S. S. Jain Subodh PG (Autonomous) College, Jaipur
Department of Physics
Bachelor of Science (B.Sc. Pass Course)
Subject – Physics

Examination Scheme :

Semester - I		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	MECHANICS – I	50 Marks
PAPER – II	ELECTROMAGNETISM – I	50 Marks
PAPER – III	OSCILLATIONS AND WAVES –I	50 Marks
Physics Practical – I		75 Marks
Semester - II		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	MECHANICS – II	50 Marks
PAPER – II	ELECTROMAGNETISM – II	50 Marks
PAPER – III	OSCILLATIONS AND WAVES –II	50 Marks
Physics Practical – II		75 Marks
Semester - III		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	STATISTICAL AND THERMODYNAMICAL PHYSICS-I	50 Marks
PAPER – II	OPTICS –I	50 Marks
PAPER – III	ELECTRONICS & SOLID STATE DEVICES –I	50 Marks
Physics Practical– III		75 Marks
Semester - IV		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	STATISTICAL AND THERMODYNAMICAL PHYSICS-II	50 Marks
PAPER – II	OPTICS –II	50 Marks
PAPER – III	ELECTRONICS & SOLID STATE DEVICES –II	50 Marks
Physics Practical - IV		75 Marks
Semester - V		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	MATHEMATICAL PHYSICS AND SPECIAL THEORY OF RELATIVITY - I	50 Marks
PAPER – II	QUANTUM MECHANICS - I	50 Marks
PAPER – III	SOLID STATE PHYSICS	50 Marks
Physics Practical – V		75 Marks
Semester - VI		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	MATHEMATICAL PHYSICS AND SPECIAL THEORY OF RELATIVITY - II	50 Marks
PAPER – II	QUANTUM MECHANICS - II	50 Marks
PAPER – III	NUCLEAR PHYSICS	50 Marks
Physics Practical - VI		75 Marks

Examination Scheme for each Paper

Part A 7 QUESTIONS (very short answer Questions) 7X 1 MARK EACH = 7 Marks

Part B 4 QUESTIONS (1 question from each unit with Internal choice) 4X 7 MARK EACH = 28 Marks

Total of End semester exam (duration of exam 3 hours) = 35 Marks

Internal assessment = 15 Marks

Maximum Marks (Each theory paper) = 50Marks

Max. Practical Marks = 75 Marks

(Internal Marks 45+ external marks 30)

Total of Theory Papers : 3 X 50 Marks Each = 150 Marks (Min. Pass Marks 40%)

Total of Practical Marks = 75 Marks

Grand Total of Subject per Semester = 225 Marks

Semester - I

PAPER I: MECHANICS – I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Physical Laws and Frames of Reference:

Inertial and non-inertial frames, examples. Transformation of displacement, velocity and acceleration between different frames of reference involving translation. Galilean transformation and invariance of Newton's law. Non-inertial frames, fictitous or pseudo forces, Transformation of displacement, velocity and acceleration between rotating co-ordinate systems, centrifugal acceleration, Coriolis force and its applications, Motion relative to earth. Foucault's pendulum

UNIT-II Special Theory of Relativity:

Postulates of special theory of relativity. Lorentz transformations, Addition of velocities and acceleration, Time dilation and length contraction. Variation of mass with velocity, Relativistic energy and mass energy relation.

UNIT-III Conservation Laws:

Conservative forces. Potential energy. Potential energy in gravitational and electrostatic field. Rectilinear motion under conservation forces. Discussion of potential energy curves and motion of a particle. Conservation of angular momentum about an arbitrary point, Precessional motion of Spinning top, Spin precession in constant magnetic field.

UNIT-IV Rigid Body Dynamics:

Equation of motion of a rotating body, inertial coefficients, case of J not parallel to w, kinetic energy of rotation and idea of principle axis. Calculation of moment of inertia of a disc, spherical shell, hollow and solid spheres and cylindrical objects (cylindrical shell, solid cylinder) about their symmetric axis through centre of mass.

Paper – II ELECTROMAGNETISM – I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one mark for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT -I Vector Fields :

Partial derivative. Gradient of a scalar function. Line integral of a vector field. Divergence of a vector field. Divergence in the Cartesian coordinates, Concept of solid angle. Gauss divergence theorem, Gauss law in differential form, Gauss law from inverse square law, physical meaning of divergence of a vector, The Laplacian operator. Possion's and Laplace equations.

UNIT -II Curl and the Field of Stationary Charge:

Curl of a vector field, curl in Cartesian coordinates, Stoke's theorem, physical meaning of curl. Potential difference and potential function. Potential energy of a system. Application : energy required to build a uniformly charged sphere. Classical radius of the electron, potential and field due to a short dipole, torque and force on a dipole in a Z external field.

UNIT -III The Field of Moving Charge:

Magnetic force, Measurement of charge in motion, Invariance of charge. Electric field measured in different frames of reference, Field of a point charge moving with constant velocity, Force on a moving charge, Interaction between a moving charge and other moving charges.

UNIT – IV The Magnetic Field:

The definition of magnetic field, properties of the magnetic field. Ampere's circuital law with applications. Ampere's Law in the differential form. Vector potential. Poissions equation for vector potential. Field of any current carrying wire and deduction of Bio-Savart law.

Paper – III OSCILLATIONS AND WAVES –I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts of end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT -I Oscillations:

Oscillations in an arbitrary potential well, Simple harmonic motion, examples-spring mass system, mass on a spring, torsional oscillator, LC circuit, energy of the oscillator,

UNIT -II Damped Oscillator:

Damping of oscillator, viscous and solid friction damping. Power dissipation. Anharmonic oscillator, simple pendulum as an example.

UNIT -III Driven Oscillator:

Driven harmonic oscillator with viscous damping. Frequency response, phase relations. Quality factor, Resonance. Introduction of j operator concept in Electrical oscillations, series and parallel LCR circuit. Electro-mechanical system-Ballistic Galvanometer Effect of damping.

UNIT – IV Coupled Oscillator:

Equation of motion of two coupled S.H Oscillators. Normal modes, motion in mixed modes. Transient behaviour. Effect of coupling in mechanical systems. Electrically coupled circuits, frequency response. Reflected impedance. Effect of coupling and resistive load.

Physics Practical : I

Max. Practical Marks	**= 75 Marks**
Internal Marks	**= 45 Marks**
External Practical Exam.(Duration : 3 hrs.)	**= 30 Marks**

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. To study the variation of power transfer to different loads by a D.C. source and to verify maximum power transfer theorem.
2. To study the variation of charge and current in a RC Circuits with different time constant (using a DC source).
3. To study the behaviour of an RC Circuits with varying resistance and capacitance using AC mains as a Power source and also to determine the impedance and phase relations.
4. To study the rise the decay of current in an LR circuit with a source of constant emf.
5. To study the voltage and current behavior of an LR circuit with an AC power source. Also, determine power factor, impedance and phase relations.
6. To study the characteristics of a semiconductor junction diode and determine forward and reverse resistances.
7. To study the magnetic field along the axis of a current carrying circular coil. Plot the necessary graph and hence find the radius of the circular coil.
8. To determine the specific resistance of a materials and determine difference between two small resistance using Carey Foster's bridge.
9. To convert galvanometer into an ammeter of a given range.
10. To convert galvanometer into a voltmeter of a given range.
11. Any experiment according to theory paper.

Semester - II

Paper I MECHANICS – II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts of end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Centre of mass frame:

Centre of mass, Two particle System, motion of centre of mass and concept of reduced mass, Conservation of energy and linear momentum, Collision of two particles in one and two dimensions (elastic and inelastic), Analysis of collision in centre of mass frame. Slowing down of neutrons in moderator. System with varying mass. Angular momentum and charged particle scattering by a nucleus as an example.

UNIT-II Motion under central forces :

Motion under central force, Gravitational interaction, Inertial and gravitational mass. General solution under gravitational interaction. Rutherford scattering. Discussion of trajectories. Cases of elliptical and circular orbits. Kepler's laws,

UNIT-III Elasticity-I :

Elasticity, Small deformations, Young's modulus, Bulk modulus and Modulus of rigidity for an isotropic solid, Poisson's ratio, relation between elastic constants. Elastic theorems.

UNIT-IV Elasticity-II :

Theory of bending of beams and Cantilever, Torsion of a cylinder, Bending moments and Shearing forces. Experimental determination of elastic constants by bending of beam.

Paper – II ELECTROMAGNETISM – II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts of end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT – I Magnetic Fields in Matter :

Electric current due to orbital electron, the field of current loop, Bohr magneton. Orbital gyro magnetic ratio Electron spin and magnetic moment. Magnetic susceptibility, magnetic field caused by magnetized matter. Magnetization current. Free current and the field H.

UNIT –II Electric Field in Matter :

The moment of a charge distribution. Atomic and molecular dipoles. Atomic polarizability. Permanent dipole moment, dielectrics. The Capacitor filled with a dielectric. The potential and field due to a polarized sphere.

UNIT –III Dielectric :

Dielectric.. Dielectric sphere placed in a uniform field. The field of charge in dielectric medium and Gauss's law. The connection between electric susceptibility and atomic polarizability. Polarization in changing field. The bound charge (polarization) current.

UNIT -IV Transient behavior and Maxwell's Equations:

Transient behaviour of an R-C circuit. Electromagnetic Induction and Maxwell's Equations, Faraday's law in differential form. Mutual inductance, Self inductance Transient behaviour of an L-R circuit, the displacement current, Maxwell's equations in differential and integral forms.

Paper – III OSCILLATIONS AND WAVES –II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts of end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT -I Lattice dynamics:

Dynamics of a number of oscillators with near-neighbour interactions. Equation of motion for one dimensional mono-atomic and diatomic lattices, acoustic and optical modes, dispersion relations. Concept of group and phase velocities.

UNIT – II Electrical Transmission Line:

Electrical transmission line, propagation velocity, losses, characteristic impedance, standing waves, effect of termination.

UNIT –III Wave Motion:

Wave motion – Elastic waves in a solid rod. Pressure waves in a gas column. Transverse waves in a string, waves in three dimensions, spherical waves, Fourier series and Fourier analysis.

UNIT – IV Electromagnetic Wave:

Plane electromagnetic (EM) wave. Energy and momentum of EM wave. Radiation pressure. Radiation resistance of free space. EM waves in dispersive media (normal case). Spectrum of electromagnetic radiations.

Physics Practical : II

Max. Practical Marks = 75 Marks
Internal Marks = 45 Marks
External Practical Exam.(Duration : 3 hrs.) = 30 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. To study the random decay and determine the decay constant using the statistical board.
2. Using compound pendulum study the variation of time period with amplitude in large angle oscillations.
3. To Study damping using Compound pendulum study the damping.
4. To study the excitation of normal modes and measure frequency splitting using two coupled oscillator.
5. To study the frequency of energy transfer as a function of coupling strength using coupled oscillators.
6. (a) To study the viscous fluid damping of a compound pendulum and determing damping coefficient and Q of the oscillator.
   (b) To study the electromagnetic damping of a compound pendulum and to find the variation of damping coefficient with the assistance of the conducting lamina.
7. To find J by Callender and Barne's Method.
8. To determine Youngs modulus by bending of beam.
9. To determine Y. σ and η Searle's method.
10. To measure Curie temperature of Monel alloy.
11. To determine modulus of rigidity of a wire using Maxwell's needle.
12. Study of normal modes of a Coupled pendulum system. Study of oscillations in mixed modes and find the period of energy exchange between the two oscillators.
13. To study Variation of surface tension with temperature using Jaegger's method.
14. Any experiment according to theory paper.

Semester - III

Paper –I STATISTICAL AND THERMODYNAMICAL PHYSICS-I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT I General Thermo-dynamical Interaction:

Thermal interaction ; Zeroth law of thermodynamics Helmholtz free energy; Adiabatic interaction and enthalpy ; General interaction and first law of thermodynamics; Infinitesimal general interation; Gibb's free energy and Phase transitions. Clausius-Clapeyron equation; Vapour pressure curve.

UNIT II Carnot's Engine and Maxwell Relation:

Heat engine and efficiency of engine, Carnot,s Cycle; Thermodynamic scale as an absolute scale; Maxwell relations and their applications.

UNIT III Production of Low Temperature:

Joule Thomson expansion and J.T. coefficients for ideal as well as Vander Waal's gas. Porous plug experiment, Temperature inversions. Regenerative cooling and cooling by adiabatic expansion and demagnetization.

UNIT IV Application of Low Temperature:

Liquid Helium, He I and He II, super fluidity, quest for absolute zero. Nernst heat theorem. Qualitative Discussion of Superconductivity.

Reference books:

1. Berkeley series Vol. V, Statistical Physics
2. Reif-Thermodynamics and Statistical Physics
3. Lokanathan and Khandelwal-Thermodynamics and Statistical Physics
4. Sears- Thermodynamics, Kinetic theory of gases and Statistical Physics
5. Kittle - Thermal Physics

Semester - III

Paper – II OPTICS –I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Geometrical Optics:

Fermat's principle, Laws of reflection and refraction from Fermat's principle, refraction at a spherical surface. Axial, lateral, angular magnification and their interrelationship; Abbe's Sine condition for spherical surfaces;

UNIT-II Lenses :

Refraction through a thick and thin lenses and its Focal length , Focal length of two thin lenses separated by a distance, Cardinal points of a co-axial lens system, properties of cardinal points; construction of image using cardinal points.

UNIT-III Interference :

Young's double slit experiment, temporal and spatial coherence, coherence length, Division of amplitude, Interference in thin films, colour in thin films. Wedge shaped film, Newton rings and determination of wavelength

and refractive index by Newton ring. Michelson Interferometer, Measurement of wavelength and refractive index by Michelson Interferometer.

Unit-IV Polarization:
Polarization states of electromagnetic (EM) waves, reflection and refraction of plane EM wave at plane dielectric surface, boundary conditions, derivation of Fresnel's relations. Huygen's theory, Theory of double refraction using Fresnal's ellipsoidal surface (no mathematical derivation). Production and analysis of plane, circularly and elliptically polarized light, quarter and half wave plates.

Reference Books :

1 **Principles of Optics by B.K. Mathur**
2. Optics by D.P. Khandelwal
3. Introduction to Modern Optics by A.K. Ghatak (Tata McGraw Hill)
4. Optics by Brij Lal and Subramanium.
5. An Introduction to Modern Optics by G.R. Fowels.
6. Optical Physics by Lipson and Lipson
7. Essentials of Lasers by Allen.

Semester - III

Paper – III ELECTRONICS & SOLID STATE DEVICES –I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Circuit Analysis:
Network-some important definitions, loop and nodal equation based on DC and AC circuits (Kirchhoff's Laws), Four terminal network parameters; Current volt conventions, Open circuit, short circuit and hybrid parameters of any four terminals network. Input, Output and mutual impendence for an active four terminal network.

UNIT – II Network Theorems:
Superposition, Thevenin, Norton, Reciprocity, Compensation and maximum power transfer and miller theorems.

UNIT – III Semiconductors:
Intrinsic and extrinsic semiconductors, charge densities in N and P materials, conduction by drift and diffusion of charge carriers. PN diode equation, capacitance effects. Nature of charge carriers by Hall effect and Hall coefficient. Zener Diode, tunnel diode, photovoltaic effect.

UNIT – IV Rectifiers and Voltage Regulation:
Half-wave, full wave and Bridge rectifiers, Calculation of ripple factor, efficiency and regulation. Filters: shunt inductors, shunt capacitor, L sections and π sections filters. Voltage regulation and voltage stabilization by Zener diode, Voltage multiplier circuits.

Reference books :

1. John D. Ryder, Electronic Fundamentals and Applications, Prentice Hall of India Pvt. Ltd., New Delhi.
2. John D. Ryder, Engineering Electronics, McGraw Hill Book Company, New Delhi.
3. Jacob Millman and Christosc Hailkias, Integrated Electronics. Analog and Digital Circuits and systems: McGraw-Hill Ltd. (1972)
4. Albert Paul Malvino, Digital Computer Electronics, Tata McGraw- Hill Pub. Co. Ltd., New Delhi (1983).
5. Kumar & Gupta, Hand book of Electronics.
6. G.K. Mithal, Hand Book of Electronics.

Semester - III

Physics Practical : III

Max. Practical Marks = 75 Marks
Internal Marks = 45 Marks
External Practical Exam.(Duration : 3 hrs.) = 30 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. Study of dependence of velocity of wave propagation on line parameter using torsional wave apparatus.
2. Study of variation of reflection coefficient on nature of termination using torsional wave apparatus.
3. Using Platinum resistance thermometers find the melting point of a given substance.
4. Using Newton's rings method find out the wave length of a monochromatic source and find the refractive index of liquid .
5. Using Michelson's interferometer find out the wavelength of given monochromatic source (Sodium light).
6. To determine dispersive power of prism.
7. To determine wave length by grating.
8. To determine wave length by Biprism.
9. Determine the thermodynamic constant γ using Clements & Desorme's method.
10. To determine thermal conductivity of a bad conductor by Lee's method.
11. Determination of ballistic constant of a ballistic galvanometer.
12. Study of variation of total thermal radiation with temperature
13. To study the Specific rotation of sugar solution by polarimer.
14. Any experiment according to theory paper.

Semester – IV

Paper –I STATISTICAL AND THERMODYNAMICAL PHYSICS-II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT I Kinetic Theory of Gases:

Distribution law of molecular velocities, most probable, average and RMS velocities, Energy distribution function; Experimental verification of the Maxwell velocity distribution the principle of equipartition of energy.

UNIT II Transport Phenomenon of Gases:

Transport Phenomenon: Mean free path, distribution of free paths, coefficients of viscosity, thermal conductivity, diffusion and their interrelation.

UNIT III Classical Statistics:

Validity of classical approximation, Phase space, micro and macro states; Thermodynamical probability, entropy and thermodynamic probability; Monoatomic ideal gas; Barometric equation ; Specific heat capacity of diatomic gas; Heat capacity of solids.

UNIT IV Quantum Statistics:

Black body radiation and failure of classical statistics, Postulates of quantum statistics, indistingushability , wave function and exchange degeneracy, a priori-probability; Bose Einstein statistics and its distribution function ;Plank distribution function and radiation formula ;Fermi Dirac statistics and its distribution function ,contact potential ,thermionic emission ;Specific heat anomaly of metals ;Nuclear spin statistics (para and ortho hydrogen)

Reference books:

1. Berkeley series Vol. V, Statistical Physics
2. Reif-Thermodynamics and Statistical Physics
3. Lokanathan and Khandelwal-Thermodynamics and Statistical Physics
4. Sears- Thermodynamics, Kinetic theory of gases and Statistical Physics
5. Kittle - Thermal Physics

Semester – IV

Paper – II OPTICS –II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Fraunhofer Diffraction:

Fraunhofer diffraction at single slit and a circular aperture, intensity distribution and width of central maxima, and determination of slit size, two slit diffraction and its intensity distribution with missing orders. Diffraction due to N slits with intensity distributions. Plane transmission grating its formation and intensity distribution.

UNIT-II Fresnel class of Diffraction & Resolving Power:

Fresnel class of diffraction, half period zones, zone plate, diffraction due to circular aperture. Diffraction at straight edge, thin and thick wire, rectangular slit. Rayleigh's criterion, resolving power of prism, telescope, microscope and plane transmission grating.

Unit-III Optical Activity and Holography :

Optical activity, Specific rotation, biquartz and half shade polarimeters. Basic concepts of holography, construction of a hologram and reconstruction of the image, important features of hologram and uses of holography.

Unit-IV Lasers:

Difference between ordinary and laser source, stimulated and spontaneous emission, stimulated absorption. Einstein's A and B coefficients, population inversion, conditions for laser action, meta-stable states, pumping. Types of lasers, construction, working and energy level schemes of He-Ne and Ruby laser. Properties and uses of lasers.

Reference Books :

1 **Principles of Optics by B.K. Mathur**
2. Optics by D.P. Khandelwal
3. Introduction to Modern Optics by A.K. Ghatak (Tata McGraw Hill)
4. Optics by Brij Lal and Subramanium.
5. An Introduction to Modern Optics by G.R. Fowels.
6. Optical Physics by Lipson and Lipson
7. Essentials of Lasers by Allen.

Semester – IV

Paper – III ELECTRONICS & SOLID STATE DEVICES –II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Transistor:

Notations and volt -ampere characteristics for bipolar junction transistor, concept of load line and operating point, hybrid parameters. Transistor as Amplifiers: CB, CE, CC configurations, its characteristic curves and their equivalent circuits. Analysis of transistor amplifiers using hybrid parameters and its frequency response. Fixed and emitter biasing, bias stability in transistor circuits.

UNIT-II Amplifiers with Feedback:

Concept of feedback, positive and negative feedback, voltage and current feedback circuits, Advantages of negative feedback- stabilization of gain by negative feedback, Effect of feedback on output and input resistance. Reduction of nonlinear distortion by negative feedback. Effect on gain- frequency response.

UNIT-III Operational Amplifier & Oscillators:

Differential amplifier, DC levels shifter, operational amplifier, input and Output impedances, input offset current. Application: Unity gain buffer, Adder, Subtractor, Integrator and Differentiator. Feedback requirements for oscillations, circuit requirement for oscillation, basic oscillator analysis. Colpitt and Hartley oscillators. R-C oscillators, Piezoelectric frequency control.

UNIT-IV Field Effect Transistor and Digital Circuits:

Field Effect Transistor (FET) and its characteristic biasing JFET, ac operation of JFET and MOSFET.

Binary, Hexadecimal and Octal number systems. Binary arithmetic. Logic fundamentals AND, OR, NOT, NOR., NAND, XOR gates, Boolean theorems, transistor as a switch, logic gates: circuit realization of logic functions. Analog to digital and digital to analog analysis. DDL, RTL, TTL circuits.

Reference books :

1. John D. Ryder, Electronic Fundamentals and Applications, Prentice Hall of India Pvt. Ltd., New Delhi.
2. John D. Ryder, Engineering Electronics, McGraw Hill Book Company, New Delhi.
3. Jacob Millman and Christosc Hailkias, Integrated Electronics. Analog and Digital Circuits and systems: McGraw-Hill Ltd. (1972)
4. Albert Paul Malvino, Digital Computer Electronics, Tata McGraw- Hill Pub. Co. Ltd., New Delhi (1983).
5. Kumar & Gupta, Hand book of Electronics.
6. G.K. Mithal, Hand Book of Electronics.

Semester – IV

Physics Practical : IV

Max. Practical Marks = 75 Marks
Internal Marks = 45 Marks
External Practical Exam. (Duration : 3 hrs.) = 30 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. Plot thermo emf versus temperature graph and find the neutral temperature (Use sand bath)
2. Study of power supply using two diodes/bridge rectifiers with various filter circuits.
3. Study of half wave rectifier using single diode and application of L and π section filters.
4. To study characteristics of a given transistor PNP/NPN (Common emitter, common base and common collector configurations
5. Determination of band gap using a junction diode.
6. Determination of power factor (cos ϕ) of a given coil using CRO.
7. Study of single stage transistor audio amplifier (Variation of gain with frequency).
8. To determine e/m by Thomson's method.
9. Determination of velocity of sound in air by standing wave method using speaker, microphone and CRO
10. Measurement of inductance of a coil by Anderson's bridge.
11. Measurement of capacitance and dielectric constant of a liquid and gang condenser by de- Sauty Bridge.
12. Any experiment according to theory paper.

Semester – VI

Paper – I Mathematical Physics and Special Theory of Relativity – II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT – I Lorentz Transformation:
Lorentz transformation and rotation in space-time, time like and space like vector, world line, macro-causality.

UNIT – II Four vector Formulation:
Four vector formulation, energy momentum four vector, relativistic equation of motion, invariance of rest mass, orthogonality of four force and four velocity, Lorentz force as an example of four force, transformation of four frequency vector, longitudinal and transverse Doppler's effect.

UNIT – III Transformation between Lab and CM:
Transformation between laboratory and center of mass system. Four momentum conservation, kinemations of decay products of unstable particles and reaction thresholds: Pair production, inelastic collision of two particles, Compton effect.

UNIT – IV Transformation electric and Magnetic field:
Transformation electric and Magnetic fields between two inertial frames.

Reference Books :

1. Mathematical Methods for Physicists by George Arfken, Academic Press.
2. Applied Maths for Engineers and Physicists by Pipes and Harvel (McGraw Hill)
3. Mathematical Methods by Potter and Goldberg (Prentice Hali, India)
4. Special Relativity by A.P. French (English Language Book Society)
5. Theory of Relativity by Synge.

Semester – V

Paper – II QUANTUM MECHANICS – I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT I Origin and Experimental Evidence of Quantum Theory:

Development of quantum theory –Historical development and experimental evidence for quantum theory Electromagnetic Radiation: Black Body Radiation, qualitative discussion of spectral distribution of energy, limitation of classical theory, Planck's radiation law, photoelectric effect, Compton effect, Matter Waves: De Broglie hypothesis, Davison Germer experiment.

UNIT–II Uncertainty Principles and Schrodinger's Wave Mechanics :

Uncertainty principle and its consequences gamma ray microscope, diffraction at a single slit, its application such as (i) Non existence of electron in nucleus, (ii) Ground state energy of H–atom, (iii) Ground state energy of harmonic oscillator (iv) Natural width of spectral lines. Schrodinger's equation : Its need and justification, time dependent and time independent forms, physical significance of the wave function and its interpretation, probability current density.

UNIT–III Postulate's and Operators of Quantum Mechanics :

Operators in quantum mechanics, definition of an linear operator. Linear and Hermition operator, state function. Expectation value of dynamical variable-position, momentum and energy, Fundamental postulates of quantum mechanics, Eigen function and eigen values, Degeneracy. Orthogonality of eigen function, Commutation relations, Ehrenfest's theorem and complementarily wave packet, group and phase velocities, Principle of superposition, Gaussian wave packet.

UNIT IV Simple Solutions of Schrodinger equation :

Time independent Schrodinger equation and stationary state solution, Boundary and continuity conditions on the wave function, particle in one dimensional box, eigen function and eigen values , discrete energy levels, extension of results for three dimensional case and degeneracy of levels.

Reference Books :

1 H.S. Mani, G.K. Mahta, Introduction to Modern Physics, East West Press Pvt. Ltd., New Delhi (1988)

2. A.K. Ghatak and S.Lokanathan, Quantum Mechanics : Theory and Applications, Macmillan India Ltd., Delhi (1984), Third edition.
3. Richtmeyer, Kennard and Cooper, Mc Graw-Hill, 1969, sixth edition.
4. A. Beiser, Perspectives of Modern Physics
5. Parasmal Agrawal, Quantum Theory
6. S.S. Rawat and S.Singh, Elementary Quantum Mechanics and Spectroscopy (in Hindi)

Semester – V

Paper - III SOLID STATE PHYSICS

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Crystal Binding and Crystal Structure:

Various types of Bindings: Cohesive energy and compressibility of ionic crystals , Space Lattice and Crystal Structure, Bravis Lattice, Miller Indices and Crystal Structure, Spacing of Planes in Crystal Lattice, Determination of different crystal properties for SC, FCC, BCC,HCP and perovaskite structure, X-ray Diffraction and Bragg's Law, Laue equation of X-ray diffraction, Debye Scherer and Laue Camera.

UNIT-II Thermal and Electrical Properties of the Solids:

Concepts of Thermal Energy and Phonons, Internal Energy and Specific Heat, The Various Theories of Lattice Specific Heat of Solids: The Einstein Model, Debye Model, Electronic Contribution of the internal Energy hence to the Specific Heat of Metals, Thermal Conductivity of the lattice. Electrical Conductivity: Drude-Lorentz Theory of Electrical Conductivity, Boltzmann Transport Equation, Sommerfield Theory of Electrical Conductivity, Mathiessen's Rule, Thermal Conductivity and Wildemann-Franz's Law, The Hall Effect.

UNIT-III Band Theory of Solids:

Formation of Bands, Periodic Potential of a Solid, Wave Function in a Periodic Lattice and Bloch Theorem, Density of states , Kronig Penny Model, Velocity of the Bloch electrons and Dynamical Effective Mass, Momentum, Crystal Momentum and Physical Origin of the Effective Mass, Negative Effective Mass and concept of Holes, The distinction between metals, insulators, and semiconductors.

UNIT-IV Magnetic Properties:

Classification of Magnetic Materials, Origin of Atomic Magnetism, Dynamics of Classical Dipole In Magnetic Field, Magnetic Susceptibility, phenomenon of Diamagnetic, Para magnetic susceptibility of Ionic Crystal, Ferromagnetism, Temperature Dependence of Saturation of Spontaneous Magnetization, The Paramagnetic Region, The Nature of Ferromagnetism, Nature and Origin of Weiss Molecular Field, Heisenberg's Exchange Interaction, (Quantum Theory of Ferromagnetism), Relation between Exchange Integral and Weiss Constant, Ferromagnetism Domains, Magnetostriction

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Reference Books :

1 . Perspectives of Modern Physics, A Beiser.
2. Solid state Physics by G.I. Epifanov (Mir r Publisher ,)
3. Introduction to solid state physics, C. Kittel (Weley Eastern Ltd.)

Semester – V

Physics Practical : V

Max. Practical Marks = 75 Marks
Internal Marks = 45 Marks
External Practical Exam.(Duration : 3 hrs.) = 30 Marks

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. Study of a R-C transmission line at 50 Hz
2. Study of a L-C transmission line
   (i) at fixed frequency.
   (ii) at variable frequency.
3. Study of resonance in an LCR circuit (using air core inductance and damping by metal plate)
   (i) at fixed frequency by varying C, and
   (ii) by varying frequency.
4. Study of the characteristics of junction diode & Zener diode.
5. Study of
   (i) Recovery time of junction diode and point contact diode.
   (ii) Recovery time as a function of frequency of operation and switching current.
6. To design Zener regulated power supply and study the regulation with various loads.
7. To study the characteristics of a field effect transistor (FET) and design/study amplifier of finite gain (10).
8. To study the frequency response of a transistor amplifier and obtain the input and output impendence of the amplifier.
9. To design and study of an R-C phase shift oscillator and measure output impedence (frequency response with change of component of R and C).
10. To study a voltage multiplier circuit to generate high voltage D.C. from A.C.
11. Using discrete components, study OR, AND, NOT logic gates, compare with TTL integrated circuits (I.C.'s).
12. Application of operational amplifier (OP-AMP) as : Minimum two of the following exercises–(a) Buffer (for accurate voltage measurement) (b) Inverting amplifier (c) Non inverting amplifier (d) Summing amplifier.

Semester – V

Paper – I Mathematical Physics and Special Theory of Relativity – I

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT I Coordinate Transformation:

Orthogonal curvilinear coordinate system, scale factors, expression for gradient, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate. Coordinate transformation and Jacobian.

UNIT II Tensor analysis & Dirac Delta function :

Transformation of covariant, contravariant and mixed tensor; Addition, multiplication and contraction of tensors; Metric tensor and its use in transformation of tensors. Dirac delta function and its properties.

UNIT III Special functions :

The second order linear differential equation with variable coefficient and singular points, series solution method and its application to the Hermite, Lagendre and Laguerre differential equations: basic properties like orthogonality, recurrence relation, graphical representation and generating function of Hermite, Lagendre , Leguerre functions (simple applications)

UNIT IV Boundary Value Problems:

Techniques of separation of variables and its application to following boundary value problems (i) Laplance equation in three dimensional Cartesian coordinate system- line charge beween two earthed parallel plates (ii) Helmholtz equation in circular cylindrical coordinates – cylindrical resonant cavity, (iii) Wave equation in spherical polar coordinates – the vibrations of a circular membrane, (iv) Diffusion equation in two dimensional Cartesian coordinate system – leat conduction in a thin rectangular plate, (v) Laplace equation in spherical coordinate system – electric potential around a spherical surface.

Reference Books :

1. Mathematical Methods for Physicists by George Arfken, Academic Press.
2. Applied Maths for Engineers and Physicists by Pipes and Harvel (McGraw Hill)
3. Mathematical Methods by Potter and Goldberg (Prentice Hali, India)
4. Special Relativity by A.P. French (English Language Book Society)
5. Theory of Relativity by Synge.

Semester – VI

Paper – II QUANTUM MECHANICS – II

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT I Bound State Problems - I:

Potential step and rectangular potential barrier, calculation of reflection and transmission coefficient, Qualitative discussion of the application to alpha decay (tunnel effect), square well potential problem, calculation of transmission coefficient.

UNIT II Bound State Problems- II:

Particle in one dimensional infinite potential well and finite depth potential well, energy value and eigen functions. Simple harmonic oscillator (one dimensional) eigen function, energy eigen values, zero point energy.

UNIT – III Applications of Quantum Theory to Atomic Spectroscopy :

Quantum features of spectra of one electron atoms. Frank–Hertz experiment and discrete energy states. Schrodinger equation for a spherically symmetric potential, Schrodinger equation for a one electron atom in spherically coordinates, separation of variables, Orbital angular momentum and quantization spherical harmonics, energy levels of H–atom, Shapes of n = 1 and n = 2 wave functions, Average value of radius of H–atom, Comparison with Bohr Model and Bohr Correspondence Principle. Stern and Gerlach experiment, spin and magnetic moment. Spin orbit coupling and qualitative explanation of fine structure. Atoms in magnetic field Zeeman spliting.

UNIT – IV Molecular Spectroscopy :

Qualitative features of molecular spectra : Rigid rotator discussion of energy, eigen values and eigen function, rotational energy levels of diatomic molecules, Rotational spectra, vibrational energy levels of diatomic molecules, vibrational spectra, vibrational rotational spectra.

Reference Books :

1 **H.S. Mani, G.K. Mahta, Introduction to Modern Physics, East West Press Pvt. Ltd., New Delhi (1988)**

2. A.K. Ghatak and S.Lokanathan, Quantum Mechanics : Theory and Applications, Macmillan India Ltd., Delhi (1984), Third edition.
3. Richtmeyer, Kennard and Cooper, Mc Graw-Hill, 1969, sixth edition.
4. A. Beiser, Perspectives of Modern Physics
5. Parasmal Agrawal, Quantum Theory
6. S.S. Rawat and S.Singh, Elementary Quantum Mechanics and Spectroscopy (in Hindi)

Semester – VI

Paper – III NUCLEAR PHYSICS

Duration : 3 hrs. **Max. Marks : 35**

Note: There will be two parts in end semester theory paper.

Part A of the paper shall contain 7 short answer questions of 7 marks. Each question will carry one marks for correct answer.

Part B of the paper will consist four questions one question from each unit with internal choice. Each question will carry 7 marks.

UNIT-I Nuclear Properties:

Rutherford's theory of a particle scattering, Properties of Nuclei: Quadrupole Moment and Nuclear Ellipticity, Quadrupole Moment and Nuclear spin , Parity and Orbital angular momentum, Parity and its conservation, Nuclear Mass and Mass Spectroscopy, Nuclear Energy, Discovery of neutron and proton-neutron hypothesis, Neutron to proton Ration(n/z),The nuclear potential, Nuclear mass, Mass Defect and Binding energy, Theory of Nuclear forces.

UNIT-II Nuclear Fission:

The Discovery of Nuclear Fission, The Energy Release in Fission, The Fission products mass distribution of fission products, Charge distribution of fission products, ionic charge of fission products, Fission cross Section and threshold, Neutron emission in fission, The prompt neutron and delayed neutrons, Mechanism for the emission of delayed neutrons. Energy of fission Neutrons, Theory of nuclear fission and Liquid Drop Model, Barrier Penetration-Theory of Spontaneous fission, Nuclear Energy Sources, Nuclear Fission as a source of Energy, The Nuclear Chain Reaction, condition of controlled chain Reaction, Nuclear Reactors.

UNIT-III Elementary particles:

Classification of Elementary Particles, Fundamental Interactions, Unified approach (Basic ideas), The conservation Laws, Quarks (Basic ideas), Charmed and color Quarks. Nuclear Fusion: The sources of stellar Energy.

UNIT-IV Detector and Accelerators:

Particle and Radiation Detectors: Ionization Chamber, Region of Multiplicative Operation, Proportional Counter, Geiger-Muller Counter, Cloud Chamber, BF3 and Scintillation detector. Ion sources, Cock-Craft-Walten High Voltage Generators, Van De-Graff Generators, Drift Tube Linear Accelerators, Wave Guide Accelerator, Magnetic Focussing In cyclotron, Synchrocyclotron, Betatron, The Electromagnetic Induction Accelerator, Electron Synchrotron, Proton Synchrotron

Reference Books :

1. Introduction to Nuclear Physics, W.E. Burcham
2. Introduction to Nuclear Physics, Wong
3. Modern Physics, HS Mani & G K Mehta
4. Nuclear Physics, R C Bhandari & D Somayajulu

Semester – VI

Physics Practical : VI

Max. Practical Marks = **75 Marks**
Internal Marks = **45 Marks**
External Practical Exam.(Duration : 3 hrs.) = **30 Marks**

Note: Out of the following experiments, 8 experiments must be done by the students.

(4 hrs per week)

1. Determination of Planck's constant by photo cell (retarding potential method using optical filters, preferably five wave length).
2. Determination of Planck's constant using solar cell.
3. Determination of Stefan's constant (Black body method)
4. Study of the temperature dependence of resistance of a semi-conductor (four probe method).
5. Study of Iodine spectrum with the help of grating and spectrometer and ordinary bulb light.
6. Study of characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.
7. Study of β-absorption in Al foil using GM Counter.
8. To find the magnetic susceptibility of a paramagnetic solution using Quinck's method. Also find the ionic molecular susceptibility of the ion and magnetic moment of the ion in terms of Bohr magneton.
9. Determination of coefficient of rigidity as a function of temperature using torsional oscillator (resonance method).
10. Study of polarization by reflection from a glass plate with the help of Nichol's prism and photo cell and verification of Brewster law and law of Malus.
11. e/m measurement by helical Method.
12. Measurement of magnetic field using ballistic galvanometers and search coil. Study of variation of magnetic field of an electromagnet with current.
13. Measurement of electric charge by Millikan's oil drop method..