

GUJARAT UNIVERSITY

S. Y. B.Sc.

PHYSICS

(In force from June, 2004)

PAPER III

- 1. Heat and Thermodynamics :** Properties of pure substances, T-S diagram, Gibb's U-V-S surface, Enthalpy, Helmholtz function, Gibb's function, Names and symbols of thermodynamic functions, Two mathematical theorems, Maxwell's equations, First and Second T-ds equations, Energy equations, Difference and ratio of heat capacities, Expansivity, Compressibility, Joule - Thomson effect, Porous plug experiment, Conditions for heating and cooling of gas, Inversion temperature with respect to Van der Waal's equation.

(Scope : Heat and Thermodynamics by Zeemansky)

Thermodynamics of thermoelectricity

(Ref : University Physics - Sears and Zeemansky 3rd edition)

- 2. Solid State Physics :** Crystal binding : Cohesive energy, Characteristics of inert gas solids, Van der Waal's interactions, Total potential energy, condition for stability, Equation of state, Bulk modulus, Ionic crystals, Madellung energy, Covalent crystal, metal crystals, Hydrogen bond.

(Ref : Solid State Physics by Kittel)

Thermal properties : Introduction, Lattice specific heats, classical theory, Einstein theory, Debye theory of atomic heat, Thermal expansion, Gruneisen parameter, Equation of state Gruneisen relation, Thermal conductivity.

(Ref : Solid State Physics - C. M. Kachhawa, TMH Publication, Art Nos. 4.1 to 4.6)

- 3. Sound :** Reflection, refraction and diffraction of sound. Acaustic impedance of a medium. % reflection and refraction at a boundary Impedance matching for transducers. Principle of sonar system and sound ranging. Tranducers and their characteristics, recording and reproduction of sound measurement of frequency, velocity, waveform and intensity.

Ultrasonic waves, Magnetostriction effect, Piezo electric effect, Uses of ultrasonic waves, Acoustics of autitorium, Quality of sound with Fourier analysis.

- 4. Optics :** Defect of lenses, Schmidt corrector plates, oil imersion objectives miniscus lenses, common type of eye pieces.

Diffraction : Fresnel diffraction by circular aperture, half-period zones, Zone plate, Fresnel diffraction by rectangular slit, Cornu's spiral, Fraunhoffer diffraction by two slits, by 'n' slits, Plane diffraction grating, Rayleigh's criteria, Resolving power of optical instruments, R. P. of grating, concave grating R. P. of telescope, Polarisation, Double refraction, Huygen's explanation of double refraction in uniaxial crystal, Calcite crystal, Tourmaline plate, Nicol's prism, Polaroids, Production of elliptically and circularly polarised light (Mathematical treatment, quarter wave plate, phase contrast microscope Half wave plate, Analysis of Polarised light. (Identification of linearly, circularly and elliptically polarised light).

- 5. Statistical Mechanics :** Phase spaces, concept of ensemble, Canonical ensemble, Thermodynamical relations in canonical ensemble, Microcanonical ensemble, Grand canonical ensemble.

Partition function for the system and for the particles - Transtational partition function, Gibb's paradox, Sackur - Tetrod - equation, Boltzmann equipartition theorem.

(Ref : Statistical Mechanics and properties of matter by ESR Gopal. The Macmillan Company of India Limited. Art. Nos. 1.1 to 1.6 and 2.1 to 2.4)

PAPER IV

Electromagnetics

- 1. Magnetostatics :** Electric current, Ohm's law - Electrical conductivity, The calculation of resistance, Magnetic effects, The magnetic field, Force on a current, Biot-Savart law, The laws of magnetostatics, The magnetic potentials, Magnetic dipole in a non-uniform magnetic field, Magnetic vector potential due to a small current loop, An alternative method for finding the vector

potential A and hence the field B due to a current loop, Magnetic media, Magnetisation, Magnetic field vector, Magnetic susceptibility and permeability, Boundary conditions, Uniformly magnetized sphere in External magnetic field, A comparison of static electric and magnetic fields.

(Scope : Electromagnetics - by B. B. Laud, Art. Nos. 4.1 to 4.9, 4.11 to 4.20)

2. Electronics :

(a) Solid State Devices, Description, Characteristics and uses :

- (i) Tunnel diode (3.12)
- (ii) Semiconductor photodiode (3.13)
- (iii) Light emitting diode (3.15)
- (iv) Varactor diode (from 3.7)
- (v) Silicon controlled Rectifier (28.1)
- (vi) Unijunction transistor (UJT) (28.5)
- (vii) Photo transistor
- (viii) Opto coupler
- (ix) FET
- (x) MOSFET (Structure and characteristics)

Book recommended : Electronic Devices and Circuits by A Mottershead.

Integrated Electronics by Millman and Halkias.

- (b) **Basic Characteristics of the Transistor** : Introduction, Basic transistor amplifier, Two-diode analog for a transistor, transistor input characteristics, transistor collector characteristics, collector cutoff current I_{CEO} , Forward current transfer ratio (CE). Permissible operating area of transistor (CE), The basic common base amplifier, Forward current transfer ratio (CB), Relation between α and β , collector cutoff current (I_{CBO}) physical explanation of CB and CE amplifying action. Reduction of CE leakage current to I_{CEO} , common collector amplifier. Identifying the transistor leads.

Book recommended : Chapter IX Electronics Devices and Circuits by A. Mottershead.

- (c) **The Common base Amplifier** : Introduction, Analysis of CB amplifier, The amplifier as hole, Power relationships, Efficiency, Phase relationships, Input waveform considerations, Harmonic distortion.

Book recommended : Chapter X Electronics Devices and Circuits by A. Mottershead.

- (d) **The Common Emitter Amplifier** : Introduction, Graphical analysis of CE Class A amplifier, Input and output resistance, Effect of adding an AC load, conversion efficiency of a Class A amplifier with a direct coupled resistive load, Phase relationships in a CE amplifier, Input waveform consideration, comparison of basic transistor amplifier.

Book recommended : Chapter XI Electronics Devices and Circuits by A. Mottershead.

- (e) **Thermal Stability (Transistor BIASING)** : Introduction, Factors contributing to thermal instability, Effect of temperature increase, Stability factor S, Common-base stability, collector to base bias, Disadvantages of collector to base bias, Emitter bias, voltage divider bias with emitter bias, Emitter bypass capacitor, Additional stability factors, Bias compensation.

Book recommended : Chapter XII Electronics Devices and Circuits by A. Mottershead.

- (f) **Hybrid Equivalent Circuit for a Transistor** : Introduction, conversion of an amplifier circuit to a standard form, general "black box" theory, Hybrid h parameters, obtaining the hybrid h parameters, typical h-parameter values, Amplifier equations, Voltage and current gains taking into account R_g of source, Dependence of amp. characteristics on R_L and R_g , Comparison of CB, CE and CC characteristics.

Book recommended : Chapter XIV Electronics Devices and Circuits by A. Mottershead.

- (g) **Logic Circuits** : (1.1) Binary number system, (1.2) Invertors (1.3) OR gates, (1.4) AND gates, (1.5) Boolean algebra, (1.6) NOR gates, (1.7) NAND gates.

Book recommended : Digital Principles and Applications by A. P. Malvino & Leach, 4th Ed. Ch.1.

3. Modern Physics : Spectroscopy, Vector atom model, space quantization, spin, magnetic moments and angular momentum. The Stern-Gerlach experiment, Pauli's exclusion principle, Periodic classification and explanation of configuration of electron in the atoms of elements with

some illustrations, Normal Zeeman effect, anomalous Zeeman effect, the magnetic moment of the atom, Emitted frequencies in anomalous transition, the Lande “g” factor, the Paschen-back effect, Stark effect, Intensity and width of spectral lines.

(Scope : Spectroscopy Vol. 1 by Walker and Straw. Additional Ref : Atomic and Molecular Spectra by Raj Kumar, Kedar Nath Ram Nath Prakashan - Meerut)

4. **Nuclear Physics** : Tools for doing Nuclear Physics - Physical Tools : Introduction, Interaction between particle and matter, A brief-survey, Detectors for Nuclear particles, Particle accelerators, Beta - ray spectrometer. Mass spectrography.

(Ref : Nuclear Physics - S. B. Patel Art. Nos. 1.1.1 to 1.1.5)

The Q-equation : Introduction, Types of nuclear reactions, the balance of mass and energy in Nuclear reactions, The Q-equation, Solution of the Q-equation.

(Ref : Nuclear Physics by S. B. Patel Art. Nos. 3.1 to 3.5)

The constitution of the nucleus and some of their properties : Introduction, Measurement of Nuclear radius, constituents of the nucleus and their properties, Nuclear spin, moments and statistics.

(Ref : Nuclear Physics by S. B. Patel Art. Nos. 4.1.1., 4.1.3., 4.1.4, 4.1.5)

PAPER V

1. **Classical Mechanics** :

(a) Rotation about moving axis, Top, Gyroscope

(b) Collision of particles : Elastic and inelastic scattering, Elastic scattering, Laboratory and centre of mass system, Kinematics of elastic scattering, in the laboratory system, Inelastic scattering, Cross section, The Rutherford formula. Binary stars.

(Ref : Classical Mechanics by Takwale and Puranik Art. Nos. 7.1 to 7.6.)

(c) Moving Coordinate systems : Rotating coordinate systems, Their coriolis force, Motion on the earth Effect of coriolis force on freely falling particles.

(Ref : Classical Mechanics by Takwale and Puranik Art. Nos. 9.2, 9.3, 9.4, & 9.5)

(d) Mechanics of system of particles, Motion of system with variable mass.

(Ref : Classical Mechanics by Takwale and Puranik Art. Nos. 3.5, 3.6)

1.1. Matrices : Types of matrices, Inversion, rank of a matrix, solution of simultaneous equations, Diagonalization.

2. **Quantum Mechanics** : The Schrodinger equation and probability interpretation for an N-particle system, The fundamental postulates of wave mechanics, Adjoint of an operator and self-adjointness, The Eigen value problem, Degeneracy, Eigen values and Eigen functions of self-adjoint operators, The Dirac delta function, Observables, Completeness and Normalization of Eigen functions, Closure, Physical interpretation of Eigen values, Eigen functions and expansion coefficients. Momentum Eigen functions, Wave function in momentum space, The uncertainty principle, States with minimum value for uncertainty product, Commuting observables, Removal of degeneracy, Evolution of system with time, Constants of the motion, Non-interacting and interacting systems, Systems of identical particles.

(Ref : Quantum Mechanics by Mathews and Venkatesan Art. Nos. 3.1 to 3.16)

Basic Concepts :

3. 1.1. Introduction
 1.2. Composition and characteristics of a Plasma
 1.3. Collisions
 1.4. Surface Phenomena
 1.5. Transport (or Transfer) Phenomena
 1.6. Diffusion and Mobility : Ambipolar Diffusion
 1.7. Viscosity : Conductivity
 1.8. Recombination
 1.9. Ohm's Law
 1.10. Gas Discharges
 1.11. Comparison of various natural and man-made plasmas
 1.12. Plasma diagnostics
 1.13. Plasma waves and Instabilities confinement of plasma
 1.14. Space plasma

Motion of Charged Particles in Magnetic and Electric Field

- 2.1 Microscopic and Macroscopic description
- 2.2 Maxwell's equation and charge conservation
- 2.3 Motion of a charged particle in electric and magnetic fields
- 2.4 Uniform magnetic field and oscillating electric field
- 2.5 Drift velocity in a gravitational field
- 2.6 Magnetic field varying in space and time : adiabatic invariance of the magnetic moment.
- 2.7 Inhomogeneous magnetic field : gradient drift and curvature drift.
- 2.8 Peculiarity of drift motions
- 2.9 Converging magnetic field : magnetic mirror
- 2.10 Longitudinal adiabatic invariant
- 2.11 Periodic magnetic field : Gyro-relaxation effect
- 2.12 Motion of magnetic lines of force

Ref : Elements of plasma physics by S. N. Goswami, New Central Book Agency (P) Ltd. Calcutta.

4. **The special theory of relativity** : The Michelson-Morley experiment, The special theory of relativity, The Galilean Transformation, The Lorentz transformation, The Lorentz Fitzgerald contraction, Time dilation, Relativity of mass, mass and energy, some relativistic formulae, Velocity addition, Doppler Effect in light.
(Ref : Concepts of Modern Physics by Beiser).
5. **Remote Sensing** : Electromagnetic spectrum, Human vision, remote sensing through photography in the visible and near infrared, solid state detectors for IR, Television systems, Earth's features recognition.
(Ref : Introduction to optical remote sensing by P. R. Pisharoty, Pub. ISRO Bangalore).
6. **Atmospheric Physics** : Planetary system, planetary data composition of planetary atmospheres, Evolution of atmosphere, origin of life on earth, earth's neutral atmosphere, pressure, atmospheric variation, Energetics of lower atmosphere atmospheric circulation, comparison of planetary atmospheres.
(Ref : An introductory course on space science and Earth's environment by S. S. Degaonkar, Gujarat University Publication).
7. **Computers** : 1, 2, 3 in programming in C. (II Edition) Balaguruswamy.

S.Y.B.Sc.**PRACTICALS : PAPER III**

1. "g" by Bar Pendulum
2. Y - by Koenig's method
3. Optical lever
4. Wavelength of prominent spectral lines by diffraction grating
5. Flatness of plate by Newton's rings
6. Resolving power of grating
7. Resolving power of telescope
8. Wavelength of light by Biprism
9. Wavelength of light by Edser's "A" pattern
10. Diffraction by single slit
11. Searle's Goniometer
12. To study double refraction in calcite prism.

PAPER IV

1. Figure of merit of a mirror galvanometer
2. Absolute value of capacity by B. G.
3. C_1 / C_2 by DeSauty's method
4. High resistance by Leakage
5. L by Maxwell's bridge
6. L by Anderson's bridge
7. Uni-Junction transistor
8. Characteristics of FET

9. h - parameters of CE - transistor
10. Logic gates
11. Measuring charge of electron using hollow prism and benzene
12. To study the variation of I_c and VCE with temperature in fixed bias circuit and collector to base bias circuit for CE configuration.
13. To study the variation of I_c and VCE with temperature in fixed bias circuit and potential divider bias circuit for CE configuration.

PAPER V

1. Wavelength of light using Hartmann formula
2. e/m by Thomson's method (Integral to be found by using Simpson's rule)
3. Absorption coefficient of liquid using Photocell
4. Analysis of elliptically polarised light using photocell
5. Stefan's constant
6. Activation energy of a semiconductor
7. Identification of elements in a line spectra
8. Study of electron diffraction pattern
9. Temperature of flame
10. Emissivity of a metal surface
11. To find the value of permeability of free space μ_0 .
12. Resonance pendulum.