U.P. 437—7-85—150 +25.

UNIVERSITY OF DELHI

SCHEME OF EXAMINATION AND COURSES OF READING FOR B.Sc. (Hons.) Examination in Physics

Part I Examination 1989
Part II Examination 1990
Part III Examination 1991

labus applicable for students seeking admission to the . (Hons.) Physics Course in the academic year, 1988-89

Price : 12-00

B.Sc. (Hons.) Physics

SCHEME OF EXAMINATION

Part I Examination 1989

		Duration Hours	*Maximum Marks*
Paper I :	Mathematical Physics I	3	50
Paper II :	Mechanics	3	50
Paper III :	Elect. & Mag.	3	50
Paper IV :	Practicals	4	75

Part II Examination : 1990

Paper V :	Mathematical Physics II	3	50
Paper VI :	Thermal Physics I	3	50
Paper VII :	Vibrations and Wave Optics	3	50
Paper VIII :	Practicals	5	75

Part III Examination : 1991

Paper IX :	Mathematical Physics III	3	50
Paper X :	Thermal Physics II	3	50
Paper XI :	Electromagnetic Theory	3	50
Paper XII :	Electronics	3	50
Paper XIII :	Atomic Physics and Quantum Mechanics	3	50
Paper XIV :	Physics of Materials	3	50
Paper XV :	Practicals	5	75
Paper XVI :	Practicals	5	75

Note : One fourth of the marks for the practical paper shall be reserved for the Laboratory record of the candidates.

The Honours Examination for the degree of Bachelor of Science shall include :

1. A qualifying test in English at the end of the first year.
   (i) Students who have not read English beyond class X in school will study the first year English A course.

(ii) Students who have not read English even upto class X in school will study the above mentioned course, but they may, if so advised, also take the Remedial English Course in addition.

(iii) Students who read core English in classes XI and XII will study the first year English 'B' course.

(iv) Students who have read Elective English in classes XI and XII will study the first year Elective English Course.

Note : Composition exercises, where set will include topics of interest to students in Science and Vocational Courses.

2. A qualifying test in one of the following subjects at the end of the second year—One Paper 100 Marks.

(a) Physical Sciences consisting of Physics or Chemistry/ Mathematical Science including Statistics.

(b) Life Sciences consisting of Botany/Zoolgy and Anthropology.

(c) Earth Sciences comprising basically of Geological Sciences.

(d) Mathematical Sciences including Statistics and Operational Research.

(e) Behavioural Sciences.

(f) History of Science and Scientific Method.

Subsidiary Subjects : Two Examinations in each of two subsidiary subjects. (First Examination at the end of first year and second examination at the end of second year).

(a) Chemistry and

(b) Mathematics.

Detailed Courses of Reading

PAPER—I : MATHEMATICAL PHYSICS—I

Vector Algebra : Scalar and vector products ; polar and Axial vectors and their examples from Physics. Triple and quardupule products vector equation of a straight line, plane and sphere.

Vector Calculus : Scalar and vector fields. Differentiation of a vector with respect to scalars. Gradient, divergence, Curl and ∇^2 operations and their meaning. Idea of line, surface and volume integrals. Gauss, Stokes, and Green's Theorems. General orthogonal coordinates; expression for gradient, div; curl and ∇^2 in cartesian, spherical and cylindrical coordinates.

Multiple Integrals : Evaluation of line, surface and volume integrals. change of variables, Jacobian.

Probability and statistics : Basic axioms and concepts of probability. Addition and multiplication of probabilities. Inverse probability. Mean values. Dispersion. Binomial, poisson and Normal distributions. Moments and moment generating functions.

Numerical Analysis : Systematic and Random errors. Propagation of errors. Normal law of errors. Standard error and probable error. Least square fitting of Data (linear case). Linear interpolation. Newton's method of forward and backward interpolation.

Fourier Series : Fourier series. Dirichlet conditions (statement only) Sine and Cosine series and their orthogonality and completeness. Distinctive features of Fourier expansion. Applications : square wave, triangular wave, output of full wave rectifier. Summing of infinite series, Gibbs phenomenon.

Second order ordinary differential equations : With constant coefficients and their general solution. Complementary function and particular integral. Linear independence. Wronskian. Solution by Fourier series.

PAPER—II : MECHANICS

Dynamics of a system of particles. Centre of mass. Conservation of momentum. Idea of conservation of momentum from Newton's third law. Impulse. Momentum of variable mass system; motion of rocket.

The work-energy theorem : Potential energy. Energy diagrams and stable and unstable equilibrium. Force as a gradient of potential energy. Conservative and non-conservative forces. General law of conservation of energy. Particle collision. Centre of mass frame and Lab-frame.

Angular Momentum : of a particle and system of particles. Torque Conservation of angular momentum. Rotation about a fixed axis. Mo-

ment of inertia and its calculation for rectangular, cylindrical and spherical bodies. Theorems of parallel and perpendicular axes. Kinetic energy of rotation. Motion involving both translation and rotation. The Gyroscope. Application of gyroscopic motion.

Oscillatory motion : Equation of motion of a simple pendulum and compound pendulum loaded spring and LC circuit. Energy considerations. Time average of energy. Damped harmonic oscillator Q-factor. Lightly damped systems. Forced harmonic oscillator. Resonance in a lightly damped system. Transients and steady state solutions.

Gravaittional interaction and centrcl Force motion : Law of Gravitation. Invertial and Gravitational mass. Gravitational potential energy and field. Gravitational field due to spherical shell and solid sphere. Gravitation self energy. Motion of particle in a plane. Central forces Angular momentum in central forces. Central motion as one body problem. Two body problem, Reduced mass. The energy equation and energy diagram. Equivalent one body problem and its solution Kepler's laws. Scattering cross section. Rutherford scattering.

Non-inertial systems : Intertial frames and Galilean transformation, Uniformly accelerating system. Non-in ertial frames and fictitious forces. Physics in rotating coordinate systems. Centrifugal and coriolis forces.

Special Theory of Relativity : Michelson Morley experiment and its outcome. Postulates of special Relativity. Lorentz transformations. Simultaneity and order of events. Lorentz contraction and Time dilation. Relativistic transformation of velocity, frequency and wave number. Velocity dependendence of mass and equivalence of mass and energy. Relativistic Doppler effect. The twin paradox. Relativistic kinematics. Transformation of energy and momentum Elementary ideas about Minkowski space.

PAPER—III : ELECTRICITY AND MAGNETISM

Review of laws of induction and circuit elements—L, C, R.

Circit Theory and Electric Measurement : Kirchhoff's Laws and their applications to D.C. circuits. Sensitivity of Wheatstone bridge. Solution of second O.D.E. Transients in LCR circuits. Series and parallel circuits subjected to harmonic emf Rotating magnetic fields and principal of induction motor. Kirchhoff's Laws for A.C. Bridges-Anderson and Owen's

Bridge for self-Inductance measurement. Ballistic Galvanometer. Measurement of high resistance by Leakage. Magnetic field measurement by search coil

Electric Field : Electric charge; conservation and quantization. Measurement of charge by Millikan's method. Superposition principle. Electric field and electric lines. Gauss's flux theorem. Differential form of Gauss's theorem. Charge distribution. Fields of spherical linear and plane distribution. Line integral of electric field. Electric potential. Field as gradient of potential. Potential and electric field of an electric dipole a charged wire and charged-disc. Potential due to an arbitrary charge distribution at a distant point; monopoles dipoles and quardrupoles, Force and Torque on a dipole placed in an electric field. Poisson's and Laplace's equations for potential (no solution required). Uniqueness Theorem Dielectric polarization and polarization charges. Gauss's law in dielectrics. Field vectors D and E and their boundary conditions. Description of a system of charged conductors. An isolated conductor and a capacitance. Method of images and its application to simple electrostatic problems. Capacitors filled with dielectrics.

Electrostatic Energy : Of a system of charges. A uniform sphere. The energy of a condensor. The electrostatic energy of an ionic crystal. E.S. energy in nuclei. Energy in e s field. The energy of point charge.

Magnetic Field : Magnetic force between current elements. Magnetic induction B. Vector potential Properties of B-Ampere circuital law. Curl and div of B. Magnetic flux. Calculation of B-for circular and solenoidal currents. Torque on a current loop in a uniform magnetic field. Magnetic dipole : Forces on an isolated moving charge.

Electromagnetic Induction : A conducting rod moving through a uniform magnetic field. A loop moving through a non-uniform magnetic field. A stationary loop with field source moving. Universal law of Induction $\left(\nabla \times E = -\frac{\partial B}{\partial t}\right)$ Mutual Induction —A Reciprocity Theorem ($M_{12} = M_{21}$) Self Induction. Energy stored in magnetic field.

Magnetic Contribution of Matter : Magnetic field H Magnetic parameters in matter ($B = \mu H$) Magnetic susceptibility. Stored magnetic energy in matter. Magnetic circuit. Permanent magnets.

PAPER—IV PRACTICALS

1. Measurement of 'g' (by compound and Kater's pendulum).
2. Expts. with elastic springs (Stiffness constants.
3. Elastic constants of the wire (Searle's method).
4. Transistor characteristics and parameters.
5. Triode constants by Bridge method-inter electrode capacitance) Triode characteristics.
6. Measurement of viscosity of Liquid (influence of temperature).
7. S.T. Variation with Temperature and concentration (JAEGER'S METHOD)
8. Excitation and Ionization potentials.
9. Expt on Random errors.
10. Self-Inductance by A.C. Bridge. (Owen's bridge).
11. Measurement of Temperature (Thermo-couple).
12. Resonance of an A. C. Circuit (LCR) Q-of an Oscillating system.
13. Variation of resistance with temperatuse.
14. Comparison of conductivity of highly dilute and highly concentrated solution.

PAPER—V : MATHEMATICAE PHYSICS

Complex Variables, Evolution of the number system. Complex numbers.

Graphical representation of complex numbers. De Moivre's theorem. Roots of Complex numbers. Euler's formula.

Limit, continuity, differentiation and Riemann intergration of functions of real variables. Functions of complex variables. Examples. Cauchy-Riemann conditions. Analytic functions, Singularities. Differentiation and integration of a function of a complex variable. Cauchy's theorem. Cauchy's integral formula. Morera's theorem. Cauchy's inequality. Liouville's theorem. Fundamental theorem of algebra. The Argument theorem. Power series of a complex variable; absolute and uniform convergence tests. Taylor and Laurent series. Residue and Residue Theorem. Contour integration and its application to evaluation of integrals and series. Multiple value functions. Branch points and idea of Riemann surfaces. Analytic continuation.

Series Solution of Linear second order differential equations and special functions :

Singular points of second order differential equations and their importance. Series method (Frobenius). Solution of Harmonic Oscillator. Legendre, Bessel, Hermite and Laguerre differential equations, Gamma, Beta, functions and Riemann Zeta function.

Orthogonal Polynomials :

Legendre polynomials, Rodrigue's formula; Generating function, Recurrence relations, Orthogonality. Associated Legendre functions, Hermite and Laguerre polynominals; their generating functions, Rodrigue's formulas, Recurrance relations and Orthogonalty Bessel functions.

Bessel Functions :

Bessel functions of first and second kind. Generating function, Recurrence formulas, zeros of Bessel functions, Orthogonality and Asymptotic formulas. Series expansion of a function in terms of a complete set of othogonal functions. Fraunhoffer Diffraction integral, Hankel function and Cylindrical travelling waves. Modified Bessel functions and Fresnel integrals.

Partial Differential Equations :

Wave equation in 3-dimension. Transverse vibration of stretched string 'D' Alembert's solution. Oscillation of hanging chain. Vibrations of rectangular and circular membrane. Heat conduction and Diffusion equations. Derivation of the equation of heat conduction Linear flow. Two and three dimensional heat conduction. Temperature inside circular plate. Laplace equation in cartesian, cylindrical and spherical coordinate systems. Problems of steady flow of heat in an infinite and semi infinite rod, Rectangular and circular plate. Potential of a ring. Potential about a spherical surface. Circular and spherical harmonics.

PAPER—VI : THERMAL PHYSICS—I

Thermodynamics—Concepts and Applications : Concepts : zeroth and First law of thermodynamics. Reversible and Irreversible processes. Conversion of heat into work. Carnot theorem. Second law of thermodynamics. Thermodynamic temperature. Clausius inequality. Entropy. Entropy changes in reversible and irreversible processes. Temperature-Entropy diagrams The principle of increase of Entropy.

Applications

Ideal gases : Equation of state, internal energy, Specific heats entropy. Isothermal and Adiabatic processes. Compressibility and expansion coefficient. Adiabatic lapse rate.

Real gases : Deviations from the ideal gas equation. The virial equation Andrew's experiments on CO_2 gas, continuity of liquid and gaseous state. Vander Waal's. equation. Critical constants and law of corresponding states. Free expansion, Joule-Thompson effect.

Magnetism : Magnetic work Magnetic cooling by adiabatic demagnetisation. Approach to absolute zero.

Thermodynamic Potentials : Enthalpy, Gibb's Helmholtz functions, Maxwells' relations and their applications. T-ds equations. Gibb's Helmholtz equation. EMF of a reversible cell.

Equilibria of Physico-chemical system : Change of phase, Equilibrium between a liquid and its vapour, Clausius-Clapeyron equation. The triple-point. Second order phase transitions. Chemical potentials. Phase equilibrium. The Gibb's phase rule and its application.

Kinetic Theory of Gases : Derivation of Maxwell's law of distribution of velocities and its experimental verification. Mean-free path. Transport phenomena-viscosity, conduction and diffustion. One dimensional Random walk. Brownian motion. Langevin and Einstein's theories and experimental determination of Avogadro's number. Examples of Brownian motion in physics-Galvanometer mirror. Sedimentation and Johnson noise.

PAPER—VII : VIBRATIONS AND WAVE OPTICS

Vibrations : Free oscillations with one degree of freedom. Linearity and superposition principle. System with two degrees of freedom (coupled oscillators). Normal coordinates and normal modes. Energy transfer. Normal modes of N coupled oscillators plucked and struck string.

Waves : Wave equation. Travelling waves. Plane and spherical waves. Huygen's principle. Law of reflection. Superposition of two harmonic waves. Superposition of N harmonic waves. Pulses and wave packets.

Wave Optics : Light waves. Electromagnetic nature of light waves

Two-beam interference : Division of amplitude. Division of wave. front. Young's double slit. Fresnel's Biprism. Michelson's interferometer. Circular and straight fringes. Visibility curve. Standardization of metre.

Multiple Beam Interference : Interference in thin films. Haidinger and Brewster fringes. Localized fringes. Newton's Rings. Fabry-Perot inter-ferometer. Airy's formula for intensity. Resolving power and range. Fabry-Perot etalon. Method of exact fractions. Channelled spectra.

Interference between two independent sources. Time of coherence. (Qualitative discussions). Spatial and Temporal Coherence Partial coherence. Holography.

Fraunhoffer Diffraction : Difraction at a single slit, circular aperture and at two parallel slits. Plane diffraction grating. Resolving power of telescope and microscope. Numerical aperture. Resolving power and dispersive power of a plane diffraction grating.

Fresnel's Diffraction : Division of wave front into half-period zones Rectilinear propagation. Zone Plate. Fresnel's integrals. Cornu's spiral Applications of Cornu's spiral to the analysis of diffraction at a straight edge, a slit, a wire, an opapue strip and a circular aperture.

PAPER—VIII : PRACTICALS

1. Ultrasonic grating-determination of frequency.
2. Diameter of a wire by diffraction method. wavelength of light by Biprism.
3. Refractive index by Total Internal reflection using Gaussian eye piece.
4. Michelson Interferometer.
5. Diffraction grating (wave length and resolving power).
6. Newton's rings
7. Spectrometer-Cauchy's constants, Resolving power and Dispersive power of the prism.
8. Study of B.G.
9. Thermal conductivity of Bad conductors by Lees' method.

10. M. by B.G. and L/M Maxwell's Bridge method.
11. Viscosity of a gas (Anderson's method).
12. High Resistance by leakage.
13. Dielectric constant by the ratio of units.
14. Magnetic field measurement by Search Coil.

PAPER—IX: MATHEMATICAL PHYSICS III

Linear-Vector Spaces and Matrices : Vector Space and Linear independence—Basis and dimensions. Linear transformations.

Non-Singular transformations. Matrix representation of linear transformation. Matrix algebra. Special matrices. Hermitian and Skew-hermitian matrices. Singular and non-singular matrices. Inverse of a matrix. Change of basis. Similarity transformation. Eigen vectors and Eigen values. Diagonaliztion. Reduction of coupled linear differential equation of eigen value problem. Trace of a matrix. Inner products of vectors. Unitary and orthogonal matrices.

Cartesian Tensors : Transformation of coordinates. Tensorial Character of the physical quantities, Symmetric and antisymmetric tensors. Contraction and differentiation. Pseudotensors. Kronecker and alternating tensors. Moment of Inertia tensor and Euler's equation of motion. Stress and strain tensor- Elastic constant. Polarization tensor.

Integral Transform : Fourier Integral Theorem. Fourier Integral transform. Sine and cosine transform Convolution theorem. Laplace transform of elementary function of derivatives, integrals and unit step function and of periodic functions, Translation, substitution and convolution theorem. Laplace inverse transform.

Applications of Laplace Transform : Solution of first and second order ordinary differential equations with constant coefficients and simultaneous first order ordinary differential equations. Solution of one dimensional diffusion and wave equation-Heat flow in an infinite and semi-infinite rod.

Dirac Delta function. Green functions and their use in solution of one dimensional differential equations.

Calculus of variation : Maxima and minima of a function of several variables. Constrained maxima and minima. Method of Lagrange

undetermind multipliers. Variational principle. Euler's equation and its appplication to geodesics and minimum surface area.

Fluid Motion : The continuity equation $\left(\Delta.\vec{J} + \frac{\partial P}{\partial t} = 0\right)$ Equation of motion

$$\left(\frac{\partial \vec{v}}{\partial t} + \left(\vec{v}.\nabla\right)\vec{v} = -\frac{\nabla p}{P} - \nabla\varphi\right)$$ Steady Flow Bernoulli's Theorem, Circulation, Vortex lines, Viscous Flow-Poiseuille's Formula. Reynold number : Flow past a Circular cylinder.

PAPER—X THERMAL PHYSICS II

Classical Statistics : Entropy and thermodynamic probability. Maxwell Boltzmann distribution. Thermodynamic functions of a system having a finite number of energy levels; negative temperature. Thermodynamic functions of an ideal gas. Classical entropy expression. Gibb's Paradox. Law of equipartition of energy and its application to specific heats. Specific heat of hydrogen. Ortho and para hydrogen.

Classical Theory of Radiation : Properties and thermodynamics of thermal radiation. Kirchhoff's law. Stefan's law. Wien's displacement law. Temperature of Stellar atmosphere.

Quantum Theory of radiation: Planck's law—Derivation ond experimental verification.

Quantum Statistics : Bose-Einstein and Fermi-Dirac distribution laws. Calculation of the thermodynamic functions of an ideal weekly degenerate gas.

Strong degeneration :

Calculation of thermodynamic functions of an ideal Bose gas. Bose Einstein condensation. Properties of liquid ^{4}He. (qualitative description).

Radiation as a gas of photons and Bose's derivation of Plank's law Flux of radiant energy. Radiation pressure. Thermal equilibrium of radiation. Einstein's A ond B coefficients. Working principle of Lasers.

Fermi energy. Thermodynamic functions of an ideal Fermi gas. Relativistic Fermi gas. White dwarf stars. Chandrashekhar mass limit. Saha's ionization formula. Third law of thermodynamics. Absolute definition of entropy. Consequences of third law. Unattainability of absolute zero.

PAPER—XI : ELECTROMAGNETIC THEORY

Maxwell's equations. Displacement current. Vector and scalar potentials. Boundary conditions at interfaces between different media. Wave equation. plane waves in dielectric media. Poynting theorem and Poynting vector. Polarization of e.m. Wave. Description of linear, circular and elliptic polarization.

Reflection and refraction of a plane wave at a plane interface between dielectrics. Fresnel formulae and their verification. Total internal reflection. Waves in conducting media. Metallic reflection (normal incidence) Skin depth. Elementary theory of the optical constants of metals and their determination. Rectangular and cylindrical Cavities. Wave guides. Modes in a rectangular wave guide. Energy flow and attenuation in wave guides. Resonant cavities. Power loss in a cavity. Q of a cavity. Production of polarized light by specular reflection (Brewster's angle) by control of emission, by selective absorption.

Propagation of e.m. waves in anisotropic media. Fresnel's formula. Light propagation in uniaxial crystal. Double refraction. Nicol Rochon and Wollaston prism, Production of circularly and elliptically polarized light. Babinet compensator. Analysis of polarized light.

Maxwell's equations in microscopic media (Plasma) Characteristic plasma frequency. Refractive index. Reflection of microwaves in ionosphere

Lorenz-Lorentz formula. Elementary theory of normal and anomalous dispersion. Cauchy and Sellmier's relation. Wood experiment

PAPER—XII : ELECTRONICS

Linear Network : Multimesh Networks—Loop and Junction Analysis Superposition theorem. Frequency spectrum method. Phasor diagrams.

Non-linear elements and their linear equivalents : Diode, Triode, Pentode and their characteristics. Crystal diodes and Transistors. Transistor configurations. 4-terminal equivalent circuit representation of

Triode and Transistors Hybrid model of Transistors. Elementary idea of Field effect Transistor and Tunnel Diode.

Linear Circuits with Active Elements :

Tube and Transistor Amplifier : Basic principle, untuned amplifiers, its classifications, and frequency response. R-C coupled and Transformer-coupled amplifiers. Feed back in amplifiers and its advantages. Amplifier distortion. Tuned voltage amplifier.

Oscillators : Barkhausen criterion for self-sustained oscillations. Tuned plate oscillator. Crystal oscillator. R-C. Oscillators. Sawtooth generators. Multivibrator.

Non-Linear Parametric Networks : Amplitude modulation-small signal (square law). modulators. Demodulation-plate detection and Diode detection. Elementary ideas of Frequency modulation and phase modulation. Non-Linear effects in Amplifiers-Power Amplifier (pushpull type).

Rectifiers and Power Supplies : Semiconductor Diode as halfwave and full wave rectifers, their efficiency and ripple factors. Bridge rectifiers. Harmonic generation in rectifier circuits. Series inductance filter shunt capacitance filters. L-section and pi section filters. Regulation characteristics and ripple factors.

Instruments : Basic principles of Radio and Television receivers and Transmitters, Oscilloscope, and V.T.V.M.

PAPER—XIII : ATOMIC PHYSICS & QUANTUM PHYSICS

Atomic Structure, Energy levels and Spectra : Alpha—particle scattering. Bohr-Sommerfeld theory of hydrogen atom; correspondence principle, stationary states. quantum numbers J, Q. M, and their detailed discussions, energy levels degeneracy spectral lines and selection rules. Examples of hydrogen and hydrogen like atoms. Electron spin. Sodium D. lines. Spin-orbit coupling and fine structure effects. Removal of degeneracy. Zeeman effect. Bohr magneton and Stern-Gerlach experiment. Vector model of the atom. Many electron atoms. Pauli's Principle. Periodic table.

Quantum Mechanics : Wave Particle Dualism for light and Matter Photo electric effect. Einstein's equation. Determination of Planck's constant. Diverse Photoelectric effect (X-ray production and determina-

tion of h) Wave nature of Matter : Electron diffraction. (Davisson-Germer Expt.) De Brogile Waves Packets. Uncertainly principle. Illustration of wave-particle dualism : Compton scattering. Simple ideas of Pair creation and annihilation and Bremsstrahlung.

Two slit experiment superposition principle. Need for probability amplitude. Wave function. Schrodinger equation. One dimentional barrier and rectangular well problems. Particle in a box and linear harmonic oscillator. Rigid Rotator.

Elementary Nuclear Physics : Size, mass and charge of the nucleus binding energy. Nuclear forces. Semi-empirical mass formula. Liquid drop, Nuclear fission. Elementary ideas of shell model. Nuclear reactions and Radioactivity. Laws of decay and growth. α-decay (Gamow's theory), β decay (neutrino hypothesis) and γ decay.

Detection and Acceleration of Elementary Particles : Motion of charged particles in electric and megnetic fields. Focussing electrons in electric and megnetic fields. Electron microscope, Principle of linear accelerator, cyclotron and Aston mass spectrograph. Working principle of G.M. Counter, cloud chamber and bubble chamber.

PAPER XIV : PHYSICS OF MATERIALS

Crystal Structure : Elementary ideas of Crystal structure ; lattice translation vectors. Lattice with a basis, Unit Cell, reciprocal lattice. Types of lattices. Crystal Diffraction : Bragg's law. Diffraction of X-rays.

Elementary Lattice Dynamics : Lattice vibrations— linear mono-atomic and diatomic chains. Acoustical and optical phonons. Qualitative description of the phonon spectrum in solid. Brillouin zones. Einstein and Debye theories of specific heat of solids. The T^3 law.

Dielectric properties of materials : Polarization. Local electric field at an atom. Depolarization field. Lorentz fields of dipoles inside a cavity. Field in dielectric between capacitor plates.

Dielectric constant and Polarizability : Electric susceptibility polarizability, Clausius—Mossoti Equation. Classical theory of electronic polarizability. Orientational polarizability and Langevin-Debye equation Conducting and dielectric sphere in a Uniform field. Qualitative discussion of ferroelectric properties of materials.

Megnetic properties of Matter : Response of substances to megnetic field. Dia, para and ferri and ferromegnetic materials. Absence of megnetic charge, electric currents in atoms, electron spin and megnetic moment. Measurement of the susceptibility of paramegnetic substances. Larmor precession and gyromognetic ratio. Langevin's theory of dia and paramegnetism. Curie's law. Weiss theory of ferromagnetism. Ferromegnetic domains. B—H Curve and energy loss in hysteresis.

Elementary Band Theory : Kronig Penny model. Band gaps. Conductors. Semiconductors and Insulators.

Free electron gas model for metals. Specific heat of metals. Richardson's equation. Wiedemann-Franz law. Thermoelectric effects.

PAPER—XV AND XVI : PRACTICALS

1. R—C Coupled (two stage) Amplifier.
2. Tuned plate Oscillator.
3. Study of simple power supply.
4. Transistor Amplifier.
5. Transistor Oscillator.
6. B—H Curve.
7. Magnetic Susceptibility.
8. e/m bar magnet Magnetron Magnetic focussing.
9. Use of oscilloscope study of pulse wave form using a neon tube circum.
10. Half—life of radioactive decay (G—M Counter).
11. Study of elliptically polarized light.
12. Polarimeter.
13. Cornu's method for elastic constants.
14. Constant deviation spectrometer—Mercury Spectrometer.
15. To measure low voltage accurate upto 1 microvolt.
16. Stefan's constant.
17. Jamin's interferometer : refractive index.
18. 'e' by Millikan's method.
19. and suitable five experiments can be added.

In additions to the above experiments, a student will be required to take up a project of his choice with the prior permission of the teacher-in-charge. A suggestive list of projects is given below. Projects of similar nature may be added :—

1. To construct and study a regulated power supply of a given range.
2. Design of a R—C coupled amplifier and to study variation of phase with frequency.
3. To construct and calibrate a valve voltameter of given range.
4. To construct a D.C. dynamo.
5. To assemble a Transistor receiver.

Note :—25% marks for the project.
25% marks for the note book and
50% marks for two experiments spread over two days 5 hours each day.

I Yhar : Theory 12 periods per week
Practicals : 6 periods per week.

II Year : Theory : 12 periods per week.
Practicals : 9 periods per week.

III Year : Theory : 18 periods per week.
Practicals : 18 periods per week.