves; angle of contact; excess pressure on a curved liquid surface; capillary rise – Jurin's law; some standard methods for measurement of surface tension (principles only – to be taught as a background for practical classes) (5)

(b) *Viscous Fluids* : Newtonian fluids; streamline and turbulent flows; coefficient of viscosity; flow through capillary tube and Poiseuille's equation; dimensional analysis, critical velocity and Reynold's number; Stoke's law and applications; some standard laboratory methods of measurement of viscosity (again principles only – to be taught as a background to practical classes). (5)

(c) *Kinematics of Moving Fluids* : Euler's equation; equation of continuity; Bernoulli's theorem Torricelli's theorem; elementary applications. (6)

Reference Books :

1. Newman and Searle : General Properties of Matter – Radha.
2. C.J. Smith : General Properties of Matter – Radha.
3. D.P. Raychaudhuri : Padarther Dharma (in Bengali) – W.B. State Book Board.

Paper-II

Full Marks : 75

Group-A (No. of Lectures : 45)

Waves, Oscillations and Accoustics - 45 marks

(5 questions to be set, 3 to be answered)

1 Vibrations : Simple harmonic oscillator; free and forced vibrations of damped harmonic oscillator; resonance; Q factor, motion under more than one simple harmonic forcing; Lissajous figures.

Coupled oscillations; normal modes of vibration.

Superposition principle : beats, non-linear vibration and harmonic generation, vibration under double forcing; combinatorial tones, Helmholtz resonator. (8)

2. Waves : General equation of wave motion and its general solution, plane waves and spherical waves; wave parameters; sinusoidal waves.

Progressive waves; energy transport in wave motion; wave packets; group velocity and phase velocity; dispersive and non-dispersive propagation; examples.

Stationary waves and their properties. (12)

3. Sound waves :

   a) Nature of sound waves; propagation characteristics in different media; factors governing the velocity of sound waves in different types of media (e.g., solids, liquids, gases, strings).

   b) Intensity of sound waves; measurement of intensity (e.g. Rayleigh disc method – principles only), intensity level and its units; reflection and refraction of sound waves.

   c) Doppler effect; generation and detection of ultrasonics; wave propagation through liquids and crystals; shock waves.

   d) Fourier analysis study of vibrating strings under different types of excitation (plucked, struck and bowed); kinetic energy of a vibrating strings and its normal modes : vibrating rods and air columns; Kundt's tube, vibration of rectangular membranes. (13)

4. Ultrasonic and Building Acoustics : Production and detection of ultrasonic waves, measurement of ultrasonic wavelength, Applications of ultrasonics;

   Building Acoustics : growth and decay of intensity, Time of reverberation, design of good auditorium, intensity of wave, loudness, Weber-Fechner law, sound absorbers. (12)

Reference Books :

1. Crawford : Waves – Berkeley Physics Course, vol.III, McGraw Hill.
2. French : Waves and Oscillations – Arnold Heinemann.
3. Kinsler and Fees, Fundamentals of Acoustics John Wiley.
4. D.P. Chaudhuri : Advanced Acoustics – New Book Stall.
5. Undergraduate Physics, Vol.I – Bhattacharya and Bhattacharya, NCBA.
6. Jugal Kisore Mukhopadhyay : Uchchatara Swanavidya (in Bengali) – W.B. State Book Board.

Group-B (No. of Lectures : 30)

General Optics - 30 Marks

(3 questions to be set, 2 to be answered)

1. Nature of light, ray approximation : Fermat's principle, application of Fermat's principle of reflection and refraction at plane surfaces : prism; image formation due to prism. (6)
2. Reflection and Refraction at Curved Surfaces :
   a) Application of Fermat's principle; Gaussian or paraxial approximation; fundamental paraxial equation; image formation by mirrors and thin lenses; different types of magnification : matrix method in paraxial optics. (8)
   b) Two thin lenses separated by a distance; thick lenses; cardinal points; equivalent lens; angular magnification; Helmholtz-Lagrange's law; determination of cardinal points by nodal slide method (principles only); rainbow. (6)
3. Dispersion : Dispersive power; dispersive power of prisms; irrationality of dispersion . (3)
4. Optical Instruments and Aberrations : (12)
   a) Microscope; telescope; objectives; Ramsden's and Huygens' eyepieces.
   b) Chromatic aberration; methods of reduction; achromatic lens combination.
   c) Seidel aberrations : Different types of Seidel aberrations (qualitative treatment only) : methods of reducing these in optical instruments.

Reference Books :

1. Longhurst : Geometrical and Physical Optics – Longmans.
2. Jenkins and White : Fundamentals of Optics – McGraw Hill Kogakusha.
3. C.J. Smith : Optics – Radha.
4. Ghatak : Optics – Tata McGraw Hill.
5. Hecht and Zajak : Optics – Addison Wesley.
6. Mayer and Arendt : Optics – Prentice Hall.

Paper-III

FullMarks : 50

Practical

Note :

1. Students are to maintain a laboratory note book which would serve as the log book of their day to day laboratory work as well as contain a full report of each experiment performed. Data should be directly recorded in the laboratory note book during the practical class and these should be signed by an attending teacher. No separate fair laboratory note book is to be maintained.
2. Each student has to perform one experiment during the Final examination. The experiment would be allotted by drawing of lots.
3. 10 marks are to be set aside on the regularity of students in attending classes and the assessment of their performance during the whole course in the laboratory as evident from the laboratory note book.
4. 10 marks would be earmarked for oral questions on the experiment and associated topics and which will be asked during the examination.
5. 30 marks would be allotted for the experiment to be performed during the examination.
6. Before the students actually start their laboratory work in the first year, some introductory lectures, demonstrations involving the actual use of equipment by the student must be arranged on the following topics :
   a) Use of vernier scales and micrometers.
   b) reading the barometer and using the common balance
   c) drawing of graphs and least square fits.
   d) error analysis, significant figures and limits of accuracy of an experiment.

List of Experiments :

1. Measurement of the moment of inertia of a rigid body.
2. Measurement of Young's modulus of the material of a bar by flexure.
3. Measurement of the rigidity modulus of a wire by dynamic method.
4. Measurement of surface tension of a liquid by capillary tube method and verification of Jurin's law (capillary tubes of different bores to be supplied).
5. To measure the viscosity coefficient of a liquid by Poiseuille's method.
6. To draw the frequency – resonance length curve of a sonometer wire and to determine an unknown frequency of a tuning fork.

7. To draw the tension – resonant length curve of a sonometer wire
8. Determination of the frequency of a tuning fork by Melde's method.
9. Measurement of the coefficient of linear expansion of a solid using an optical lever.
10. Determination of the refractive index of a liquid with the help of a plane mirror and a convex lens.
11. Determination of the refractive index of a liquid by apparent depth method with the help of a travelling microscope.
12. Measurement of focal length of a concave lens by combination method.
13. Measurement of the focal length of a concave lens by auxiliary lens method.
14. Verification of the inverse cube law for magnetic dipoles (study of the dependence of the field of a magnetic dipole on distance) and determination of the horizontal component of the earth's magnetic field by deflection and oscillation magnetometers.
15. Determination of the temperature coefficient of resistance of the material of a coil by carry Foster's method.
16. Determination of the resistance per unit length of a metre bridge wire and to determine the specific resistance of the material in the form of a wire by Carey Foster's method.
17. Measurement of the resistance of a mirror galvanometer by the half deflection method and to determine its figure of merit.
18. Measurement of the emf of a cell with a potentiometer.
19. Measurement of current of an external circuit with a potentiom eter and a standard resistance.

PART-II

Paper-IV

Full Marks : 75

Group-A (No. of Lectures : 35)

Heat and Kinetic Theory - 30 marks

(3 questions to be set; 2 to be answered)

1. Thermometry : Concept of temperature; principles of thermometry; thermometric substances and properties; constant volume and constant pressure thermometers; resistance thermometers; thermocouples; extreme high and extreme low temperature measurement techniques. (5)
2. Kinetic Theory of Gases : Fundamental assumptions; deduction of perfect gas laws; significance of temperature; degrees of freedom; Maxwell's distribution law; its experimental verification; average, root mean square and most probable speeds; distribution of free paths; mean free path; experimental measurement; equipartition of energy (derivation not required); application to specific heats; Dulong and Petit's law. (10)
3. Transport phenomena :
   a) Viscosity, thermal conduction and diffusion.
   b) Brownian Motion; Einstein;s theory; Perrin's work; determination of Avogadro;s numebr. (6)
4. Real gases : Experimental studies of isotherms of real gases; Andrew's and Amagat's experiments; continuity of state; deviations from Boyle's law; Boyle temperature; Van der Waal's equation of state; other equations of state (mention only); critical constants and their determination; law of corresponding states; virial equation of state and virial coefficients. (7)
5. Conduction of Heat : Thermal and thermometric conductivity; Fourier's equation of heat propagation – its solution for rectilinear and radial (spherical and cylindrical) flow of heat; periodic flow of heat; Wiedemann-Franz relation; Angstrom's experiment; important methods of measurement of thermal conductivity of good and bad conductors (principles only – to be taught as a background for practical classes). (7)

Group-B (No. of Lectures : 45)

Thrmodynamics - 45 marks

(5 questions to be set, 3 to be answered)

1. First Law of Thermodynamics : Basic concepts : microscopic and macroscopic points of view; thermodynamic variables of a system; exact and inexact differentials; thermal equilibrium and the zeroeth law; concept of temperature: internal energy; external work; thermodynamic equilibrium; quasi -static processes; first law of thermodynamics and applications; magnet ic systems; specific heats and their ratio; isothermal and adiabatic changes in perfect and real gases (6)
2. Second Law of Thermodynamics : Reversible and irreversible processes : Carnot's cycle and Carnot's theorem – efficiency of heat engines; entropy; second law of thermodynamics –different formulations and their equivalence; Clausius theorem: entropy changes in simple processes : T -S diagrams for simple processes; isothermal and adiabatic elasticities; increase of entropy in nat ural processes; entropy and disorder; probabilistic interpretation of entropy. Kelvin's scale of temperature – relation to perfect gas scale. (10)
3. Thermodynamic Functions : Enthalpy, Helmholtz and Gibbs Free energies : legendre transformations; Maxwell's relations and simple deductions using these; thermodynamic equilibrium and free energies. (5)
4. a) Heat Engines : External Combustion engine – steam engine and the Rankine cycle; internal combustion engines – Otto and Diesel cycles.
   b) Refrigerators : Compression and absorption types of machines (5)
5. Thermodynamics of Reversible cells – Gibbs Helmholtz equation (2)
6. Change of State : Equilibrium between phases and triple point : Gibbs phase rule and simple applications; first and higher order phase transitions – Ehrenfest's classification; Clausius Clapeyron's equation; Joule Thomson effect; inversion temperature, regenerative cooling, liquefaction of air, hydrogen and helium; cooling by adiabatic expansion and adiabatic d emagnetization. (6)
7. Multicomponent Systems : Thermodynamic functions for a mixture of gases; change of entropy in diffusion; law of mass action; heat of reaction; effect of temperature and pressure on reaction constant; chemical potentia l; conditions of chemical equilibrium; principle of Le -Chatelier. Nernst heat theorem; third law of thermodynamics. (5)

8. Radiation : Prevost's theory of exchanges; emissive and absorptive powers; Kirchoff's law, black body radiation; energy density; radiation pressure; Wien's displacement law; Stefan Boltzmann law; Wien's law (no derivation) and Rayleigh Jean's law; Planck's law and deductions from Planck's law, radiation pyrometer. (6)

Reference Books :

1. Saha and Srivastava : A Treatise on Heat – Indian Press, Allahabad.
2. Zemansky and Ditman; Heat and Thermodynamics – McGraw Hill Kogakusha.
3. Sears and Salinger : Thermodynamics, Statistical Mechanics and Kinetic Theory – Narosa.
4. Kittel and Kroemer : Thermal Physics – Freeman.
5. Loeb : Kinetic Theory - Radha
6. Jeans : Dynamical theory of Gases - Cambridge
7. Fermi : Thermodynamics – Chicago University Press
8. Callen : Thermodynamics – Wiley International
9. Pratip Chaudhuri : Gaser Anabiktatwa (in Bengali) = W.B. state Book Board.
10. Ashoke Ghosh : Tapgatitatwa (in Bengali) – W.B. state Book Board.

Paper-V

Full Marks : 75

Total No. of Lectures : 100

Electricity and Magnetism – 75 marks

(10 questions to be set, 6 to be answered of which 1 is compulsory)

1. Electrostatics in Vacuum : Coulomb's law; electric field and electrostatic potential; electric lines of force; flux; calculation of electric fields and pot entials due to various standard charge distributions; Gauss's law and applications; Laplace's and Poisson's equations; Earnshaw's theorem; conservative nature of electrostatic field; ∇E and $\nabla \times E$ relations. (6)
2. Multipoles : Electric dipole; field and potential due to an electric dipole; multipole expansion of the electric field and potential – identification of the monopole, dipole and quadrupole terms; torque on a dipole in a uniform external field; force on a dipole in a non-uniform field; dipole-dipole interaction – mutual potential energy and torque. (6)

3. Electrostatics in Material Media : Dielectrics and conductors; polarization; permittivity and susceptibility; dielectric constant; electric displacement vector D; Gauss's law and Coulomb's law in dielectrics; boundary conditions. (3)
4. Capacitance : Condensers; calculation of capacitances for various geometries (with and without dielectrics). (3)
5. Electrostatic Energy : Field energy; energy of a charge distribution (including spherical charge distribution); self-energy of a point charge (qualitative); energy stored in a capacitor. (3)
6. Electric Properties of Materials : Electronic, ionic and dipolar polarisability; molecular field in a dielectric; Clausius Mosotti relation. (3)
7. Solution of Standard Potential Problems :
   a) Deductions from the inverse square law regarding minimum and maximum values of electrostatic potential; solution of Laplace's equation for some spherically symmetric cases. (4)
   b) Uniqueness theorem; method of images : infinite conducting plane in front of a point charge; Conducting sphere in front of a point charge; calculation of surface charge density and its angular dependence; force between a point charge and a conductor in front of it; conducting sphere in uniform exter nal field. (4)
   c) Application of boundary conditions in solving problems involving dielectrics : Semi-infinite dielectric slab in front of a point charge; dielectric sphere in a uniform field. (4)
8. Stationary Currents : Drift velocity and electric current density; units of current; current and charge conservation; electrical power; current and energy conservation; resistance and Ohm's law resistivity; Ohm's law from the microscopic point of view; variation of resistivity with temperature (ordinary, semi and super conductors, qualitative only). (2)
9. D.C. Circuits : Kirchhoff's laws and applications; sensitivity of Wheatstone's bridge : potentiometer. (3)
10. Electromagnetism in Vacuum :
    a) Source of magnetic field – Biot-Savart's law, magnetic induction vector B and magnetic flux; calculation of B for various current distributions; Ampere's circuital law and applications. (5)
    b) Lorentz force; force between current carrying conductors; torque on a closed circuit loop in a magnetic field; equivalence between current loops and magnetic dipoles; magnetic shell; multipole expansion of a magnetic field due to a current distribution. (4)

c) Magnetic Potentials (scalar and vector) : conservative and non-conservative fields : ∇. B and ∇ B relations. (2)

d) Field due to a solenoid; Helmholtz coil; Hall effect. (2)

11. Electromagnetic Induction :

a) Linked flux; Faraday's and Lenz's laws : calculation of induced fields in standard cases; rotating coil in a magnetic field; moving conductor in a magnetic field. (4)

b) Mutual and self inductances; proof of M_{12} and $M = k\sqrt{(L_1L_2)}$; calculation of L and M for some standard geometries; energy stored in an inductor, energy of coupled circuits. (3)

c) Eddy currents. (1)

12. Transients : Growth and decay of currents and voltages in L-R, C-R and L-C-R circuits; electrical oscillations in L-C circuits. (3)

13. Magnetic Fields in Material Media and Magnetic Materials :

a) Magnetic field B of a uniformly magnetised slab; magnetisation and magnetisation current; free and bound currents; surface and volume densities of magnetisation currents : free current and the field; line integral of the H field; magnetic susceptibility and permeability. (4)

b) Magnetic scalar potential; boundary conditions for **B** and **H**; solution of magnetic problems with simple geometry; magnetic sphere of high permeability placed in a uniform magnetic field. (4)

c) Derivation of expressions of susceptibilities of dia and para magnetic substances. Curie and Curie-Weiss laws; ferromagnetic domains; magnetization cycles; hysteresis, soft and hard ferromagnetic materials and their uses. (4)

d) Magnetic circuits; energy stored in a magnetic field; production of magnetic fields, electromagnets and permanent magnet. (2)

15. Thermoelectricity: Seebeck, Peltier and Thomson effects; thermoelectric series; thermoelectric diagram; application of thrmodynamics to thermoelectricity; applications of thermoelectricity. (3)

16. Alternating Currents :
    a) Basic ideas of generation; mean and r.m.s. values; use of complex var iables; impedance; circuits containing R,L, and C; phase diagrams; power factor; Watt Hour; three phase systems. (4)
    b) Series and parallel L-C-R circuits; resonance; Q value; bandwidth; coupled circuits and coefficient of coupling; i mpedance matching; ideal transformer; transformers in practice. (5)
    c) General form of Wheatstone's bridge; balance conditions; A.C. measurement of L.M. and C. (2)
17. Units and Dimensions : CGS, Gaussian and SI units; conversion b etween different systems of units; dimensions of various quantities in the three systems of units. (4)
18. Electrical measuring Equipment : Moving coil galvanometer : ballistic galvanoemter; fluxmeter/gaussmeter. (3)

Reference Books :

1. Purcell: Electricity and Magnetism-Berkeley Physics, Vol.II McGaw Hill.
2. Halliday and Rensick: Physics, Vol.II – John Wiley.
3. Fewkes and Yarwood : Electricity and Magnetism - Oxford
4. Reitz, Milford and Christy: Electromagnetic theory – Addison Wesley.
5. Bleaney and Bleaney : Electricity and Magnetism – Oxford.
6. Feynmah, Leighton and Sands : Feynman Lecture Notes on Physics. Vol.II Narosa.
7. C.J. Smith : Electricity and Magnetism – Radha.
8. Griffiths : Introduction to Electrodynamics – Prentice Hall India.
9. Jackson : Classical Electrodynamics – John Wiley.
10. Cotton : Electrical Technology – ELBS.
11. Undergraduate Physics, Vol.II-Bhattacharya and Bhattacharya, NCBA.

Paper-VI

Practical

Full Marks : 50

Note :

1. Students are to maintain a laboratory note book which would serve as the log book of their day to day laboratory work as well as contain a full report of each experiment performed. Data should be directly rec orded in the laboratory note book during the practical class and these should be signed by the teacher everyday at the end of the class. The full report of each experiment should also be signed by an attending teacher. No separate fair laboratory note book is to be maintained.

2. Each student has to perform one experiment duri ng the final examination. The experiment would be allotted by drawing of lots.
3. 10 marks are to be set aside on the regularity of students in attending classes and the assessment of their performance during the whole course in the laboratory as evident from the laboratory note book.
4. 10 marks would earmarked for oral questions on the experiment and associated topics and which will be asked during the examination. 30 marks are set aside for the experiment.

List of Experiments :

1. Measurement of g by Kater's pendulum.
2. Study of temperature variation of surface tension of a liquid by Jaeger's method.
3. Measurement of coefficient of viscosity by Stoke's methpd.
4. Measurement of the velocity of sound by Kundt's tube.
5. Measurement of thermal conducti vity of a bad conductor by Lee and Chorlton's method incorporating Bedford corrections.
6. Determination of the boiling point of a liquid by Platinum resistance thermometer.
7. Determination of the refractive index of the material of a thick prism by spectrometer.
8. Study of variation of thermo-emf of a thermocouple with temperature and measurement of its thermoelectric power.
9. Determination of the melting point of a solid with a thermocouple.
10. Measurement of J by Callendar and Barne's method.
11. Study of series L-R and C-R ac circuits, to draw the phase diagrams to find the Ohmic losses and to draw the frequency response curves.
12. Study of the series L-C-R ac circuit, to draw the response curve to find the resonant frequency and to study the varia tion of Q with C.
13. Study of the parallel L-C-R ac circuit, to draw the response curve to find the resonant frequency and to study the variation of Q with C.
14. Measurement of high resistance by leakage using a capacitor and a ballistic galvanometer.
15. Drawing of B-H curve of a ferromagnetic specimen and determination of the area under the hysteresis loop.
16. To measure the inductances of two coils separately and in series by Anderson's bridge and hence to estimate the coefficient of coupling between the two coils.

PART-III

Paper-VII

Full Marks : 80

Total No. of Lectures : 120

Group A (No. of Lectures : 60)

Physical Optics - 40 marks

(5 questions to be set, 3 to be answered)

1. Wave Nature of Light : Huygen's theory; deduction of laws of reflection and refraction at both plane and curved surfaces from Huygen's principle; basic properties of waves – superposition principle, interference and diffraction; Huygens-Fresnel principle. (7)
2. Interference of Light Waves : Coherent and incoherent superposition – condition of interference; methods of division of wavefront and division of amplitude; biprism; Lloyd's minor – phase change on reflection; multiple beam interferometry – transmitted and reflected beams; thin films and colour of thin films; Newton's rings. (8)
3. Diffraction of Light Waves :
   a) Fresnel's half period zones; explanation of rectilinear propagation of light and formation of shadows; Fresnel and Fraunhofer types of diffraction; Babinet's principle. (4)
   b) Fraunhoefer Diffraction : single slit; double slit; rectangular aperture; circular aperture (no derivation of formula); plane diffraction grating; (4)
   c) Fresnel Diffraction : single slit; rectangular and circular apertures; straight edge; circular disc construction of half period strips; zone plate; Fresnel diffraction patterns in terms of Fresnel integrals.. (5)
4. Resolving Power of Optical Instruments : Rayleigh criterion; resolving powers of prism, grating, telescope and microscope. (2)
5. Interferometers : Michelson's interferometer – description and uses; Fabry Perot interferometer description, resolving power and uses; standardization of the meter. (4)
6. Coherence : Temporal and spatial; spontaneous and stimulated emission: principles of LASER and MASER (qualitative); basic principles of holography. (6)

7. Polarisation :
   a) Nature of Polaised light – plane, circularly and elliptically polarised height. (2)
   b) Production of Polarised light : polarisation by reflection and refraction. Brewster's law, double refraction in anisotropic crystals – optical axis; principal section and principal plane; uniaxial and biaxial crystals; diachro nic crystals. (5)
   c) Uniaxial Crystals: Huygen's construction and experimental verification; Nicol prism and uses; Malus law; experimental measurement of μ_o and μ_c.(3)
   d) Babinet's Compensator : Construction; investigation of properties of elliptically polarized light by Babinet's Compensator : Construction; investigation of properties of elliptically polarised light by Babinet's compensator, retardation plates; Fresnel's rhomb; production, detection and analysis of plane, circularly and elliptically polarised lights. (7)
   e) Rotatory Polarisation and Optical Activity; Fresnel's theory: some common types of polarimeters and their uses (principles only – to be taught as a background for practical classes). (3)

Reference Books :

1. Jenkins and White : Fundamentals of Optics – McGraw Hill Kogakusha.
2. Longhurst : Geometrical and Physical Optics – Longmans.
3. Ghatak : Optics – Tata McGraw Hill.
4. Rossi : Optics – Addison Wesley.
5. Ditchburn : Light – Pergamon.
6. Mathur and Pande : Principles of Optics – Gopal Press (Kanpur).
7. Bijay Sankar Basak : Bhouta Alokevigyan (in Bengali) – W.B. State Book Board.
8. Suhas Bandopadhyay : Aloeker Samabartan (in Bengali) – W.B. State Book Board.

Group B (No. of Lectures : 60)

Electromagnetic Theory and Special Theory of Relativity - 40 marks

(5 questions to be set, 3 to be answered)

1. Electromagnetic Theory :
   a) Displacement current; continuity equation; Maxwell's equations; scalar and vector potentials, wave equation for the electromagnetic wave and its solution – plane wave and spherical wave solutions; relation between E and B; field energy; Poynting vector and Poynting's theorem; boundary conditions. (6)

b) Wave equation in Isotropic Dielectrics; reflection and refraction at plane surfaces; reflection and transmission coefficients; Fresnel's formulae and applications; change of phase on reflection; Brewster's law; total internal reflection. (5)

c) Wave equation in Anisotropic Dielectrics; crystal optics – equation of the wave surface: electromagnetic theory of optical activity. (5)

d) Waves in a Conducting Medium; reflection and transmission at metallic surface – skin effect. Propagation of electromagnetic waves between parallel conducting plates – wave guides with rectangular cross-sections; TE and TM modes. Optical fibres – total internal reflection; optical fibre as wave-guide; step index and graded index fibres. (7)

2. Dispersion : Normal and Anomalous Dispersions; Sellmeier's and Cauchy's formulae from electromagnetic theory. (3)

3. Scattering : Radiation from an Oscillating Dipole (qualitative only) scattering of radiation by a bound charge. Rayleigh scattering; depolarization factor; blue of the sky; absorption; Raman scattering (qualitative). (6)

4. Electro-and Magneto-optic Effects : Zeeman and Faraday effects (Vector atom model to be used) qualitative discussions of Stark effect and Kerr electro-optic effect. (5)

5. Special Theory of Relativity :

a) Michelson Moreley experiment : implication of this experiments; non-invariance of Maxwell's equations under Galilean transformation. (4)

b) Postulates of Special Theory of Relativity; Lorentz transformation; length contraction; time dilatation; simultaneity; velocity addition theorem; explanation of stellar aberration, Fizeau's experiment and Michelson Morley experiment; Doppler effect; variation of mass with velocity; force and kinetic energy; transformation relations for momentum, energy and force : invariance of Maxwell's wave equation under Lorentz transformation. (9)

c) Proper time and Light Cone; Mjnkowski space; Lorentz transformations as orthogonal transformations in 4-dimensoional space; four vectors; space like, time like and light like four vectors; causality. (3)

d) Relativistic Kinematics; kinematics of decay products of unstable particles; centre of momentum transformations and reaction thresholds; particles with zero mass. (4)

e) Acceleration of a charged particle by longitudinal and transverse electric fields: Lorentz force in a moving medium. (3)

Reference Books :

1. Born and Wolf : Principles of Optics – Pergamon.
2. Sommerfeld : Optics – Academic Press.
3. Jackson : Classical Electrodynamics – John Wiley.
4. Ditchburn : Light – Pergamon.
5. Marion and Heald : Classical Electromagnetic Radiation – Academic Press.
6. Reitz, Milford and Christy : Electromagnetic Theory – Addison Wesley.
7. Kittel, Knight and Ruderman : Mechanics, Berkeley Physics, Vol.I – McGraw Hill.
8. French : Special Theory of Relativity – ELBS.
9. Sriranjan Bandopadhyay : Apekshikata Tatwa (in Bengali) – W.B. State Book Board.
10. A.K. Raychaudhuri : Uchchatara Gratividya (in Bengal) – W.B. State Book Board.

Paper-VIII

Full Marks : 80

Total No. of Lectures : 115

Group A (No. of Lectures : 25)

Classical Mechanics - 24 marks

(3 questions to be set, 2 to be answered)

1. Degree of freedom; generalized coordinates – examples: constraints – holonomic and non-holonomic; examples. (3)
2. Virtual displacement and virtual work; principle of virtual work : D Alembert's principle; simple applications; generalized force and generalized momenta : work and energy. (4)
3. The Lagrangian; Lagrange's equation of motion – application to simple systems; canonically conjugate momenta; ignorable co-ordinates; constraints and Lagrange's undetermined multipliers. (7)
4. Hamilton's action function; Hamilton's principle : principle of least action : Lagrange's equation from Hamilton's principle. (3)
5. The Hamiltonian; Hamilton's equations of motion – application to simple systems: Poisson Brackets. (5)
6. Small oscillations : Normal modes and eigen frequencies. (3)

Reference Books :

1. Greenwood : Classical Dynamics – Prentice Hall India.
2. Norwood : Intermediate Classical Mechanics – Prentice Hall India.
3. Symon : Mechanics – Addison Wesley.
4. Marion : Classical Dynamics – Harcourt, Brace and Jovanovich.
5. A.K. Raychaudhuri : Classical Mechanics – Oxford.
6. A.K. Raychaudhuri : Uchchatara Gatividya (in Bengali) – W.B. State Book Board.

Group B (No. of Lectures : 35)

Statistical Mechanics 0 24 marks

(3 questions to be set, 2 to be answered)

1. Phase space : microstates and macrostates; elementary ideas about pr obability and probability distributions; hypothesis of equal *a priori* probability for microstates; statistical weights; distribution functions. (9)
2. Statistical ensembles; isolated, closed and open systems; interactions between two systems thermal, mechanical and diffusive; statistical definitions of temperature, pressure, entropy and chemical potential; partition function. (6)
3. Maxwell's distribution law of molecular velocities; identification of β with $(kT)^{-1}$; connection between partition function and thermodynamic quantities; equipartition theorem and simple applications; calculation of thermodynamic quantities for ideal monatomic gas; Gibbs' paradox. (6)
4. Quantum Statistics : Identical particles and symmetry requirements; quantisation of phase space and minimum volume of a phase cell; derivation of MB, BE and FD distribution laws as the most probable distribution (micro -canonical ensemble); degeneracy criterion. (4)
5. Fermi-Dirac distribution at zero and non-zero temperatures; Fermi energy and its expression in terms of particle density; classical limit; degenerate free electron gas; electronic specific heat of metals at low temperature; thermionic emission – Richardson Dushman's law; quantum theory of paramagne tism. (5)
6. Bose-Einstein distribution; classical limit; application to radiation – Planck's law; Stefan's law; phonons and lattice specific heat of solids – connection with Einstein's and Debye's theory; Bose-Einstein condensation (qualitative discussions). (5)

Reference Books :

1. Reif : Thermal and Statistical Physics – McGraw Hill Kogakusha.
2. Saha and Srivastava : A Treatise on Heat-Indian Press, Allahabad.
3. Kittel and Kroemer : Thermal Physics – Freeman.
4. Sears and Salinger : Thermodynamics, Kinetic theory and Statistical Mechani cs – Narosa.

Group C (No. of Lectures : 55)

Quantum Physics - 32 marks

(3 questions to be set, 2 to be answered)

1. Failure of Classical Physics and the Evaluation of the Old Quantum Theory :
   a) Black body radiation – shortcomings of the Rayleigh - Jean's law and Wien's law; Planck's law, quantisation of energy of harmonic oscillators. (4)
   b) Photoelectric effect. (1)
   c) Compton scattering – dual nature of radiation. (2)
   d) Electron diffraction : Davisson-Germer experiment. (2)
   e) Atomic Spectra : Bohr-Sommerfeld atomic model and quantum conditions: hydrogen spectrum; excitation and ionisaton of atoms – Franck and Hertz experiment; fine structure and intrinsic spin of the electro n; Stem Gerlach experiment; magnetic moment of the electron; Lande g factor; vector atom model – space quantisation; L-S and J-J couplings; alkali atom spectra; Pauli exclusion principle, shell structure and periodic table. (1 2)

      X-rays : continuous and characteristic X-rays; Moseley's law and its explanation from Bohr's theory. (2)
2. Basic Quantum Mechanics :
   a) de Broglie's hypothesis; group velocity and phase velocity; group velocity of waves and particle velocity. (3)
   b) Principle of superposition; Schroedinger's wave equation; equation of continuity; probabilistic interpretation of the wave function. (3)
   c) Dynamical variables and linear hermitean operators; properties of eigenfunctions and eigenvalues of hermitean operators; momentum, energy and angular momentum operators. (3)
   d) Momentum, angular momentum operators and Schroedinger's equation in rectangular Cartesian, spherical polar and cylindrical coordinates; (3)

e) Result of measurement of dynamical observables; expectation values; Bohr' s correspondence principle; Ehrenfest's theorem; stationary and non -stationary states; time dependent and time independent wave equations. (4)

f) Commutation relations between operators; simultaneous measurement; Heisenberg's uncertainty principle with illustrations. (3)

3. Simple Applications of Quantum Mechanics :

   a) One dimensional potential well and barrier; boundary conditions; bound and unbound states; reflection and transmission (similarities and difference with classical systems are to emphasized at each step). (4)

   b) Free particle in one dimensional motion; momentum eigen functions; box normalization (2)

   c) Linear harmonic Oscillator; solution of the wave equation for the ground state; discreteness of the energy eigen values; parity of wave function. (4)

   d) Diatomic Molecules : Rotational and vibrational energy levels, basic ideas about molecular spectra. (3)

Reference Books :

1. Semat and Albright : Atomic and Nuclear Physics – Chapman and Hall.
2. Richtmayer, Kennard and Cooper : Introduction to Modern Physics – Tata McGraw Hill.
3. Eisberg and Resnick : Quantum Physics of Atoms, Molecules and Nuclei – John Wiley.
4. White : Introduction to Atomic Spectra – McGraw Hill Kogakush.
5. Littlefield and Thorley : Atomic and Nuclear Phyisics – ELBS.
6. Mathews and Venkatesan : A Text Book of Quantum Mechanics – Tata McGraw Hill.
7. Ghoshal : Introductory Quantum Mechanics – Calcutta Book House.
8. Powell and Crasemann : Quantum Mechanics – Oxford and IBH.

Paper-IX

Full Marks : 80

Total No. of Lectures : 140

Group A (No. of Lectures : 65)

Structure of Matter - 40 marks

(5 questions to be set, 3 to be answered)

1. Crystal Structure : Crystalline and amorphous solids; translational symmetry; elementary ideas about crstal structure; lattices and bases; unit cell; fundamental types of lattices; Miller indices; simple cubic, fcc and bcc lattices; Laue and Bragg equations; reciprocal lattice; Structures of NaCl and KCl Crystals. (8)
2. Structure of Soldis : Types of bonding; band theory of solids (qualitative) – valence and conduction bands; electrons and holes; conduct ors; semi-conductors and insulators; metals; free electron theory of metals – Drude theory; driff current and mobility: conductivity (static and frequency dependent) and resistivity (4)
3. Semi-conductors : Intrinsic and extrinsic semiconductors; p and n t ype semi-conductors; electron and hole densities; generation and recombination of carriers; drift and diffusion of carriers; equation of continuity; diffusion length. (3)
4. Internal Structure of the Atom : The electron; Thomson's experiment and Millikan's oil drop experiment; Thomson's model of the atom; Rutherford's experiment and its implications existence of the nucleus. (3)
5. Gross properties of the Nucleus : Cosntitutents – discovery of the proton and the neutron; nuclear size, charge, mass and bind ing energy; angular momentum of the nucleus – nuclear spin; magnetic dipole moment and electric quadrupole moment of the nucleus; isobars, isotopes and isotones; measurement of atomic masses – basic principle of mass spectrographs. (4)
6. Nuclear Structure : Nature of force between nucleons; nuclear stability and nuclear binding; liquid drop model and the semi -empirical mass formula – applications to considerations of nuclear stability; elementary ideas about the shell model – magic numbers. (4)
7. Unstable. Nuclear :
   a) Radioactivity : Discovery; identification of alpha, beta and gamma rays, radioactive decay laws; disintegration constant; half life and mean life; successive disintegration transient and secular equilibriums: radioactive series; units of radio activity; dating from radioactivity and other applications.(4)

b) Alpha decay : Alpha spectra : velocity and energy of alpha particles, range of alpha particles Geiger Nuttal law; fine structure in a alpha spectra, outlines of theory of alpha decay. Coulomb barrier and tunneling, model calculation using a square barrier. (3)

c) Beta Decay : Nature of beta spectra – neutrino; energy levels and decay schemes, positron emission and electron capture; selection rules; range of beta particles. (2)

d) Gamma decay : Gamma ray spectra and nuclear energy levels; selection rules, internal conversion and Bremsstrahlung (qualitative discussions only). (2)

6. Nuclear Reactions :

a) Artificial radioactivity : Discovery, growth and decay of artificial radioactivity. (1)

b) Two body reactions : Kinematics; Q value of reactions; exo- and endoergic reactions: different types of reactions – elastic, inelastic, rearrangement and break up with examples; reaction mechanisms – characteristics and examples of compound nuclear and direct reactions – Bohr's hypothesis and Ghoshal's experiment on compound nuclear reactions. (4)

c) Nuclear Fission : Discovery; elementay explanation in terms of the liquid drop model-spontaneous and induced fission; fission products and energy release; chain reaction and the principle of nuclear reactors; tra nsuranic elements.

Fusion; energy release in stars – different cycles; birth and death of stars. (4)

8. Elementary Particles ;

a) Discovery of elementary particles – pion, muon, neutrino, positron, K-meson and the hyperons; particles and antiparticles; stable and unstable particles – lifetime and width. (2)

b) Four basic Interactions in Nature and their relative strengths; examples of different types of interactions; classification of elementary particles – hadrons, leptons, baryons, mesons; quantum n umbers and conservation laws; elementary ideas about the quark model. (3)

c) Cosmic rays : nature and origin; primary and secondary rays; showers; van Allen belt (2)

9. Experimental Techniques :

   a) Accelerators : Electrostatic machines – Van de Graff and Cockroft Walton, cyclic accelerators – cyclotron; focusing condition and phase stability; synchrocyclotron, synchrotron; betatron; linear accelerators; colliding beam accelerators. (6)

   b) Detectors : Passage of charged particles through matter – Bohr's formula; ionization loss for light and heavy charged particles (no derivation of formula).

   Gas Counters – ionization chamber, proportional counter and Geiger-Muller counter; spark chambers and wire counters.

   Cloud chamber and Bubble chamber.

   Interaction of electromagnetic radiation with matter – Compton scattering, photoelectric effect and pair production (qualitative discussions – no derivation of any formula); scintillation counter.

   Semi-conductor detectors. (6)

Reference Books :

1. Semat and Albright : Atomic and Nuclear Physics – Chapman and Hall.
2. Littlefield and Thorley; Atomic and Nuclear Physics – ELBS.
3. Kaplan : Nuclear Physics – Addison Wesley /Oxford and IBH.
4. Ghoshal : Atomic and Nuclear Physics, Vols. I and II – S Chand and Co.
5. Green : Nuclear Physics – McGraw Hill Kogakusha.
6. Burcham and Job Elements of Nuclear Physics, Longman.
7. Eisberg and Resnick : Quantum Physics of atoms, Molecules and Nuclei. John Wiley.
8. Bhattacharya and Bhattacharya, Undergraduate Physics, Vol.II, NCBA.
9. S.N. Ghoshal : Paramanu O Kendrak Gathan Parichay (in Bengali) – W.B. State Book Board.
10. D. Bandopadhyay, Paramanu o Kendrin (in Bengali), W.B. State Book Board.
11. A.K. Sarkar : Kathin Abasthar Padarthavigyan (in Bengali) W.B. State Book Board.

Group B (No. of Lectures : 75)
Electronics - 40 marks

(5 questions to be set, 3 to be answered)

1. Networks : Mesh and Nodal methods; T and π circuits and their conversions : voltage and current divider rules; Thevenin's, Norton's and superposition theorems; maximum power transfer theorem. (5)

2.a) Thermionic Emission : Richardson's and Child-Langmuir equations (derivation not required) (2)

b) Cathode Ray Oscillograph : Construction, deflection sensitivity time-base circuits, frequency and phase measurements. (3)

3. Semi-conductor Devices :

a) p-n junctions; space charge and electric field distribution at junction; contact potential and depletion layer, junction capacitances; forward and reverse bias; Fermi level and band diagram : Einstein's relation; diode equation; diode as a rectifier; equivalent circuit; diode characteristics and load line; breakdown in diodes; Zener diode-characteristics. (5)

b) Bipolar junction Transistors : p-n-p and n-p-n transistors; majority and minority carriers – carrier distributions and current components; biasing of transistors; common emitter, common base and common collector configurations; two port network analysis; α, β and γ parameters; h parameters and their conversion; hybrid model; equivalent circuits; transistor characteristics; load line and Q point. (6)

c) Field Effect Transistors : JFET structure : Characteristics, pinch off, biasing and applications, basic concept of MOSFET. (3)

4. Amplifiers : Principle of operation; voltage gain, current gain and power gain; frequency response bandwidth and risetime; input and output impedances; operating point. (3)

Common emitter, common base and common collector configurations – gains and impedances : basic single stage amplifier; emitter follower, wide band and tuned amplifiers. (5)

Multistage amplifier, basic principles and elementary circuits. (1)

Power Amplifiers : Q points of class A, class B, class AB and class C amplifiers; elementary circuits, push-pull amplifier and cross over distortion; coupling of power amplifiers. (3)

5. Feedback : Principle of feedback; advantages of feedback; positive and negative feedbacks; voltage and current feedbacks and their applications; some basic circuits of negative feedbacks; Nyquist criteria. Miller effect; positive feedback – Barkhausen criterion for sustained oscillation; LC oscillator – Hartley/Colpitts oscillator; RC oscillator – phase shift oscillator; crystal oscillator (10)
6. Operational Amplifiers : Differential amplifier; OP-AMP characteristics; inverting and non-inverting amplifiers; buffer, use of differential amplifier as comparator, integrator and differentiator. (5)
7. Digital and Logic Circuits : Binary, decimal and hexadecimal systems; conversion from one system to another. (1)

   Boolean algebra; fundamental postulates; basic theorems. (3)

   Logic systems; AND, OR, NOT, NOR and NAND gates : truth tables, construction of these gates using diodes and transistors : combination of these gates for obtaining various Boolean functions, TTL NAND GATES, Counter, Shift Registers, A/D converter, Half Adder, Full Adder, decoder, Encoder, ROM, RAM (7)
8. Microprocessor : Block diagram of 8085, ALU, Timing and control unit, Registers, Data and address Bus, Opcode and Operands, Instruction ward size, Timing and control signals, Instruction and data flow, Memory read and memory write, addressing modes, assembly language. (8)
9. Power Supply : Half wave, full wave and bridge rectifiers : voltage doubler; ripple factor, Filters : capacitor, inductor and π types; voltage regulation using pass element and zener as reference. (5)

Reference Books :

1. Ryder : Network, Lines and fields – Prentice Hall India.
2. Brophy : Basic Electronics – McGraw Hill.
3. Ryder : Electronic Fundamentals and Applications – Prentice Hall India.
4. Le Croissette : Transistors – Prentice Hall India.
5. Millman and Halkias : Electronic Devices and Circuits – McGraw Hill, Kogakusha.
6. Bhattacharya : Electronic Principles and Applicatio n – Central.
7. Bhattacharya and Bhattacharya : Undergraduate Physics, Vol.III, NCBA.
8. Millman and Grabel : Microelectronics – McGraw Hill.
9. Malvino : Digital Principles and Applications – McGraw Hill.

Paper-X

(Practical) **Full Marks : 80**

Optics Experiments

Note :

1. Students are to maintain a laboratory note book which would serve as the log book of their day to day laboratory work as well as contain a full report of each experiment performed. Data should be directly recorded in the laboratory note book during the practical class and these should be signed by the teacher everyday at the end of the class. The full report of each experiment should also be signed by an attending teacher. No separate fair laboratory note book is to be maintained.
2. Every student has to perform an experiment during the examination and write up a report on the experiment. The experiment would be allotted by drawing of lots. The experiment would carry 45 marks.
3. 15 marks are to be set aside on the regularity of students in attending classes and assessment of their performance during the whole course in the laboratory as evident from the laboratory notebook.
4. Another 15 marks would be earmarked for oral questions on the experiment and related topics and which will be asked during the examination.

List of Experiments :

1. Determination of wavelength of monochromatic light by Fresnel's bprism.
2. Determination of wavelength of monochromatic li ght by Newton's rings.
3. Determination of the width of a single slit by Fraunhoefer diffraction.
4. Measurement of separation and width of two identical slits by double slit Fraunhofer diffraction.
5. Measurement of wavelength of light with plane transmi ssion grating.
6. Determination of the resolving power of a plane reflection/transmission grating.
7. To draw the refractive index – wavelength curve of the material of a prism and to find its dispersive power.
8. To draw the deviation – wavelength of the material of a prism and to find the wavelength of an unknown line from its deviation.
9. To verify Brewster's law and Fresnel formulae for reflection of electromagnetic waves with the help of a spectrometer, a prism and two polaroids.
10. To study the characteristics of elliptically polarized light (produced by a Polaroid and a quarter waveplate) with a Babinet's compensator.
11. Measurement of optical activity, calibration of a polarimeter and determination of concentration of sugar solution.
12. To measure Planck's constant with a photoelectric tube.

Paper-XI

(Practical) **Full Marks : 80**

Electricity, Magnetism and Electronics Experiments

Note :

1. Students are to maintain a laboratory note book which would serve as the log book of their day to day laboratory work as well as contain a full report of each experiment performed. Data should be directly recorded in the laboratory note book during the practical class and these should be signed by the teacher everyday at the end of the class. The full report of each experiment should also be signed by an attending teacher. No separate fair laboratory note book is to be maintained.
2. Every student has to perform an experiment during the examination and write up a report on the experiment. The experiment would be allotted by drawing of lots. The experiment would carry 45 marks.
3. 20 marks are to be set aside on the regularity of students in attending classes and assessment of their performance during the whole course in the laboratory as evident from the laboratory note book.
4. Another 15 marks would be earmarked for oral questions on the experiment and related topics and which will be asked during the examinations.

List of Experiments :

1. To measure the mutual inductance of two coaxial coils at various relative orientations using a ballistic galvanometer.
2. To measure capacitance by Wein's bridge.
3. To draw the I-V characteristics of a semi-conductor diode and a Zener diode.
4. tod raw the I-V characteristics of a valve diode and to verify the laws of thermionic emission.
5. To determine the Fourier spectrum of (i) square, (ii) triangular and (iii) half sinusoidal waveforms with the help of a CRO.
6. To draw the common emitter characteristics of a transistor and to find its parameters.
7. To draw the common base characteristics of a transistor and to find its parameters.

8. To measure the hybrid parameters and leakage current of a transistor using an ac source.
9. To measure the voltage gain, bandwidth, input and output impedances of a single stage common emitter amplifier for various RC combinations.
10. To determine and compare the gains and bandwidths of common emitter amplifier with RC, LC and transformer coupling in the output.
11. To determine the voltage gains, bandwidths and their products for a common emitter amplifier with and without negative voltage and curren t feedbacks.
12. To construct OR, AND, NOT and NAND gates using discrete components and to verify truth tables using these.
13. To design and test the following circuits using an OP -AMP : (i) Differential amplifier, (ii) Inverting and non -inverting amplifier and (iii) a square or a triangular wave generator.
14. To construct a regulated power supply on a breadboard using a power transistor and a zener-diode and to study its performance.
15. Experiments on μ Processor.
16. Simplification of Boolean expressio n and its circuit realization using IC's.

07/08/2009
Secretary, Faculty Councils (U.G.)
University of Kalyani
Kalyani, Nadia

University of Kalyani

Revised Syllabus for B.Sc. (General) Course in

PHYSICS

(w.e.f. the session 2009-2010)

According to the New Examination Pattern
Part – I, Part – II & Part – III

Details of the Physics(General) Course

& Contents

Examination	Paper	Subjects		No. of Lectures	Marks	Page Number	Total marks & Lectures
B.Sc. Part-I	Paper-I	Group A : Mechanics		40	34	G-1	100 marks
		Group B : Gravitation & Genl. Properties of Matter		18	16	G-2	118 lectures
		Group C : Waves, Oscillations and Acoustics		15	16	G-2	
		Group D : Thermal Physics		45	34	G-3	
B.Sc. Part-II	Paper-II	Group A : Electr. & Magn.		40	34	G-4	100 marks 114 lectures
		Group B : Optics		30	32	G-5	
		Group C : Modern Physics		44	34	G-6	
	Paper-III	Practical			100	G-7	100 marks
B.Sc. Part-III	Paper-IV	Theory	Group A : Exp. Techniques	20	12	G-10	60 marks 76 lectures
			Group B : Electronics	26	24	G-10	
			Group C : Computers & Programming	30	24	G-11	
		Practical			40	G-11	40 marks

PART-I

Paper-I

Full Marks : 100 **No. of Lectures : 118** **Time : 3 Hours**

Group A : Mechanics **40 Lectures** **34 marks**

(4 questions to be set, 2 to be answered)

1. Units and Dimensions : Different systems of units; dimensions of phys ical quantities – fundamental and derived; principle of dimensional homogeneity. (3)
2. Vectors : Definition; addition of vectors; axial and polar vectors; scalar and vector products; triple products of vectors; geometrical interpretation; scalar and vecto r fields; gradient, divergence and curl, line integral, surface integral and volume integral; Gauss's theorem and Stoke's theorem (statement and explanation only – no derivation); the Laplacian. (7)
3. Velocity and Acceleration; tangential and normal compo nents; systems moving with uniform velocity and uniform acceleration; addition of velocities; relative velocity(6)
4. Newton's laws of motion; inertial frames; principle of conservation of linear momentum; time integral of force – impulse; path integral of force – work; conservative and non-conservative systems; potential and kinetic energies; principle of conservation of energy; elastic and inelastic collisions; system with variable mass; dissipative forces – friction. (8)
5. Rotational Motion : Angular ve locity and angular acceleration; uniform motion along a circular path – centripetal acceleration; torque and angular momentum – equation of motion; conservation of angular momentum. (3)
6. Rigid Body : Definition; types of motion – translational and rotat ional; translational motion in terms of centre of mass, linear momentum, external force and translational kinetic energy. (2)

   Rotational motion : axis of rotation; rotational kinetic energy; angular momentum of rotation; moment of inertia and radius of gy ration; parallel and perpendicular axes theorems: calculation of moment of inertia for simple geometries. (3)

   Translation combined with rotation; rolling with and without slipping on horizontal and inclined planes. (2)
7. Special Theory of Relativity : Reference frame; frame independence of velocity of light; postulates of special relativity: Lorentz transformation equations (no derivation) : length contraction, time dilatation and simultaneity; relativistic expressions of total energy, rest energy, kine tic energy and momentum – variation of mass with velocity; equivalence of mass and energy; velocity addition theorem (no derivation – statement and difference with Newtonian mechanics to be pointed out). (6)

Group B (18 Lectures)

Gravitation and General Properties of Matter - 16 marks

(2 questions to be set, 1 to be answered)

1. Graviation :
   (a) Newton's law of graviation and acceleration due to gravity, concept of central force and conserved quantities; Kepler's laws (no derivation – statement and explanation only) (2)
   (b) Gravitational potential and intensity : calculations for a spherical shell and a solid sphere, gravitational self-energy of a sphere, rocket and satellite notion, geo-stationary orbit, escape velocity. (4)
2. Elasticity : Hooke's law; different elastic constants and their interrelations : torsion of a cylinder bending of beams – cantilever. (4)
3. Surface Tension : Surface tension and surface energy; molecular theory, liquid in contact with solid – angle of contact; capillary rise and fall of liquid columns – Jurin's law; excess pressure on a curved surface; variation of surface tension with temperature (qualitative discussions only) (4)
4. Fluid Motion : Streamline and turbulent motion of a liquid; Newtonian fluids; viscosity of fluids: flow through a capillary tube – Poiseuille's formula; critical velocity; Reynold's number : Stoke's law; variation of viscosity with temperature (qualitative discussions only); Bernoulli's theorem on fluid flow. (4)

Group C (15 Lectures)

Waves, Oscillations and Acoustics - 16 marks

(2 questions to be set, 1 to be answered)

1. Simple harmonic Motion – differential equation and solution; superposition of simple harmonic motions; damped and forced vibrations – resonance. (5)
2. General Equation of Wave Motion : plane waves and spherical waves; Fourier's theorem (no proof); sinusoidal waves – properties; longitudinal and transverse waves – examples and properties; progressive and stationary waves; nodes and antinodes; energy flow; dispersive waves – group velocity and phase velocity.(5)
3. Sound Waves : Characteristics of sound waves; velocity of sound waves in solids, gases and strings: loudness and intensity of sound waves; Doppler effect (5)

Group D (45 Lectures)

Thermal Physics - 34 marks

(4 questions to be set, 2 to be answered)

1. Thermometry : definition of temperature: constant volume gas thermometer : international temperature scale; resistance thermometer; thermo couple. (4)

3. Kinetic Theory : Ideal gas; simple gas laws from kinetic theory; pressure of an ideal gas: elementary ideas about probability and the concept of probability distributions; Maxwell's velocity Distribution law (derivation not required statement and explanation), mean, r.m.s and most probable speeds; degrees of freedom: principle of equipartition of energy with application to simple cases, mean free path and collision probability, qualitative study of Brownia n motion, variation of atmospheric pressure and temperature with height (10)

3. Real gases : Deviations from Boyle's law : Andrew's experiments, van der Waal's equation (simple derivation); critical constants; law of coresponding states. (4)

4. Thermal Conductivity : thermal diffusivity; Fourier's equation in one dimension and its solution in simple cases; theory of Ingen Hausz's experiment; Wiedemann -Franz law (no derivation : statement only) (4)

5. Thermodynamics : Isothermal, isobaric, isochoric and adiabatie changes, thermal equilibirum and the zeroeth law of thermodynamics; equvalence of mechanical, electrical and thermal energies – the constant J; state variables and state function; internal energy; first law of thermodynamics; relation between specific heats and other simple applications of the first law; reversible and ireversible processes; P -V diagrams; Carnot engine and Carnot cycle – efficiency: second law of thermodynamics; concept of entropy; Clausius' theorem : entropy changes in reversible and irreversible processes; thermodynamic scale of temperature; principle of operation of external and internal combustion engines; principle of refrigeration. Joule-Thomson effect; enthalpy; inversion temperature; regenerat ive cooling and adiabatic cooling. (15)

6. Introduction to Statistical Mechanics : System of very large number of particles; microscopic and macroscopic properties; MB, BE and FD distribution formulae (no derivation) explanation and applicability of the formulae. (3)

7. Radiation : Emissive and absorptive power; black body; Kirchhoff's law; Stefan's law: Newton's law of cooling; Planck's law (no derivation) and graphical interpretation: Wien's displacement law (no derivation) and graphical illustration; principle of radiation pyrometers. (5)

Paper-II

Full Marks : 100 **No. of Lectures : 114** **Time : 3 Hours**

Group A (40 Lectures)

Electricity and Magnetism - 34 marks

(4 questions to be set, 2 to be answered)

1. Electric charge, quantisation of charge – implications of Millikan's oil drop experiment (no calculation here); conservation of electric charge, units of electric charge (2)

2. Electrostatic Field and Potential : Coulomb's law; electric field intensity and static potential, calculation of these quantities for systems of point charges and simple charge distributions; lines of force and flux; Gauss's law and simple applications; Laplace's and Poisson's equations

   Electric dipole : potential and field due to a dipole: potenti al energy of a dipole in a uniform electric field.

   Dielectric medium; polarisation; electric displacement vector D; energy of a charge distribution; electrostatic field energy.

   Capaciatance and condensers; calculation of capacitance for some cases with sim ple geometry; energy stored in a capacitor. (8)

3. Steady Currents: Concept of current – transportation of charge; flow of charge due to potential difference: units of curent and potential difference; Ohm's law, resistivity and conductivity. Kirchhoffs la ws and applications; energy and power in electric circuits sensitivity of a Wheatstone's bridge arrangement; potentiometer – principle and applications. (4)

4. Magnetic effect of Current : Absence of magnetic monopoles, the magnetic field B. Biot Savart law; Ampere's law; application of these laws to current distributions with simple geometries solenoid: Helmholtz coil; magnetic field due to a closed current loop – magnetic dipole and dipole moment; Lorentz force; some simple applications – cyclotron, Hall effect (elementary discussions) force on a current carrying conductor in a uniform magnetic field; force between two currents; torque on a closed current loop in a magnetic field. (5)

5. Magnetism in Material Media and Magnetic Properties of materials: the three magnetic vectors **B, H** and **M** – illustration in case of a bar magnet; magnetic susceptibility : types of materials – dia, para and ferro magnetic substances and their properties; Curie's law and Curie-Weiss law (no derivation). Curie temperature; magnetisation cycle, hysteresis loss in ferromagnetic materials, prac tical applications – electromagnets and permanent magnets. (4)
6. Electromagnetic Induction : Magnetic flux: Faraday's and Lenz's laws of electromagnetic induction; elementary applications; self and mutual inductances calculation for cases with simple problems, L-R, C-R, and L-C-R circuits, growth and decay of currents. (5)
7. Alternating Currents: Mean and r.m.s. values of alternating currents and voltages. I.R.C.R. and L.C.R circuits with sinusoidal current voltage sources; impedance, phase angle power factor resonance in L-C-R circuits; Q factor; working principles of transformers; generators and electric motors. (5)
8. Thermoelectricity : Seebeck, Peltier and Thomson effects: thermoelectric curve neutral and inversion temperatures; thermoelectric power. (2)
9. Electromagnetic Theory : Equation of continuity; laws of static electromagnetic field; displacement current; Maxwell's equations; electromagnetic waves in vacuum; wave speed, light as electromagnetic phenomenon; wave equation and its plane wave solution, transverse mature of electromagnetic waves; Hertz experiment. (5)

Group B (30 Lectures)

Optics - 32 marks

(4 questions to be set, 2 to be answered)

1. Geometerical Optics :
   (a) Fermat's principle; laws of reflection and refraction at plane surfaces from Fermat's principle; laws of reflection and refraction at spherical surfaces – lens formula; combination of thin lenses – equivalent focal length. (4)
   (b) Prism, dispersion and dispersive power. (1)
   (c) Chromatic aberration and its remedy; qualitative discussions about Seidel aberrations and their remedies. (3)
   (d) Optical Instruments : Eyepieces : Ramsden and Huygens (basic descriptions only) : astronomical telescope; simple and compound microscopes (in all cases basic principles are to be illustrated – no detailed description required); magnifying power. (3)

2. Wave Nature of Light : Light as an electromagnetic wave; the full electromagnetic spectrum; Huygens' principle – wavefronts; explanation of laws of reflection and refraction at plane surfaces from Huygen's principle. (3)
3. Interference of Light : Principle of superposition: Young's double slit experiment: conditions of interference; division of wavefront – Fresnel's biprism and Lloyd's mirror; division of amplitude, thin films and Newton's rings. (5)
4. Diffraction of Light: half period zones and rectilinear propagation of light; zone plate: Fresnel and Fraunhoefer diffractions; Fraunhoefer diffractions in single slit, double slit and plane diffraction grating (basic principles only); resolving power and Rayleigh criterion. (6)
5. Polarisation : Different states of polarisation; production of polarised light by reflection and refraction, double refraction; uniaxial crystals. Nichol prism and polarised light, plane, circularly and elliptically polarised light, optical activity . (5)

Group C (44 Lectures)

Modern Physics - 34 marks

(4 questions to be set, 2 to be answered)

1. Quntum Theory :

   (a) Photo electric effect; Compton effect; black body radiation and Planck's law; Raman effect; qualitative discussions to illu strate the existence of quantum effects in microscopic world. (3)

   (b) Line spectra and Bohr's theory of the hydrogen atom: Franck and Hertz experiment (principles only); the concept of quantum numbers. (2)

   (c) Wave particle duality and de Broglie waves, wave and group velocity. Davison-Germer experiment (principles only). (2)

   (d) Schroedinger wave equation (time dependent and time independent) interpretation of the wave function; stationary states; Heisenberg's uncertainty principle (qualitative discus sion with examples), particle in one dimensional infinite well; particle crossing a potential barrier -tunneling (no detailed algebra – qualitative discussions with examples – difference with classical physics to be emphasized). (5)

   (e) Vector Atom Model : Stem-Gerlach experiment (principles only) : electron spin, alkali spectra (qualitative discussions); Pauli exclusion principle and the periodic table; Zeeman effect (4)

2. Solids : Amorphous and crystalline solids; elementary ideas about crystal structure, unit cell, basis, lattice; fundamental types of lattices; diffraction of X-rays by a crystal lattice, Bragg's law, Moseley's law (its importance and its explanation from Bohr's theory). (3)
3. Semiconductor Physics : Qualitative ideas about energy bands, intrinsic semiconductors, doping and extrinsic semiconductors; electr ons and holes; majority and minority carriers; p-n junction and properties – depletion region, barrier voltage, junction capacitance (5)
4. Atoms: Discovery of the electron; Thomson's experiment; Millikan's oil drop experiment: atomic weight and atomic num ber; general principles of mass spectrometers; isotopes. (3)
1. Nuclear Physics :
   (a) Constituents of the Nucleus : Description and conclusions from Rutherford's experiment (no derivation of formula); constituents of the nucleus; discoveries of the proton and the neutron, properties of the proton and the neutron. (2)
   (b) Nuclear Gross Properties : Mass and binding energy; binding energy curve, nuclear energy levels, nuclear spin; qualitative discussions about nuclear structure (liquid drop model and shell mode l) (3)
   (c) Unstable Nuclei: radioactivity; radioactie decay laws; alpha, beta and gamma rays, successive decay and radioactive equalibrium (secular) (2)
   Systematics and energy spectra in alpha and beta decays (2)
   (d) Nuclear Reactions – examples; systematics and characteristics, artificial radioctivity (2)
   (e) Fission – systematics and energy release; Fusion – energy cycles in stars (qualitative) (2)
   (f) Accelerators – Linear accelerators and cyclotron (basic principles only) (2)
   (g) Nuclear detectors – GM counters and scintillation detectors (basic principles only) (2)

Paper-III
(Practical)

Full Marks : 100 Time : 6 Hours

Notes :

1. In the final examination, the students will have to perform two experiments, one from each group, on a single day. The experiments would be allotted by drawing of lots.

2. Students are to maintain a laboratory note book, which would serve as the log book of their day to day laboratory work as well as contain a full report of each experiment performed during the class. Data should be directly recorded in the laboratory note book during the practical class and these should be signed by the teacher everyday at the end of the class. The full report of the experiment should also be signed by the attending teacher. No separate fair laboratory note book need be maintained.
3. 20 marks are to be set aside on the regularity of students in attending classes (based on attendance records) and the assessment of their performance during the whole course in the laboratory as evidenced from the laboratory ntoe book.
4. Each experiment will carry 40 marks of which 10 will be earmarked for oral questions to be asked during the experiment on topics related to the particualr experiment.
5. Before starting the course of experiments, some introductory lectures, demonstrations should be arranged on the following topics; use of vernier scales and micrometer screws; use of common balance; drawing of graphs; reading the barometer etc.

List of Experiments

Group A :

1. Determiantion of moment of inertia of a rigid body.
2. Determination of g by compound pendulum
3. Determiantion of Young's modulus of the material of a beam by flexure (one length to be taken).
4. Measurement of the rigidity modulus of the material of a wire by static method.
5. Measurement of the rigidity modulus of the material of a wire by dynamic met hod.
6. Measurement of surface tension of a liquid by capillary tube method (capillary tubes to be suplied).
7. Measurement of coefficient of viscosity of a liquid by Poiseuille's method.
8. To draw the frequency – resonant length curve of a sonometer wire and to find the unknown frequency of a tuning fork.
9. Determination of the frequency of a tuning fork by Melde's method.
10. Verification of Newton' law of cooling.
11. Measurement of coefficient of linear expansion of a solid by Pullinger's method.
12. Determination of the refractive index of a liquid by apparent depth method.
13. Determination of the refractive index of a liquid with the help of a plano -convex lens and a plane mirror.
14. Measurement of the focal length of a concave lens by displacement me thod.
15. Measurement of the focal length of a concave lens by auxiliary lens method.

Group B :

1. To draw the I-d curve of a prism with a spectrometer and to find the angle of minimum deviation.
2. Determiantion of the refractive index of the material of a thick prism by a spectrometer.
3. Measurement of the radius of curvature of a lens by Newton's ring method.
4. Comparison of the moments of two bar magnets, and the determiantion of earth's magnetic field with deflection and oscillation magnetometers.
5. Verification of Ohm's law with a tangent galvanometer.
6. Determination of the end corrections of a metre bridge and to measure the value of an unknown resistance incorporating end corrections.
7. Determination of the resistance per unit length of a meter bridge wire and to find the specific resistant of a material in the form of a wire by Carey Foster's method.
8. Measurement of the emf of a battery with a potentiometer.
9. Measurement of current in an external circuit by a potentiometer and a standard resistance.
10. Measurement of the resistance of a mirror galvanometer by h alf deflection method and to find out figure of merit.
11. Determination of the internal resistance of a cell by Mance's method.
12. Measurement of the resistance of a table galvanometer by Kelvin's method.
13. Study of the series C-R circuit, to draw the phase diagrams and to find the capacitative loss.
14. Study of tehe series L-R circuit, to draw the phase diagrams and to find the ohmic loss in the inductor.
15. Study of the series L-C-R a.c circuit to draw the response curve and to find the resonant frequency.

PART-III

Paper-IV

Full Marks : 100

Theory (60 Marks, No. of Lectures : 76)

Group A (20 lectures)

Experimental Techniques - 12 marks

(2 questions to be set, 1 to be answered)

1. Vacuum Techniques : Rotary, diffusion and ion pumps: McLeod, Pirani and thermocouple gauges (basic principles only). (4)
2. Spectroscopic Techniques : Emission and absorption spectra : spectroscopy in visible, ultraviolet and infrared regions; different types of spectrometers. (5)
3. LASERS : Spontaneous and stimulated emission qualitative discussions, idea of population inversion; principle of LASER; different types of LASERS. (4)
4. Optical Fibres : Principle of operation; step index and graded index fibres, uses. (2)
5. Electrical wiring: Basic techniques and applications (3)
6. Conventional and Non-conventional energy sources, their uses. (2)

Group B (26 Lectures)

Electronics - 24 marks

(4 questions to be set, 2 to be answered)

1. p-n junction diode characteristics; half wave and full wave rectifier circuits : bridge rectifier, filters. (3)
2. Zener diode – characteristics; use as a voltage regulator (1)
3. Bipolar junction transistors: method of operation, current components; biasing, the constants α and β, characteristics in common emitter mode. (3)
4. Single stage amplifier in common emitter configuration, voltage gain, input and output impedances: bandwidth; power amplifiers. (3)
5. Feedback: basic principle; advantages of feedback, negative feedback; positive feedback and Barkhausen criterion: basic oscillator circuit (using block diagram only) (3)

6. OPAMP and its uses, inverting and non-inverting amplifier. (2)
7. Digital Electronics Binary arithmetic, Binary to Decimal conversion and vice versa, AND, OR and NOT gates and their truth tables: de Morgan's theorem, NOR and NAND universal gates; half adder and full adder. (5)
8. Simple ideas about modulation and demodulation. Amplitude and frequency modulation, transmission and reception of radiowaves (using block diagram only). (3)
9. Basic principles of TV transmission and reception, Block diagrams, satellite communications (descriptive-basic principles only) (3)

Group C (30 Lectures)

Computers and Programming - 24 Marks

(4 questions to be set, 2 to be answered)

1. Different types and generations of computers; basic building blocks; central processing unit; fundamentals of PC; hard disc; RAM; ROM; floppy; CD-ROM (7)
2. Operating Systems : MS DOS; Windows (5)
3. Language : BASIC/FORTRAN. (6)
4. Programming: Control statements; do loops; functions and subroutines; input and output statements; sorting; calculation of mean, median, mode and standard deviation; solution of simple algebraic equations; straight line least square fit; differentiation and integration; simple interpolat ion, plotting of graphs. (12)

Practical (40 Marks)

Notes :

1. Students are to maintain a laboratory notebook, which would serve as the logbook of their day to day laboratory work as well as con tain a full report of each experiment performed. Data should be directly recorded in the laboratory notebook during the practical class and these should be signed by the teacher everyday at the end of the class. The attending teacher should also sign the f ull report of the experiment. No separate fair laboratory notebook need be maintaiend.
2. 8 makrs are to be set aside on the regularity of students in attending classes and the assessment of their performance during the whole course in the laboratory as evidenced from the laboratory notebook.

3. During the final examination, a student has to perform one experiment and write a report on the experiment. The experiment will be allotted by drawing of lots. Of the 32 marks earmarked for the experiment, 8 marks will be for oral questions to be asked during the experiment on topics related to that particular experiment.

List of Experiments :

1. To draw the I-V characteristics of a semi-conductor diode.
2. To draw the I-V characteristics of a Zener diode.
3. To draw the common emitter characteistics of a transistor.
4. To construct a regulated power supply on a breadboard.
5. To convert an ammeter into a voltmeter and vice versa.
6. To study the use of OP-AMP in the construction of a fixed gain amplifier.
7. To construct OR, AND and NOT gates using discrete components and to verify truth tables using these.
8. To practice the operating system commands of a computer.
9. To write and execute a simple programme in BASIC/FORTRAN and execute it.
10. To use any of the software packages for any particular purpose.

Reference Books for the Physics(General) Course :

1. Haliday and Resnick : Physics, Vols. I and II.
2. Sinha and Das Sharma : College Physics, all volumes.
3. D.P. Raychaudhuri : All volumes of Physics Pass Course Books.
4. Alonso and Finn : Fundamentals of University Physics. Vols.I, II and III.
5. Beiser : Concepts of Modern Physics.
6. A.B. Bhatacharya and R. Bhatacharya : Undergraduate Physics, Vols. I, II & III, NCBA Publication.
7. Bhattacharya and Bhattacharya : Snatokiya Padarthyavidya :Vols. I, II & III (in Bengali), Central.