B.Sc. (Physics)- I Year
Semester – I
Paper – I:: Mechanics and Oscillations
(DSC - Compulsory)

Unit – I

1. Vector Analysis (10)

Scalar and Vector fields, Gradient of a Scalar field and its physical significance. Divergence and Curl of a Vector field and related problems. Vector integration, line, surface and volume integrals. Stokes', Gauss's and Green's theorems- simple applications.

Unit – II

2. Mechanics of Particles (6)

Laws of motion, motion of variable mass system, motion of a rocket, multi-stage rocket, conservation of energy and momentum. Collisions in two and three dimensions, concept of impact parameter, scattering cross-section.

3. Mechanics of Rigid Bodies (6)

Definition of Rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum and inertial tensor. Euler's equation, precession of a top, Gyroscope.

Unit – III

4. Central Forces (7)

Central forces – definition and examples, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force, gravitational potential and gravitational field, motion under inverse square law, derivation of Kepler's laws.

5. Special theory of Relativity (7)

Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation. Concept of four vector formalism.

Unit – IV

B.Sc. (Physics)- I Year
Semester – II
Paper – II:: Thermal Physics
(DSC - Compulsory)

Unit – I
1. Kinetic theory of gases: (4)
Introduction – Deduction of Maxwell's law of distribution of molecular speeds, Transport Phenomena – Viscosity of gases – thermal conductivity – diffusion of gases.

2. Thermodynamics: (8)
Basics of Thermodynamics- Carnot's engine (qualitative)-Carnot's theorem -Kelvin's and Clausius statements – Thermodynamic scale of temperature – Entropy, physical significance – Change in entropy in reversible and irreversible processes – Entropy and disorder – Entropy of universe – Temperature- Entropy (T-S) diagram – Change of entropy of a perfect gas-change of entropy when ice changes into steam.

Unit – II
3. Thermodynamic potentials and Maxwell's equations: (6)
Thermodynamic potentials – Derivation of Maxwell's thermodynamic relations – Clausius-Clayperon's equation – Derivation for ratio of specific heats – Derivation for difference of two specific heats for perfect gas. Joule Kelvin effect – expression for Joule Kelvin coefficient for perfect and Vanderwaal's gas.

4. Low temperature Physics: (6)
Joule Kelvin effect – liquefaction of gas using porous plug experiment. Joule expansion – Distinction between adiabatic and Joule Thomson expansion – Expression for Joule Thomson cooling – Liquefaction of helium, Kapitza's method – Adiabatic demagnetization – Production of low temperatures – Principle of refrigeration, vapour compression type.

Unit – III
5. Quantum theory of radiation: (12)
Black body-Ferry's black body – distribution of energy in the spectrum of Black body – Wein's displacement law, Wein's law, Rayleigh-Jean's law – Quantum theory of radiation - Planck's law – deduction of Wein's law, Rayleigh-Jeans law, Stefan's law from Planck's law. Measurement of radiation using pyrometers – Disappearing filament optical pyrometer – experimental determination – Angstrom pyro heliometer - determination of solar constant, effective temperature of sun.

Unit – IV
6. Statistical Mechanics: (12)
Introduction, postulates of statistical mechanics. Phase space, concept of ensembles and some known ensembles ,classical and quantum statistics and their differences, concept of probability, Maxwell-Boltzmann's distribution law -Molecular energies in an ideal gas- Maxwell-Boltzmann's velocity distribution law, Bose-Einstein Distribution law, Fermi-Dirac Distribution law, comparison of three distribution laws.

NOTE: Problems should be solved at the end of every chapter of all units.

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Suggested books
1. **Fundamentals of Physics**. Halliday/Resnick/Walker.C. *Wiley India Edition 2007*.
2. **Second Year Physics** – *Telugu Academy*.
3. **Modern Physics** by R. Murugeshan and Kiruthiga Siva Prasath (for statistical Mecha

B.Sc. (Physics)- II Year
Semester – III
Paper – III:: Electromagnetic Theory
(DSC - Compulsory)

Unit I : Electrostatics (11 hrs)
Electric Field:- Concept of electric field lines and electric flux, Gauss's law (Integral and differential forms), application to linear, plane and spherical charge distributions. Conservative nature of electric field 'E', Irrotational field. Electric potential:- Concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field. Calculation of potential from electric field for a spherical charge distribution.

Unit II : Magnetostatics (12 hrs)
Concept of magnetic field 'B' and magnetic flux, Biot-Savart's law, B due to a straight current carrying conductor. Force on a point charge in a magnetic field. Properties of B, curl and divergence of B, solenoidal field. Integral form of Ampere's law, Applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field intensity. Ballistic Galvanometer:- Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

Unit III: Electromagnetic Induction and Electromagnetic waves (13)
Faraday's laws of induction (differential and integral form), Lenz's law, self and mutual Induction. Continuity equation, modification of Ampere's law, displacement current, Maxwell equations. Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation: transverse nature of EM waves, velocity of light in vacuum and in medium. Poynting's theorem.

UNIT IV:
Varying and alternating currents (6)
Growth and decay of currents in LR, CR and LCR circuits - Critical damping. Alternating current, relation between current and voltage in pure R, C and L-vector diagrams - Power in ac circuits. LCR series and parallel resonant circuit - Q-factor. AC & DC motors-single phase, three phase (basics only).

Network Theorems(6):
Passive elements, Power sources, Active elements, Network models: T and π Transformations, Superposition theorem, Thevenin's theorem, Norton's theorem. Reciprocity theorem and Maximum power transfer theorem (Simple problems).

Text Books
1. Fundamentals of electricity and magnetism By Arthur F. Kip (McGraw-Hill, 1968)
2. Telugu Academy
3. Electricity and magnetism by J.H.Fewkes& John Yarwood. Vol.I (Oxford Univ. Press, 1991).
4. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings,1998).
5. Electricity and magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
6. Electricity and magnetism. By D C Tayal (Himalaya Publishing House,1988)
7. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata McGraw Hill, 2006).

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Unit-I Waves(12)

Fundamentals of Waves -Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones, energy transport, transverse impedance.

Longitudinal vibrations in bars- wave equation and its general solution. Special cases (i) bar fixed at both ends ii) bar fixed at the mid point iii) bar free at both ends iv) bar fixed at one end. Transverse vibrations in a bar- wave equation and its general solution. Boundary conditions, clamped free bar, free-free bar, bar supported at both ends, Tuning fork.

Unit II: Interference: (12)

Principle of superposition – coherence – temporal coherence and spatial coherence – conditions for Interference of light.

Interference by division of wave front: Fresnel's biprism – determination of wave length of light. Determination of thickness of a transparent material using Biprism – change of phase on reflection – Lloyd's mirror experiment.

Interference by division of amplitude: Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (Cosine law) – Colours of thin films – Non-reflecting films – interference by a plane parallel film illuminated by a point source – Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film) – Determination of diameter of wire-Newton's rings in reflected light with and without contact between lens and glass plate, Newton's rings in transmitted light (Haidinger Fringes) – Determination of wave length of monochromatic light – Michelson Interferometer – types of fringes – Determination of wavelength of monochromatic light, Difference in wavelength of sodium D_1, D_2 lines and thickness of a thin transparent plate.

Unit III: Diffraction: (12)

Introduction – Distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction:- Diffraction due to single slit and circular aperture – Limit of resolution – Fraunhofer diffraction due to double slit – Fraunhofer diffraction pattern with N slits (diffraction grating).

Resolving Power of grating – Determination of wave length of light in normal and oblique incidence methods using diffraction grating.

Fresnel diffraction-Fresnel's half period zones – area of the half period zones –zone plate – Comparison of zone plate with convex lens – Phase reversal zone plate – diffraction at a straight edge – difference between interference and diffraction.

Unit IV: Polarization (12)

Polarized light : Methods of Polarization, Polarizatioin by reflection, refraction, Double refraction, selective absorption , scattering of light – Brewster's law – Malus law – Nicol prism polarizer and analyzer – Refraction of plane wave incident on negative and positive crystals (Huygen's explanation) – Quarter wave plate, Half wave plate – Babinet's compensator – Optical activity, analysis of light by Laurent's half shade polarimeter.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested books

1. **Optics** by Ajoy Ghatak. *The McGraw-Hill companies.*
2. **Optics** by Subramaniyam and Brijlal. *S. Chand & Co.*
3. **Second Year Physics** – *Telugu Academy.*
4. **Modern Engineering Physics** by A.S. Vasudeva. *S.Chand & Co. Publications.*
5. **Fundamentals of Optics** by Jenkins A. Francis and White E. Harvey, *McGraw Hill Inc.*
6. K. Ghatak, **Physical Optics'**
7. D.P. Khandelwal, Optical and Atomic Physics' (Himalaya Publishing House, Bombay,1988)
8. Jenkins and White: 'Fundamental of Optics' (McGraw-Hill)
9. Smith and Thomson: 'Optics' (John Wiley and sons).

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1. Thickness of a wire using wedge method.
2. Determination of wavelength of light using Biprism.
3. Determination of Radius of curvature of a given convex lens by forming Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation-polarimeter.
6. Dispersive power of a prism
7. Determination of wavelength of light using diffraction grating minimum deviation method.
8. Wavelength of light using diffraction grating – normal incidence method.
9. Resolving power of a telescope.
10. Refractive index of a liquid and glass (Boys Method).
11. Pulfrich refractometer – determination of refractive index of liquid.
12. Wavelength of Laser light using diffraction grating.
13. Verification of Laws of a stretched string (Three Laws).
14. Velocity of Transverse wave along a stretched string
15. Determination of frequency of a bar-Melde"s experiment

Note: Minimum of eight experiments should be performed Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

B.Sc. (Physics)- III Year
Semester – V
Paper – V :: (A) Modern Physics
(DSE – Elective I)

UNIT - 1 : SPECTROSCOPY (12)

Atomic Spectra: Introduction - Drawbacks of Bohr's atomic model - Sommerfeld's elliptical orbits - relativistic correction (no derivation). Stern & Gerlach experiment, Vector atom model and quantum numbers associated with it. L-S and j-j coupling schemes. Spectral terms, selection rules, intensity rules - spectra of alkali atoms, doublet fine structure, Zeeman Effect, Paschen-Back Effect and Stark Effect (basic idea).

Molecular Spectroscopy: Types of molecular spectra, pure rotational energies and spectrum of diatomic molecule. Determination of inter nuclear distance. Vibrational energies and spectrum of diatomic molecule. Raman effect, classical theory of Raman effect. Experimental arrangement for Raman effect and its applications.

UNIT – II : Quantum Mechanics (14)

Inadequacy of classical Physics: Spectral radiation - Planck's law (only discussion). Photoelectric effect - Einstien's photoelectric equation. Compton's effect - experimental verification.

Matter waves & Uncertainty principle: de Broglie's hypothesis - wavelength of matter waves, properties of matter waves. Phase and group velocities. Davisson and Germer experiment. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits. Heisenberg's uncertainty principle for position and momentum (x and p_X), Energy and time (E and t). Gamma ray microscope. Diffraction by a single slit. Position of electron in a Bohr orbit. Complementary principle of Bohr.

Schrodinger Wave Equation

Schrodinger time independent and time dependent wave equations. Wave function properties - Significance. Basic postulates of quantum mechanics. Operators, eigen functions and eigen values, expectation values.

Unit - III : Nuclear Physics (10)

Nuclear Structure: Basic properties of nucleus - size, charge, mass, spin, magnetic dipole moment and electric quadrupole moment. Binding energy of nucleus, deuteron binding energy, p-p, n-n, and n-p scattering (concepts), nuclear forces. Nuclear models- liquid drop model, shell model.

Alpha and Beta Decays: Range of alpha particles, Geiger - Nuttal law. Gammow's theory of alpha decay. Geiger - Nuttal law from Gammow's theory. Beta spectrum - neutrino hypothesis,

Particle Detectors: GM counter, proportional counter, scintillation counter.

UNIT: IV: Solid State Physics & Crystolography (12)

Crystal Structure : Crystalline nature of matter. Cystal lattice, Unit Cell, Elements of symmetry. Crystal systems, Bravais lattices. Miller indices. Simple crystal structures (S.C., BCC, FCC, CsCl, NaCl, diamond and Zinc Blende)

X-ray Diffraction: Diffraction of X -rays by crystals, Bragg's law, Experimental techniques - Laue's method and powder method.

Bonding in Crystals: Types of bonding in crystals - characteristics of crystals with different bondings. Lattice energy of ionic crystals - determination of Madelung constant for NaCl crystal. Calculation of Born Coefficient and repulsive exponent. Born-Haber cycle.

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Suggested books

1. Modern Physics by G. Aruldhas & P. Rajagopal.Eastern Economy Edition.
2. Concepts of Modern Physics by Arthur Beiser.Tata McGraw-Hill Edition.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath.S. Chand & Co.
4. Nuclear Physics by D.C. Tayal, Himalaya Publishing House.
5. Molecular Structure and Spectroscopy by G. Aruldhas.Prentice Hall of India, New Delhi.
6. Spectroscopy -Atomic and Molecular by Gurdeep R Chatwal and Shyam Anand -Himalaya Publishing

Unit – I: (12 Hrs)

Band theory of P-N junction

1. Energy band in solids (band theory), valence band, conduction band and forbidden energy gap in solids, insulators, semiconductors and pure or intrinsic semiconductors and impure or extrinsic semi-conductors. N-type semi-conductors, P-type semi-conductors, Fermi level, continuity equation.

2. **Diodes:** P-N junction diode, Half-wave, full-wave and bridge rectifier. Zener diode & its characteristics. Zener diode as voltage regulator.

Unit-II: (12 Hrs)

1. **Bipolar Junction Transistor (BJT)** – p-n-p and n-p-n transistors, current components in transistors, CB, CE and CC configurations – transistor as an amplifier - RC coupled amplifier – Frequency response (Qualitative analysis).

2. **Feedback concept & Oscillators:** Feedback, General theory of feedback – Concepts of oscillators, Barkhausen's criteria, Phase shift oscillator – Expression for frequency of oscillation.

Unit-III : (10 hrs)

Special devices- Construction and Characteristics: Photo diode - Shockley diode - Solar cell, Opto-couplers - Field Effect Transistor (FET) - FET as an Amplifier - Uni Junction Transistor (UJT). UJT as a relaxation oscillator - Silicon controlled rectifier (SCR) - SCR as a switch.

Unit-IV: (14 Hrs)

1. Digital Electronics

Binary number system, convertion of binary to decimal and vice-versa. Binary addition and subtraction (1's and 2's complement methods). Hexadecimal number system. Conversion from binary to hexadecimal and vice-versa. Decimal to hexadecimal and vice-versa.

2. Logic gates:

OR, AND, NOT gates, truth tables, realization of these gates using discrete components. NAND, NOR as universal gates, Exclusive – OR gate (EX-OR). De Morgan's Laws – Verification.

NOTE: Problems should be solved from every chapter of all units.

Suggested books

1. Electronic devices and circuits – Millman and Halkias. *Mc.Graw-Hill Education.*
2. Principles of Electronics by V.K. Mehta – *S. Chand & Co.*
3. Basic Electronics (Solid state) – B. L. Theraja , S. Chand & Co.
4. A First Course in Electronics- Anwar A. Khan &Kanchan K. Dey, PHI.
5. Physics of Semiconductor Devices- S. M. Sze
6. Physics of Semiconductors- Streetman.
7. Basic Electronics – Bernod Grob.
8. Third year Electronics – Telugu Academy
9. Digital Principles & Applications – A.P. Malvino and D.P. Leach

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1. Construction of logic gates (AND, OR, NOT, gates) with discrete components – Truth table Verification

2. AND, OR, NOT – gates constructions using universal gates – Verification of truth tables.

3. Construction of NAND and NOR gates with discrete components and truth table verification

4. Characteristics of a Transistor in CE configuration

5. R.C. coupled amplifier – frequency response.

6. Verification of De Morgan's Theorem.

7. Zener diode V-I characteristics.

8. P-n junction diode V- I characteristics.

9. Zener diode as a voltage regulator

10. Construction of a model D.C. power supply

11. R C phase shift Oscillator –determination of output frequency

❖ Every student should complete minimum 06 experiments.

Suggested Books