S. S. Jain Subodh P.G. (Autonomous) College
Jaipur

SYLLABUS

B.Sc. Honors (Physics)

(Semester Scheme)

I & II Semester Examination 2022-2023
III & IV Semester Examination 2023-2024
V & VI Semester Examination 2024-2025
[Onwards]

S. S. Jain Subodh P.G. (Autonomous) College, Jaipur
Bachelor of Science (B.Sc. Honors)
Subject – Physics

Examination Scheme

Semester – I		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER – I	MECHANICS – I	75 Marks
PAPER – II	ELECTROMAGNETISM – I	75 Marks
PAPER – III	OPTICS – I	75 Marks
PAPER – IV	ELECTRICAL AND DIGITAL ELECTRONICS – I	75 Marks
Physics Practical – I		150Marks
Semester – II		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	MECHANICS – II	75 Marks
PAPER – II	ELECTROMAGNETISM – II	75 Marks
PAPER – III	OPTICS –II	75 Marks
PAPER – IV	ELECTRICAL AND DIGITAL ELECTRONICS - II	75 Marks
Physics Practical – II		150 Marks
Semester – III		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	THERMODYNAMICAL AND STATISTICAL PHYSICS-I	75 Marks
PAPER – II	MATHEMATICAL PHYSICS AND SPECIAL THEORY OF RELATIVITY-I	75 Marks
PAPER – III	ELECTRONICS & SOLID STATE DEVICES-I	75 Marks
PAPER – IV	PHYSICS OF MATERIALS - I	75 Marks
Physics Practical– III		150 Marks
Semester – IV		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	THERMODYNAMICAL AND STATISTICAL PHYSICS -II	75 Marks
PAPER – II	MATHEMATICAL PHYSICS AND SPECIAL THEORY OF RELATIVITY-II	75 Marks
PAPER – III	ELECTRONICS & SOLID STATE DEVICES-II	75 Marks
PAPER – IV	PHYSICS OF MATERIALS - II	75 Marks
Physics Practical – IV		150 Marks
Semester – V		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	QUANTUM MECHANICS - I	75 Marks
PAPER – II	NUCLEAR PHYSICS - I	75 Marks
PAPER – III	SOLID STATE PHYSICS - I	75 Marks
PAPER – IV	ATOMIC AND MOLECULAR PHYSICS - I	75 Marks
Physics Practical – V		150 Marks
Semester – VI		
Paper	**Nomenclature of paper**	**Max. Marks**
PAPER -I	QUANTUM MECHANICS - II	75 Marks
PAPER – II	NUCLEAR PHYSICS - II	75 Marks
PAPER – III	SOLID STATE PHYSICS - II	75 Marks
PAPER – IV	ATOMIC AND MOLECULAR PHYSICS - II	75 Marks
Physics Practical – VI		150 Marks

Marks Break-Up : End-Semester Exam 54 Marks + Internal Assessment (CIA) 21 Marks = Total 75 Marks Per Paper.
Practical Marks : External Practical 90 Marks + Internal Practical Exam 60 Marks = Total 150 Marks.

Theory Classes : Two hours per week for each of the papers; end-semester exam duration of three hours for each of the papers.
Practical Classes : Eight hours practical classes per week; practical end-semester examination of five hours duration.

S. S. Jain Subodh P.G. (Autonomous) College, Jaipur
B.Sc. (Honors) – Physics

Examination Scheme For Each Paper

Part A 7 QUESTIONS (Very Short Answer Questions) 7X 2 MARK EACH = 14 Marks

Part B 4 QUESTIONS (1 Question From Each Unit With Internal Choice)

4 X 10 MARK EACH = 40Marks

Max. Marks of End-Semester Exam (Duration of Exam of3 Hours)	= 54 Marks
Internal Assessment (CIA)	= 21 Marks
Maximum Marks (Each Theory Paper)	= 75 Marks

Max. Practical Marks = 150 Marks

(Internal Marks 60 + External Marks 90)

Total of Theory Papers : 4 X 75 Marks Each = 300 Marks

(Min. Pass Marks 40% = 120 Marks)

Total of Practical Marks = 150 Marks

Grand Total of Subject Per Semester = 450 Marks

B.Sc. Honors - Physics

Semester I

Paper I : Mechanics – I

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer.(7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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

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 -III

Centre of Mass Frame: Centre of mass, Two particle System, motion of centre of mass and concept of reduced mass, Conservation ofenergy 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 -IV

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, Keppler's laws.

Reference Books

1. Mechanics by Charles Kittel, Berkeley Physics Course.
2. Introduction to Classical Mechanics, by R. G. Takwale, P S. Puranik,TMH.
3. Classical Mechanics by Herbert Goldstein, Pearson Education.
4. Classical Mechanics by Dr. J. C. Upadhyaya, Himalaya Publishing House.
5. Analytical Mechanics by Louis N. Hand, Janet D. Finch, Cambridge University Press.
6. Mechanics by L.D. Landau and E. M. Lifshitz, Elsevier.

B.Sc. Honors - Physics

Semester I

Paper II : Electromagnetism – I

Max. Marks: 54

Duration: 3 hrs.

Note: There will be two parts in end semester theory paper.
Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks.(4 x 10 marks each = 40 marks)

Unit - I

Vector Fields : Concept of field, Scalar field, Vector field, Partial derivative, Gradient of a scalar function, Gradient in Cartesian coordinates, 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, Laplacian operator, Poisson's and Laplace 's equations.

Unit - II

Curl and the Field of Stationary Charge : Curl of a vector field, curl in Cartesian coordinates, Stokes's theorem, physical meaning of curl, Potential energy of a system and discrete charges, and continuous charge distribution. 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 uniform & non-uniform electric field.

Unit -III

The Field of Moving Charge : 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, Lorentz force properties of the magnetic field. Ampere's circuital law with applications. Ampere's Law in the differential form. Magnetic vector potential, Poisson's equation for vector potential. Field of any current carrying wire and deduction of Bio-Savart law using vector potential.

Reference Books

1. Electricity & Magnetism by A.S. Mahajan & Abbas A. Rangwala Tata McGraw-Hill.
2. Introduction to Electrodynamics by David J. Griffith, Prentice Hall of India Pvt. Ltd. New Delhi.
3. Fundamental University Physics Vol II: Fields and Waves by Alonso/Finn, Addison – Wesley Publishers.
4. Classical Electrodynamics by J. D. Jackson, Wiley Student Edition.
5. Classical Electrodynamics : A Modern Perspective by Kurt Lechner, Springer International Publishing AG.
6. Classical Electrodynamics by P. Sengupta, New Age International Publishers.
7. Classical Electrodynamics (Revised Edition) by S. P. Puri, Narosa Publishers.

B.Sc. Honors - Physics

Semester I

Paper III : Optics – I

Duration: 3 hrs. **Max. Marks: 54**

Note: There will be two parts in end semester theory paper.
Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks.(4 x 10 marks each = 40 marks)

Unit - I

Geometrical Optics : Fermat's principle, laws of reflection and refraction from Fermat's principle, Refraction at a spherical surface, Linear and lateral magnifications, Refraction through thick and thin lenses. Focal lengths of thick and thin lenses. The focal length of two thin lenses is separated by a finite distance. Cardinal points.

Unit - II

Interference : Young's double slit experiment and Superposition of waves from two point sources, necessity of coherence, Concept of spatial and temporal coherence. Fringe width. Shape of interference fringes. Interference by division of amplitude, Interference in thin films. Colours of thin films in transmitted and reflected light.

Unit - III

Application of Interference : Wedge-shaped film, Newton's Rings. Determination of wavelength and refractive index by Newton's ring. Michelson's interferometer, Fringes of different shapes with Michelson's interferometer, Determination of wave length with Michelson's interferometer. Determination of refractive index by Michelson interferometer.

Unit - IV

Laser and Holography : Difference between ordinary and laser source, Spontaneous and stimulated emission, stimulated absorption. Einstein's 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. Basic concept of Holography, construction of hologram and reconstruction of the images.

Reference Books

1. Optics by Brijlal and Subramanium, S. Chand Publishing.
2. Principles of Optics by B.K. Mathur, Gopalal Printing.
3. Optics by D. P. Khandelwal, Himalaya Publishing House.
4. Introduction to Modern Optics by A. K. Ghatak, McGraw Hill.
5. An Introduction To Modern Optics by G. R. Fowels, Dover Publications.
6. Fundamentals of Optics by Ashok Kumar, D. R. Gulati & H. R. Gulati, R. Chand & Co.
7. Optical Physics South Asian Edition by A. Lipson, S. G. Lipson & H. Lipson, Cambridge University Press.

B.Sc. Honors - Physics

Semester I

Paper IV: Electrical And Digital Electronics – I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit- I

Quantization of Charge, Current, Measurement of Electric Field and electric Intensity, Kirchoff's Law, Digital Electronics : Signals: Digital & Analog Signals, Positive & Negative Logics, Basic Digital Circuits and operations: AND, OR, NOT, NAND , NOR, Exclusive OR & Exclusive NOR. Boolean algebra, De Morgan's Theorem.

Unit- II

Number system and codes number system, Binary number system, binary arithmetic, Octal number system, Hexadecimal number system, codes: Straight Binary code, Natural BCD codes, Exces-3 codes, Grey code, Hexadecimal code.

Unit- III

Standard forms for logical expression: Sum of products (SOP), Conversion into SOP forms, Products of sum (POS), Conversion into POS forms. Advantage of SOP & POS forms, Standard SOP & POS forms, Minterm & Maxterm, Interrelation between Minterm & Maxterm.

Unit- IV

Karnaugh Map, Representation of logical functions, K-map with two, three & four variables: Mapping of standard SOP & POS expressions, Minimization of the expression, Mapping of K- map from truth table, Don't care combination, QuineMc- Clusky algorithms.

References Books

1. Basics Electronics by Mehta & Mehta, S. Chand Publications.
2. Modern Digital Electronics by R.P. Jain, McGraw Hill, India.
3. Digital Circuits and Design by S. Salivahanan & S Arivazhagan, McGraw Hill , India.
4. Electronic Fundamentals & Applications by Ryder J. D., Prentice Hall of India Pvt. Ltd., New Delhi.
5. Integrated Electronics : Analog & Digital Circuits and Systems by Millman/Christos, McGraw Hill.
6. Digital Computer Electronics by Malvino A. P., Tata McGraw-Hill Pub. Co. Ltd., New Delhi.
7. Handbook of Electronics by Kumar & Gupta, Pragati Prakashan.
8. Handbook of Electronics by Mithal G. K., Pragati Prakashan.

B.Sc. Honors - Physics

Semester - I

Physics Practical - I

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 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. Study of RC circuits with AC sinusoidal.
12. Study of RC circuits with DC.
13. Study of harmonic motion.
14. Study of torsional motion.
15. Any other experiment that relates with the theory.

B.Sc. Honors - Physics

Semester II

Paper I : Mechanics – II

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit -I

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 center of mass.

Unit -II

Damping 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, 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 behavior, Effect of coupling in mechanical systems, Electrically coupled circuits, frequency response, Reflected impedance, Effect of coupling and resistive load.

References Books

1. Mechanics by Charles Kittel, Berkeley Physics Course.
2. Introduction to Classical Mechanics by R. G. Takwale, P S. Puranik,TMH.
3. Classical Mechanics by Herbert Goldstein, Pearson Education.
4. Classical Mechanics by Dr. J. C. Upadhyaya, Himalaya Publishing House.
5. Analytical Mechanics by Louis N. Hand, Janet D. Finch, Cambridge University Press.
6. Mechanics by L.D. Landau and E. M. Lifshitz, Elsevier.
7. The Physics of Wave and Oscillation by N.K. Bajaj, McGrow Hill Education.
8. Vibration and Waves by A. P. French, CBS Publishers.

B.Sc. Honors - Physics

Semester II

Paper II : Electromagnetism – II

Max. Marks: 54

Duration: 3 hrs.

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).

Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit – I

Magnetic Fields in Matter : Electric current due to orbital electron, the field of current loop, Bohr magneton, Orbital gyromagnetic ratio, Electron spin and magnetic moment, Larmor frequency, Magnetic susceptibility, Magnetic permeability, Induced magnetic moment, ferromagnetism, diamagnetism and paramagnetism, magnetic field caused by uniform and non-uniform magnetized matter. Magnetization current, Free current, bound 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. Polarization, Electric Displacement vector, Electrical susceptibility, Electrical permeability and relation between them, 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, Clausius- Mossotti relation in dielectrics.

Unit -IV

Transient behavior and Maxwell's Equations : Transient behavior of an R-C circuit. Electromagnetic induction and Maxwell's Equations, Faraday's law in differential form. Mutual inductance, Self-inductance Transient behavior of an L-R circuit, the displacement current, properties of electromagnet wave, Maxwell's equations in differential and integral forms, Electromagnetic wave in isotropic medium, Energy density of electromagnetic wave, Pointing vector, Radiation pressure of free space, Electromagnetic waves in dispersive medium, Spectrum of Electromagnetic waves.

References Books

1. Electricity & Magnetism by A.S. Mahajan & Abbas A. Rangwala Tata McGraw-Hill.
2. Introduction to Electrodynamics by David J. Griffith, Prentice Hall of India Pvt. Ltd. New Delhi.
3. Fundamental University Physics Vol II: Fields and Waves by Alonso/Finn, Addison – Wesley Publishers.
4. Classical Electrodynamics by J. D. Jackson, Wiley Student Edition.
5. Classical Electrodynamics : A Modern Perspective by Kurt Lechner, Springer International Publishing AG.
6. Classical Electrodynamics by P. Sengupta, New Age International Publishers.
7. Classical Electrodynamics (Revised Edition) by S. P. Puri, Narosa Publishers

B.Sc. Honors - Physics

Semester II

Paper III : Optics – II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).

Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Diffraction: Fresnel's class of diffraction : Fresnel's assumptions, Fresnel class of diffraction, half period zones, Zone Plate, diffraction due to circular aperture, straight edge, thin and thick wire and rectangular slit. Cornu's spiral to study Fresnel's diffraction.

Unit - II

Fraunhofer Class of 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, Dispersion by a grating, Rayleigh's criterion of resolution. Resolving power of grating.

Unit-III

Polarization : Plane electromagnetic waves E and B of linearly, circularly and elliptically polarized electromagnetic waves. Reflection and refraction of plane EM Waves at a plane dielectric surface, Boundary conditions, Derivation of Fresnel's relation, Polarisation by reflection. Propogation of EM wave in an anisotropic media.

Unit-IV

Double Refraction and Optical Activity : Huygen's Theory of Double Refraction using Fresnel Ellipsoidal Surfaces (no mathematical derivation), Production and Analysis of Plane Polarized, Circularly and elliptically polarized light, Quarter and half wave plates, optical activity, specific rotation, bi-quartz and half shade polarimeters.

Reference Books

1. Optics by Brijlal and Subramanium, S. Chand Publishing.
2. Principles of Optics by B.K. Mathur, Gopalal Printing.
3. Optics by D. P. Khandelwal, Himalaya Publishing House.
4. Introduction to Modern Optics by A. K. Ghatak, McGraw Hill.
5. An Introduction To Modern Optics by G. R. Fowels, Dover Publications.
6. Fundamentals of Optics by Ashok Kumar, D. R. Gulati & H. R. Gulati, R. Chand & Co.
7. Optical Physics South Asian Edition by A. Lipson, S. G. Lipson & H. Lipson, Cambridge University Press.

B.Sc. Honors - Physics

Semester II

Paper IV : Electrical And Digital Electronics – II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit- I

Semi-Conductor and Transistor Characteristics, Field Effect Transistor, Digital Logic Families: (a) Bipolar Logic Families, Characteristics of Digital IC's. Register Transistor Logic (RTL), DCTL, DTL, ECL, TTL- Circuits. (b) Unipolar Logic Families, MOS-Logic: MOSFET Inverter, MOSFET NAND and NOR Gates, CMOS-Logic: CMOS Inverter, CMOS NAND and NOR Gate.

Unit- II

Combinational Circuits: Multiplexers, Basic four input one output Multiplexer, IC74151- 8 to 1 Multiplexer, IC- 74150-16 to 1 Multiplexer,De-Multiplexer-1 to 4 De-Multiplexer, 1 to 8 De-Multiplexer, IC-74154-1 to 16 De- Multiplexer, Decoder: Basic Binary Decoder, 3 to 8 Decoder, IC 74154- 4 to 16 Decoder, BCD to Seven Segment Decoder, Parity generators and Checkers.

Unit- III

Sequential Circuits(Latch): Flip Flops: Flip Flops, Basic Flip Flops (the latch), R-S Flip Flop, D-type Flip Flop, J-K Flip Flop, T-type Flip Flop, Master Salve J-K Flip Flop, Applications of Flip Flops.

Unit- IV

Digital Counters: Introduction, Modulus of Counter, Asynchronous Mod-16 Ripple Counter, Synchronous Mod and Counter, Up/Down Counter, Ring Counter, Left and Right Shift Register Operations, Applications of Digital Counters and Shift Registers.

Reference Books

1. Basics Electronics by Mehta & Mehta. S. Chand Publications.
2. Modern Digital Electronics by R. P. Jain. McGraw Hill, India.
3. Digital Circuits and Design by S. Salivahanan & S Arivazhagan. McGraw Hill, India.
4. Electronic Fundamentals & Applications by Ryder J. D., Prentice Hall of India Pvt. Ltd., New Delhi.
5. Integrated Electronics : Analog & Digital Circuits and Systems by Millman/Christos. McGraw Hill.
6. Digital Computer Electronics by Malvino A. P., Tata McGraw-Hill Pub. Co. Ltd.
7. Handbook of Electronics by Kumar & Gupta. Pragati Prakashan.
8. Handbook of Electronics by Mithal G. K., Pragati Prakashan.

B.Sc. Honors - Physics

Semester - II

Physics Practical - II

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 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 determination of 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. Composition of two perpendicular SHMs.
15. Study of Fresnel's and Fraunhoffer diffraction.
16. Any experiment according to theory paper.

B.Sc. Honors - Physics

Semester III

Paper I : Thermodynamical And Statistical Physics – I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).

Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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 and efficiency of Carnot's engine, refrigerator, carnot theorem, Second law of thermodynamics, Thermodynamic scale as an absolute scale; Maxwell relations and their applications.

Unit - III

Production of Low Temperature : Joule Thomson expansion and Joule Thomson coefficients for ideal as well as Vander Waal's gas, Porous plug experiment, inversion temperature, Regenerative cooling and cooling by adiabatic expansion and cooling by 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, Persistent current, Meissner Effect and Effect of magnetic field on superconductor.

Reference Books

1. Thermal Physics by Kittel, San Francisco: W.H. Freeman Publisher.
2. Statistical and Thermal Physics by S Lokanathan, R S Gambhir, PHI Learning Publisher.
3. Statistical Physics by Berkeley Series Vol. V, McGraw Hill India.
4. Fundamentals of Statistical and Thermal Physics by F. Reif, Sarat Book House.
5. An Introduction To Thermodynamics by Y. V. C. Rao, Universities Press.
6. Thermodynamics : A Complete Undergraduate Course by Andrew M. Steane, OUP Oxford.
7. Thermodynamics (Foundations & Applications) by E. P. Gyftopoulos & G. P. Beretta, Dover Publications.

B.Sc. Honors - Physics

Semester III

Paper II : Mathematical Physics And Special Theory Of Relativity -I

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer.(7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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

Differential Equations of Second Order and Special Functions – I: Linear differential equation with variable coefficient and singular points,series solution method and its application to the Legendre's differential equations , Integral properties of Legendre's polynomials, generating functions of $P_n(x)$, Recurrence relations of $P_n(x)$,graphical representations of Legendre functions.

Unit -IV

Differential Equations of Second Order and Special Functions – II : Hermite differential equation, generating functions of $H_n(x)$, Recurrence relations of $H_n(x)$, Orthogonality relation for Hermite equation, graphical representation and generating function of Hermite functions, Laguerre differential equation, graphical representation and generating functions of Laguerre polynomials, Recurrence relations of $L_n(x)$, Orthogonality relation for Laguerre polynomials.

Reference Books

1. Mathematical Physics by V. Balakrishnan, Published by Ane Books; 1st Edition.
2. Mathematical Physics by H. K. Dass, Published by S. Chand & Company Pvt. Ltd., New Delhi.
3. Mathematical Physics by Satya Prakash, Published by Sultan Chand and Sons.
4. Mathematical Physics by A.K. Saxena, Published by Narosa Publishing House.
5. Mathematics For Physicists by A. Altland & J. von Delft, Cambridge University Press.
6. Mathematical Methods In The Physical Sciences by Mary L. Boas, Wiley.
7. Mathematical Methods by M. C. Potter & J. Goldberg, Prentice Hall Pvt. Ltd.
8. Mathematical Methods For Physicists by Arfken, Weber & Harris, Elsevier.
9. Schaum's Outline of Mathematics For Physics Students by Michael Stone & Paul Goldbart.

B.Sc. Honors - Physics

Semester III

Paper III : Electronics & Solid State Devices -I

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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 ofany 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

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.

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 Zenerdiode, Voltage multiplier circuits.

Reference Books

1. Electronics Fundamental and Applications by John D. Ryder, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Engineering Electronics by John D. Ryder, McGraw Hill Book Company, New Delhi.
3. Integrated Electronics : Analog & Digital Circuits and Systems byMillman/Hailkias,McGraw Hill Ltd.
4. Digital Computer Electronics by Albert Paul Malvino,Tata McGraw- Hill Pub. Co. Ltd. New Delhi (1983).

B.Sc. Honors - Physics

Semester III

Paper IV: Physics of Materials – I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Materials : Crystalline and non-crystalline (amorphous) materials, crystal structure and its description in seven systems, lattice, space lattice, Bravais lattice, polymers, classification of polymers, carbon nanotubes and related structures , 2D materials.

Unit - II

Bonding in Materials : Bonds, types of bonds, bond energy, bond length, ionic bonding, and calculation of lattice energy of ionic crystals, made lung constant, covalent bonding, metallic bonding, secondary bonding, vibration in bonding and their properties.

Unit - III

Synthesis of Materials: Synthesis of solid materials, Sol-gel method & Solid state diffusion method, Thin films, Physical vapor deposition method, chemical vapor deposition (CVD) method, Pulse laser deposition (PLD) method.

Unit - IV

Analysis of Materials : X-ray diffraction (XRD), Microwave diffraction, X-ray Fluorescence (XRF), Optical microscopy (UV-Vis), Raman Spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM).

Reference Books

1. Handbook of Science and Technology in India published in 2002.
2. Materials Science and Engineering by V.S. Raghvan, TMH.
3. Solar Materials and Thermal Process by J.A.Duffie, John Wiley and Sons, New York.
4. Non- Conventional Energy Resources by D. S. Chauhan & S. K. Srivastava, New age Publishers.

B.Sc. Honors - Physics

Semester - III

Physics Practical - III

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 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 $\gamma = C_P/C_V$ 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 polarimeter.
14. To study conductor interaction through fall to magnet in a hollow metal cylinder.
15. To study modulus of rigidity as a function of temperature.
16. Plot of thermo emf versus temperatures graph and determination of neutral temperature uses and bath.
17. Determination of bandgap using a junction diode.
18. Study of single-stage transistor audio amplifier i.e. variation of gain with frequency.
19. Any experiment according to theory paper.

B.Sc. Honors – Physics

Semester IV

Paper I : Thermodynamical And Statistical Physics – II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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. Thermal Physics by Kittel, Publisher: San Francisco: W.H. Freeman.
2. Statistical and Thermal Physics by S. Lokanathan & R. S. Gambhir, Publisher: PHI Learning.
3. Thermodynamics & Statistical Physics (Hindi) by Dr. Arvind Jain, Devi Ahilya Prakashan.
4. Statistical Physics by Berkeley Series Vol. V, Publisher: McGraw Hill India.
5. Fundamentals of Statistical and Thermal Physics by F. Reif, Sarat Book House.

B.Sc. Honors – Physics

Semester IV

Paper II: Mathematical Physics And Special Theory Of Relativity - II

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer.(7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit – I

Lorentz Transformation and Four vector Formulation : Lorentz transformation and rotation in space-time, time like and space like vector, world line, macro-causality. 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 – II

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

Unit - III

Relativistic Electrodynamics : Law of conservation of charge and equation of continuity. Lorentz transformation of charge and current densities, Lorentz transformation of potentials, Lorentz transformation of an electric field and magnetic field. Description of Maxwell's equation in tensor form.

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 between twoearthed parallel plates (ii) Helmholtz equation in circular cylindrical coordinates – cylindricalresonant cavity, (iii) Wave equation in spherical polar coordinates – the vibrations of a circularmembrane, (iv) Diffusion equation in two dimensional Cartesian coordinate system – heatconduction in a thin rectangular plate, (v) Laplace equation in spherical coordinate system –electric potential around a spherical surface.

Reference Books

1. Mathematical Physics by V. Balakrishnan, Published by Ane Books; 1st Edition.
2. Mathematical Physics by H. K. Dass, Published by S. Chand & Company Pvt. Ltd., New Delhi.
3. Mathematical Physics by Satya Prakash, Published by Sultan Chand and Sons.
4. Mathematical Physics by A.K. Saxena, Published by Narosa Publishing House.
5. Mathematics For Physicists by A. Altland & J. von Delft, Cambridge University Press.
6. Mathematical Methods In The Physical Sciences by Mary L. Boas, Wiley.
7. Mathematical Methods by M. C. Potter & J. Goldberg, Prentice Hall Pvt. Ltd.
8. Mathematical Methods For Physicists by Arfken, Weber & Harris, Elsevier.
9. Schaum's Outline of Mathematics For Physics Students by Michael Stone & Paul Goldbart.

B.Sc. Honors - Physics

Semester IV

Paper III: Electronics & Solid State Devices - II

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer.(7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit -I

Fixed and emitter biasing, bias stability in transistor circuits, basis idea of direct coupled and R.C coupled amplifiers, Feedback requirements for oscillations, circuit requirement for oscillation, basic oscillator analysis, Colpitt and Hartley oscillators, RC oscillators.

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 : Differential amplifier, DC levels shifter, operational amplifier, input and Output impedances, input offset current, Application: Unity gain buffer, Adder, Subtractor, Integrator and Differentiator.

Unit -IV

Field Effect Transistor and Digital Circuits : Field Effect Transistor (FET) and its characteristic biasing JFET, ac operation of JFET and MOSFET. 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. DTL, RTL, TTL circuits.

Reference Books

1. Electronics Fundamental and Applications by John D. Ryder, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Engineering Electronics by John D. Ryder, McGraw Hill Book Company , New Delhi.
3. Integrated Electronics :Analog & Digital Circuits and Systems by Millman/Hailkias :McGraw Hill Ltd.
4. Digital Computer Electronics by Albert Paul Malvino,Tata McGraw- Hill Pub. Co. Ltd.

B.Sc. Honors - Physics

Semester IV

Paper IV : Physics of Materials – II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit-I

Modification of Materials : Heating, doping, cooling, quenching, solidification and crystallization, glass transition, light induced modification; Swift heavy ion (SHI) induced modifications.

Unit-II

Defects in Materials : Defects, types of defects, point defects intrinsic and extrinsic defects, roles of defects in materials characteristics, line defects, dislocations, screw dislocations, mixed dislocations, columnar defects, volume defects, Frenckel & Shottky defects.

Unit-III

Applications of Materials : Solar cell & fuel cell fabrications, composites for flexible devices, memory devices, Nanosensors, Nanobiosensors, Optical biosensors, Reflectors & absorbers.

Unit-IV

Energy Resources : Coal, Petroleum & Natural gases, Thermal Power, Nuclear Power & Hydro Power, Non-Conventional Energy, Solar Energy, Thermal Energy, Bio Energy, Ocean Energy, Wind Energy, Geothermal energy, Animal Energy, Hydrogen Energy & Biomass.

Reference Books

1. Handbook of Science and Technology in India published in 2002.
2. Materials Science and Engineering by V.S. Raghvan. TMH.
3. Solar Materials and Thermal process by J.A.Duffie, John Wiley and Sons, New York.
4. Non-Conventional Energy Resources by D. S. Chauhan & S. K. Srivastava, New age Publishers.

B.Sc. Honors - Physics

Semester - IV

Physics Practical - IV

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 hrs. per week)

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

B.Sc. Honors - Physics

Semester V

Paper I : Quantum Mechanics - I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7 x 2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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.

References Books

1. Introduction to Modern Physics by H.S Mani, G.K. Mahta, East West Press Pvt., New Delhi (1988).
2. Introduction To Modern Physics by Richtmeyer, Kennard and Cooper, McGraw Hill, 1969, Sixth Edition.
3. Quantum Mechanics : Theory and Applications by A. K. Ghatak and S. Lokanathan, Macmillan India Ltd.
4. Perspectives of Modern Physics by A. Beiser, McGraw Hill Inc., US.
5. Quantum Mechanics by B. N. Srivastava, Pragati Prakashan.

B.Sc. Honors - Physics

Semester V

Paper II : Nuclear Physics – I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Nuclear Properties : Rutherford's theory of a particle scattering, Properties of Nuclei: Nuclear angular momentum, Nuclear magnetic dipole moment, Electric quadrupole moment and Nuclear ellipticity, Hofstadter experiment, Nuclear spin, isospin, Parity and Orbital angular momentum, Parity conservation, Nuclear Mass and Mass Spectroscopy, Packing fraction, Nuclear Energy, Discovery of neutron and proton-neutron hypothesis, Neutron to proton Ratio (n/z), The nuclear potential, Nuclear mass, Mass Defect and Binding energy, Theory of Nuclear forces, Properties of nuclear forces, Yukawa-Meson theory, Nuclear potential.

Unit - II

Radioactive Decays : Basics of α-decay, Theory of β-emission spectrum, Gammow factor, Geiger-Nuttal law, Range of α-particles.

β-decay : Kinematics of β-decay, β-decay spectrum, Positron emission, Electron capture, Pauli's Neutrino hypothesis.

Gamma decay : Basics of Gamma decay, Kinematics of Gamma decay, Internal conversion, Applications of radioactivity.

Unit - III

Detector and Accelerators : Particle and Radiation Detectors : Ionization Chamber, Gas-filled detectors, Current-mode and Pulse-mode operation of detector, Region of Multiplicative Operation, Proportional Counter, Geiger-Muller Counter, Cloud Chamber, BF_3 and Scintillation detector.

Interaction of Nuclear Radiation With Matter : Energy loss by heavy charge particles in matter, Interaction of electron with matter, Range of charge particles, Bremsstrahlung radiation, Cherenkov radiation, Gamma ray interaction with matter.

Unit - IV

Elementary Particles : Classification of Elementary Particles, Fundamental Interactions, Unified approach (Basic ideas), The conservation Laws, Quarks (Basic ideas), Charmed and Color Quarks, Intermediate vector boson, Bottom quark, Top quark, Higgs-Boson. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness etc.), Standard model for elementary particles.

Reference Books

1. Nuclear and Particle Physics by W. E. Burcham and M Jobes, Addison-Wesley Longman Inc.
2. Nuclear and Particle Physics by Brian R Martin, John Wiley & Sons.
3. Introduction to Nuclear and Particle Physics by Das and Ferbal, World Scientific.
4. Elements of Nuclear Physics by Walter E. Meyerhof, McGraw-Hill Book Company.
5. Introductory Nuclear Physics by Kenneth S. Krane, John Wiley & Sons.
6. Introduction to Elementary Particles by David J. Griffiths, John Wiley & Sons.

7. Radiation Detection and Measurement by G.F. Knoll, John Wiley & Sons.
8. Introduction To Nuclear and Particle Physics by V. K. Mittal, R. C. Verma & S.C. Gupta, PHI.
9. Concepts of Modem Physics by A. Beiser, McGraw-Hill Book Company.

B.Sc. Honors - Physics

Semester V

Paper III: Solid State Physics - I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Crystal Binding and Crystal Structure : Various types of Bindings: Cohesive energy, ionic bonds, covalent bonds, metallic bonds, van der Waal's bonding & hydrogen bonding, and compressibility of ionic crystals, Space Lattice and Crystal Structure, Translation vetcors, Bravis Lattice, Unit and primitive cell, crystal systems, Packing fractions for SC, BCC & FCC and hexagonal lattice structures, Bravais space lattices.

Unit - II

Thermal Properties of the Solids : Concepts of Thermal Energy and Phonons, Phonon dispersion relations in monoatomic and diatomic linear lattice, Internal Energy and Specific Heat, Classical theory of specific heat, Various Theories of Lattice Specific Heat of Solids: The Einstein Model, Debye Model, Dulong-Petit's law and their shortcomings, Electronic Contribution of the internal Energy hence to the Specific Heat of Metals, Thermal Conductivity of the lattice, Thermoelectric power.

Unit - III

Band Theory of Solids : Formation of Bands, Periodic Potential of a Solid, Wave Function in a Periodic Lattice and Bloch Theorem, Number of states in the bands, Density of states, Brillouin zones, 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. Energy dispersion relations : weak and tight binding.

Unit - IV

Magnetic Properties : Classification of Magnetic Materials, Origin of Atomic Magnetism, Classical Langevin Theory of dia-and paramagnetic domains, quantum theory of paramagnetism, Curie's law, Dynamics of Classical Dipole In Magnetic Field, Magnetic Susceptibility, phenomenon of Diamagnetic, Para magnetic susceptibility of Ionic Crystal, Weiss's theory of ferromagnetism, Temperature Dependence of Saturation of Spontaneous Magnetization, The Paramagnetic Region, The Nature of Ferromagnetism, Concept of domain wall, 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.

Reference Books

1. Introduction To Solid State Physics by Charles Kittel, Wiley Publications.
2. Elementary Solid State Physics by M. Ali Omar, Pearsons Education.

3. Solid State Physics by John Rita, Tata McGraw Hills.
4. Solid State Physics by S.O. Pillai, New Age International Publishers.
5. Solid State Physics by V. K. Babbar & R. K. Puri, S. Chand Publishers.

B.Sc. Honors - Physics

Semester V

Paper IV: Atomic & Molecular Physics – I

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Electron Angular Momentum : Electron Spin and Spin Angular Momentum.Larmor's Theorem. Lande-g factor, Spin Magnetic Moment. Stern-Gerlach Experiment, Magnetic Moment, BohrMagneton, Stark effect &Paschen Back Effect.

Unit - II

Many Electron Atoms : Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions.Periodic table.Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model.L-S and J-J couplings.Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Unit - III

Molecular Spectra : Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Vibrational Energy Levels, Selection Rules and Vibration Spectra.Rotation-Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra.

Raman Effect : Quantum Theory of Raman Effect. Characteristics of Raman Lines.Stoke's and Anti-Stoke's Lines. Complimentary Character of Raman and infrared Spectra.

Unit - IV

Lasers : Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion.Three-Level and Four-Level Lasers. Semiconductor Laser and He-Ne Laser.

Reference Books

1. Concepts of Modern Physics by Arthur Beiser. McGraw-Hill Book Company, 1987.
2. Atomic physics by J. B. Rajam & Foreword by Louis De Broglie, S. Chand & Co., 2007.
3. Atomic Physics by J. H. Fewkes & John Yarwood. Vol. II. Oxford Univ. Press, 1991.
4. Physics of Atoms and Molecules by Bransden and Joachein. Pearson Education India.
5. Molecular Spectroscopy by Banwell. McGraw Hill Education.
6. Optoelectronics by Ghatak and Thyagarajan. Cambridge India.
7. Principles of Lasers by Svelto. Springer.

B.Sc. Honors - Physics

Semester - V

Physics Practical - V

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 hrs. per week)

1. Study of RC transmission line at 50 Hz.
2. Study of LC transmission line at (i) at fixed frequency (ii) at variable frequency.
3. Study of resonance in an LCR circuit (using air core inductance and damping by a metal plate) at (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.
8. To study the frequency response of a transistor amplifier and obtain the input and output impedance of the amplifier.
9. To design and study of an RC phase shift oscillator and measure output impedance (frequency response with change of component of R and C).
10. To study a voltage multiplier circuit to generate high voltage DC from AC.
11. Using discrete components, study OR, AND, NOT logic gates, compare with TTL integrated circuits (ICs).
12. Application of operational amplifier (OP-AMP) as : minimum two of the exercises of (a) Buffer (for accurate voltage measurement), (b) inverting amplifier, (c) non-inverting amplifier (d) summing amplifier.
13. Any other experiment that relates to the theory.

B.Sc. Honors - Physics

Semester VI

Paper I : Quantum Mechanics - II

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 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.

References Books

1. Introduction to Modern Physics by H.S Mani, G.K. Mahta, East West Press Pvt., New Delhi (1988).
2. Introduction To Modern Physics by Richtmeyer, Kennard and Cooper, McGraw Hill, 1969, Sixth Edition.
3. Quantum Mechanics : Theory and Applications by A. K. Ghatak and S. Lokanathan, Macmillan India Ltd.
4. Perspectives of Modern Physics by A. Beiser, McGraw Hill Inc., US.
5. Quantum Mechanics by B. N. Srivastava, Pragati Prakashan.

B.Sc. Honors - Physics

Semester VI

Paper II : Nuclear Physics - II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit - I

Nuclear Models : Segre-chart, liquid-drop model, semi-empirical mass formula, condition of stability, Fermi-gas model, evidence for nuclear-shell structure, nuclear magic numbers, basic assumptions of shell model.

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, Four factor formula, 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, Classification of Nuclear Reactors and uncontrolled chain reaction.

Nuclear Fusion : Energy released in nuclear fusion, Fusion reaction in stars.

Nuclear Reactions : Classification of nuclear reactions, Conservation law, Kinematics of nuclear reactions, Q-value, Threshold energy, Reaction-rate and reaction cross-section.

Unit - III

Accelerators : Ion sources, Cock-Craft-Walten High Voltage Generators, Van De-Graff Generator, Drift Tube Linear Accelerators, Wave Guide Accelerator, Magnetic Focusing In cyclotron, Synchrocyclotron, Betatron, The Electromagnetic Induction Accelerator, Electron Synchrotron, Proton Synchrotron.

Unit - IV

Fundamental Interaction : Four fundamental forces, symmetries and conservation laws. C, P & T conservation, Applications of symmetry arguments to particle reactions, Parity non-conservation in weak interaction, CP violation.

Quark model : Flavour symmetries, Gellmann-Nishijima formula, The eight-fold way, Octet diagram for Meson and Baryon, Concept of quark model, the November revolution, Baryon decuplet, Color quantum numbers and Gluons.

Reference Books

1. Nuclear and Particle Physics by W. E. Burcham and M Jobes, Addison Wesley Longman Inc.
2. Nuclear and Particle Physics by Brian R Martin, John Wiley & Sons.
3. Introduction to Nuclear and Particle Physics by Das and Ferbal, World Scientific.

4. Elements of Nuclear Physics by Walter E. Meyerhof, McGraw-Hill Book Company.
5. Introductory Nuclear Physics by Kenneth S. Krane, John Wiley & Sons.
6. Introduction to Elementary Particles by David J. Griffiths, John Wiley & Sons.
7. Radiation Detection and Measurement by G.F. Knoll (John Wiley & Sons).
8. Introduction to Nuclear and Particle Physics by V. K. Mittal, R. C. Verma & S. C. Gupta, PHI.
9. Concepts of Modern Physics, A. Beiser, McGraw-Hill Book Company.

B.Sc. Honors - Physics

Semester VI

Paper III: Solid State Physics - II

Duration: 3 hrs. **Max. Marks : 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks).
Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit -I

Crystallography and Diffraction : Miller Indices and Crystal Structure, Spacing of Planes in Crystal Lattice, Determination of different crystal properties for SC, FCC, BCC, HCP and perovskite structure, Reciprocal lattice, Conversion of SC and FCC structures in reciprocal lattice frame, Concept of crystalline, polycrystalline & amorphous materials, X-ray Diffraction and Bragg's Law, Laue equation of X-ray diffraction, FWHM, Debye Scherrer and Laue Camera, Electron and neutron diffraction.

Unit -II

Electrical Properties of the Solids : Electrical Conductivity : Drude-Lorentz Theory of Electrical Conductivity, Boltzmann Transport Equation, Sommerfeld Theory of Electrical Conductivity, Mathiessen's Rule, Thermal Conductivity and Wiedemann-Franz's Law, The Hall Effect. Thermionic Emission, Escape of electrons from metals, Density of States.

Unit -III

Semiconductors : Energy band structures in insulators, conductors, semiconductors, concept of direct & indirect bandgap in semiconductors, generation and recombination of charge carriers, mobility, PN diode equation, capacitance effects. Hall effect in superconductors and Hall coefficient.

Unit -IV

Magnetic Properties : Experimental features of superconductivity : Critical temperature, critical magnetic field, Meissner effect, Type I and Type II Superconductors, London's equation and penetration depth, isotope effect, idea of BCS theory (no derivation), Cooper pair and coherence length, Josephson effect (no derivation).

Reference Books

1. Introduction To Solid State Physics by Charles Kittel, Wiley Publications.
2. Elementary Solid State Physics by M. Ali Omar, Pearsons Education.
3. Solid State Physics by John Rita, Tata McGraw Hills.
4. Solid State Physics by S.O. Pillai, New Age International Publishers.
5. Solid State Physics by V. K. Babbar& R. K. Puri, S. Chand Publishers.

B.Sc. Honors - Physics

Semester VI

Paper IV: Atomic & Molecular Physics-II

Duration: 3 hrs. **Max. Marks: 54**

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

Part A of the paper shall contain eight short answer questions and the candidate is required to attempt any seven questions. Each question will carry 2 marks for correct answer. (7x2 marks each = 14 marks). Part B of the paper will consists of four questions one question from each unit with internal choice. Each question will carry 10 marks. (4 x 10 marks each = 40 marks).

Unit-I

Background From Quantum Theory : The four quantum numbers (***n***, ***l***, ***m***, ***s***), *de*-Broglie equation, phase velocity & group velocity, Heisenberg uncertainty principle, dipole moment, selection rules, spectra of mono and divalent atoms, Fine structure of hydrogen lines, doublet structure of alkali spectrum.

Unit-II

Magnetic Field Effects And X-Ray Spectroscopy : Effect of magnetic fields on energy levels, Zeeman Effect (Normal& Anomalous), Gyromagnetic ratio for orbital and spin moments, vector model, L-S &J-J coupling, x-ray spectra, Continuous x-ray spectra, characteristics of x-rays, Mosley's law.

Unit-III

Diatomic & Triatomic Molecules : Spectra of diatomic & triatomic molecules, singlet and triplet characteristics, rotational energy levels, intermolecular distance, vibrational energy levels, pure rotational spectra, selection rules, vibrational & rotational spectra, Franck-Condon principle.

Unit-IV

Experimental Techniques : Emission spectroscopy: Fluorescence, Photoluminescence, Electroluminescence, Bioluminescence.

Absorption spectroscopy : UV-Vis and IR spectroscopy, X-ray photoelectron spectroscopy (XPS), photomultiplier tube (PM Tube) & Fabry Perot Experiment.

Reference Books

1. Atomic Spectra and Atomic Structure by G. Herzberg. Dover Publications Inc.
2. Atomic Spectra by H. K. Pa. Prentice Hall Press.
3. Spectroscopy Vol. I, II, III by Walker and Straughan, Springer.
4. Introduction To Molecular Spectroscopy by H. Barrow, McGrah-Hill.
5. Introduction to Molecular Spectra by R C Johnson, Metcalf Press.
6. Atomic spectra by White, McGraw-Hill Inc., US.
7. X-Ray Spectroscopy by B K Agarwal, Springer Series in Optical Sciences.
8. Optics and Atomic Physics by D. P. Khandelwal, Himalaya Publishing House.
9. Atomic and Molecular Physics by C. L. Arora, Campus Books International.
10. Atomic and molecular Physics by Raj Kumar, Campus Books International.

B.Sc. Honors - Physics

Semester - VI

Physics Practical - VI

Max. Practical Marks = 150 Marks
Internal Marks = 60 Marks
External Practical Exam (Duration : 5 hrs.) = 90 Marks

Note: Out of the following experiments, 8 experiments must be done by the students in the semester.
(8 hrs. per week)

1. Determination of Planck's constant by photocell (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 semiconductor (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 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 Nicol's prism and photocell and verification of Brewster law and law of Malus.
11. Helical method for the determination of e/m.
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.
14. Any other experiment that relates to the theory.