B.Sc. Part III

1. Physics

Paper I	Exam. 3 Hours Duration	Max. Marks 33	Min. Pass Marks 12
Paper II	Exam. 3 Hours Duration	Max. Marks 33	Min. Pass Marks 12
Paper III	Exam. 3 Hours Duration	Max. Marks 34	Min. Pass Marks 12
Practical	Exam. 4 Hours Duration	Max. Marks 50	Min. Pass Marks 18

Paper 1: Quantum Mechanics and Spectroscopy

Work Load: Two hours lecture per week

Examination Duration 3 hrs.

Scheme of Examination Five question shall be set and all are compulsory First question shall contain 12 short answer type questions (3 questions from each unit) of one mark each with answer not exceeding 50 words. Candidates have to attempt any nine questions out of these 12 questions Remaining four questions will be of 6 marks each and will be set with one question from each unit Second to fifth questions wit have 100% internal choice.

Unit - 1 Evolution of quantum physics

1. Difficulties of classical echanics to explain the black - body emission spectrum specific heat of solids Plank quanta concept and radiation law Photo electric effect and Einstein explanations, Compton effect.
2. Uncertainty principle position and momentum angle and angular momentum, energy and time Application of uncertainly principle: (i) Ground state energy of hydrogen atom, (ii) ground state of simple harmonic oscillator, (iii) Natural width of spectral lines, (iv) Non-existence of electron in nucleus.
3. **Operators :** Linear operators, product of two operators, commuting and non commuting operators, simultaneous eigen function and eigen values, orthogonal wave functions, Hermitian operators, their eiger values, Hermitian adjoint operator eigen values and eigenfunctions, expectation values of operators position, momentum energy; Ehrenfest theorem and complementarity. Concept of group and phase velocity, wave packet.

Unit II: Schrödinger wave equation and Its solutions

1. Schrodinger wave equation: general equation of wave propagation, propagation of matter waves, time dependent and time-independent Schrödinger equation, wave function representation(ψ), physical meaning of ψ. properties and conditions on ψ. postulates of wave/Quantum mechanics, operators, observable and measurements; probability current density.

2. Time independent Schrodinger equation, stationary state solution, one dimensional problem, particle in one dimensional box, eigen functions and eigen values, discrete energy levels, generalization into three dimension and degeneracy of energy levels, concept of a potential well and barrier, step potential, penetration through rectangular barrier, reflection and transmission coefficients.

Unit - III : Schrodinger equation solution in special cases

1. Symmetric square well potential, reflection and transmission coefficients, resonant scattering, Bound state problems particle in one dimensional infinite potential well and finite depth potential well, energy eigen values and eigen functions, transcendental equation and its solution, Simple harmonic oscillator, Schrodinger equation for simple harmonic oscillator and its solution eigen function, eigen values, zero point energy.
2. Schrodinger equation in spherical coordinates, Schrodinger equation for one electron atom in spherical coordinates, separation into radial and angular variables, solution of radial equation and angular equation, series solution and energy eigenvalues, stationary state wave function. Orbital angular momentum and its quantization, commutation relation, eigenvalues and eigenfunctions.

Unit - IV: H-atom, Atomic and Molecular spectroscopy

1. Energy level derivation for H-atom, quantum features of hydrogen spectra and hydrogen like spectra, Stern-Gerlach experiment, electron spin, spin magnetic moments, spin-orbit coupling, qualitative explanation of fine structure, Franck-Hertz experiment, Zeeman effect, normal Zeeman splitting, Qualitative understanding about Stark effect.
2. Molecular spectroscopy concept of rigid rotator, rotational energy levels, rotational spectra, selection rules, intensity of spectral lines, isotopic effect; Vibrational energy levels, vibrational spectra, selection rules, isotopic effect, effect of anharmonicity in vibrational spectra.

Reference books

1. David J. Griffiths, Introduction to Quantum Mechanics, 2nd edition.
2. R. Shankar, Principles of Quantum Mechanics, 2d edition.
3. Arthur Beiser, Perspective of modern Physics, 6th edition.
4. A. K Ghatak and S Lokanathan, Quantum Mechanics: Theory and application.
5. HS Mani, GK Mehta, Introduction to modern Physics.
6. C.N. Banwell and E.M. McCash, Fundamental of Molecular Spectroscopy, 4th Edition.
7. HE White, Introduction to atomic physics.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Paper-II: Nuclear and Particle Physics

Work Load: Two hours lecture per week

Examination Duration :Three hours

Scheme of Examination Five questions shall be set and all are compulsory First equation shall contain 12 short answer type questions (3 questions from each unit) of one mark each with answer not exceeding 50 words. Candidates have to attempt any nine questions out of these 12 questions Remaining four questions will be of 6 marks each and will be set with one question from each unit Second to fifth questions will have 100% internal choice

UNIT -1

Properties of Nucleus Discovery of Nucleus, Rutherford Scattering. Constituents of the Nucleus, Mass Charge, Size, Nuclear Density. Charge Distribution.

Nuclear Angular momentum, Nuclear Magnetic, Dipole Moment Electric Quadrupole Moment, Spin, Isospin, Wave Mechanical Properties Parity and Statistics, Classification of Nuclei, Mass Defect and Binding Energy, Packing Fraction, Mass Spectrograph.

Nuclear Forces: Properties of Nuclear Forces, Yukawa Meson Theory, Nuclear Potential.

Nuclear Models: Segre Chart, Liquid Drop Model, Semi Empirical Mass Formula, Condition of Stability.

UNIT - 2

Radioactive Decays: Alpha Decay-Basics of ?-Decay Processes, Theory of ? Emission Spectrum, Gammow Factor, Geiger Nuttal Law, Range of Alpha Particles.

Beta Decay Energy Kinematics for +.3-Decay Spectrum, Positron Emission, Electron Capture, Pauli's Neutrino Hypothesis.

Gamma Decay - Gamma Ray Emission and Kinematics, Internal Conversion Applications of Radioactivity. Nuclear Fission and Fusion: Nuclear Fission, Spontaneous Fission and Potential Barrier, its Explanation by tiquid Drop Model, Chain reaction, Controlled chain reaction, Four Factor Formula, Nuclear Reactors, Classification of Nuclear Reactor, Uncontrolled Chain Reaction, Nuclear Fusion, Energy released in Nuclear Fusion, Fusion in stars.

UNIT - 3

Interaction of Nuclear Radiations with Matter : Energy loss by Heavy Charged Particles in Matter, Interaction of Electrons with Matter, Range of Charged Particle, Bremsstrahlung. Cherenkov Radiation, Gamma Ray Interation with Matter.

Radiation Detectors: Gas filled detector, Avalanche, Geiger Discharge, Ionization Chamber, Proportional Counter, Geiger Muller Counter.

Particle Accelerators: lon source. Cyclotron Synchrocyclotron, Betatron, Proton Synchrotron.

UNIT-4

Elementary Particles: Necessity of high energy to discover elementary constituents, historical introduction to discovery of elementary particles (electron, positron, neutrinos strange mesons, charm quark, intermediate vettor bosons, botton quark, top quark and Hot boson) Elementary particles and their quantum numbers (charge. spin parity, isospin, strangeness, etc), elementary particles included in the standard model.

Fundamental Interactions : Four types of fundamental forces, Symmetries and onservation Laws.

Quark Model: Flavor symmetries, Gellmann Nishijima formula, the eightfold way. Quark madel, Octet Diagram for Mesons and Baryons.

Suggested Books :

1. Nuclear and Particle Physics, WE Burcham and M lobes, Addison Wesley Longman Inc
2. Nuclear and Particle Physics, Brian R Martin John Wiley & Sons,
3. Introduction to Nuclear and Particle Physics, Das and Ferbal, World Scientific.
4. Elements of Nuclear Physics, Walter E. Meyerhof, McGraw Hill Book Company.
5. Introductory Nuclear Physics, Kenneth S, Krane, John Wiley & Sons.
6. Introduction to Elementary Particles, David J Griffiths, John Wiley & Sons.
7. Radiation Detection and Measurement, G.F Knoll (John Wiley & Sons).
8. Introduction to Nuclear and Particle Physics, V.K Mittal, R.C Verma, S. C Gupta, PHI
9. Concepts of Modem Physics, A. Beiser, McGraw Hill Book Company.

Paper - III (Solid State Physics)

Work Load: Two hours lecture per week

Examination Duration: Three hours

Scheme of Examination: Five question shall be set and all are compulsory. First question shall contain 12 short answer type questions (3 question from each unit) of one mark each with answer not exceeding 50 words. Candidates have to attempt any ten questions out of these 12 questions. Remaining four questions will be of 6 marks each and will be set with one question from each unit. Second to fifth questions will have 100% internal choice.

UNIT-I

Bonding in Solids and Crystal Structure:

Force between atoms, lonic bonds, Covalent and metallic bonds, Vander Waal's and Hydrogen bonding. Periodicity in lattices, Basis, lattice point and space lattice Translation vectors, Unit and primitive cell, Crystal systems, Packing fractions for Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC) and Hexagonal lattice structures, Bravais space lattices.

Crystallography and Diffraction:

Direction, plapes and Miller indices in a crystal lattice, Reciprocal lattice and its significance, Conversion of SC and FCC Structures in reciprocal lattice frame.

UNIT - II

Band theory of Solids:

Formation of bands, Periodic potential and Bloch Theorem, Number of states in the bands, Kronig Penny model, Brillouin zones, Crystal momentum and physical origin of effective mass, Negative Effective Mass and Holes, Energy dispersion relations: weak and tight binding,

Semiconductors:

Energy band Structure in Insulators, Conductors, Semi-conductors, Concept of Direct and Indirect band gap in semi-conductors, Generation and recombination of charge carriers, Mobility of current carriers, Hall Effect in semi-conductors: Hall coefficient, Mobility, Charge carrier concentration.

UNIT -III

Thermal properties of Materials:

Elastic waves, Phonon, Phonon dispersion relations in monoatomic and diatomic linear lattice. Lattice heat capacity, Classical theory of specific heat, Dulong-Petit's law, Einstein and Debye's theory of specific heat of solids and limitations of these models.

Electrical Properties of Materials:

Drude-Lorentz theory, Sommerfeld's Model, Thermal conductivity, Electrical conductivity. Wiedemann Franz relation.

UNIT - IV

Magnetic Properties of Materials:

Classification of Magnetic Materials, Origin of Atomic Magnetism, Classical Langevin Theory of dia - and Paramagnetic Domains, Quantum theory of Paramagnetism. Curie's Law, Weiss's Theory of Ferromagnetism.

Superconductivity:

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.

Reference Books

1. Introduction to Solid State Physics- ---Charles Kittel (Wiley Publication)
2. Elementary Solid state Physic------M. Ali Omar (Pearson Education)
3. Elements of X-ray diffraction -----B.D. Cullity (Prentice Hall)

Practical Work

Teaching: 4 hrs/per week

Examination Duration: 4 hrs

Minimum Pass Marks: 18

Max. Pass Marks: 50

Note: Total number of Experiments to be performed by the students during the session should be 16 selecting any 8 from each section

(Perform any six experiments for the session 2000- 21)

Section - A

1.(A) Determination of Planck's constant with the help of a photo cell.

2.(A) To determine Planck's constant using solar cell.

3.(A) To determine the value of Stefan's constant.

4.(A) To Study the change in resistivity of any semiconductor with temperature by four probe Method.

5.(A) Study of absorption spectrum of Iodine.

6.(A) Study the characteristics of G.M. counter and hence verification of inverse square law/ for radioactive radiations.

7.(A) Determination of end point energy of B particles by using Geiger Muller counter and studyof their absorption by aluminium.

8.(A) Determination of magnetic susceptibility of ferromagnetic / paramagnetic material by sing Quinck's method and determination of ionic molecular susceptibility of ions and magnetic oment in terms of Bohr Magneton.

9.(A) Determination of modulus of rigidity of given material in the form of torsional oscillator using resonance method and study of dependence of modulus of rigidity on temperature .

10.(A) To study the polarization by reflection due to glass plate by using Nicol prism and photo cell and prove the Brewster and Mallus laws.

11.(A) To find e/m of electro by Helical method.

12.(A) Measurement of magnetic field of an electromagnet using a ballistic galvanometer, search coil and standard inductor. Study the variation of magnetic field of an electromagnet with the current.

13.(A) To determine the frequency of unknown Ac Source by Lissajous figures.

14.(A) To study frequency response of R-C coupled double stage amplifier.

15.(A) To determine the charge of an electron by Millikan's oil drop experiment.

Section - B

1.(B) To study R-C Transmission line at 50 Hz.

2.(B) To study L-C Transmission line.

3.(B) Object Study of resonance in an LCR circuit (using air core Inductance and dampling by metal plate). (i) at fixed frequency by varying C, and (ii) - by varying frequency

4.(B) To study the characteristics of given junction and zener diodes.

5. (B) Study of (i) Recovery time of a junction diode and a point contact diode. (ii) Recovery time as a function of frequency of operation and switching current.

6. (B) To design a zener regulated power supply and study the regulation with various loads

7.(B) (i)To Study and draw the characteristics curve of a given field effect transistor (FET).

(ii) To design a FET amplifier and to study its gain frequency response.

8.(B) To study the gain frequency response of a transistor amplifier with (a) Resistive load, (b) Inductive load, (c) transformer load, and (d) to find its input and output impedence.

9.(B) To design and study an R-C phase shift oscillator.

10.(B) Study of voltage multiplier circuit and conversion of alternating current into direct current with it.

11.(B) Study of OR, AND and NOT logic gates by applying different components and hence their comparison with the gates formed with integrated circuits (IC's).

12.(B) (1) To Study the operational amplifier in (a) Inverting mode, and (b) Non inverting mode, (ii) Application of operational amplifier as (a) Adder amplifier, and (b) a Buffer amplifier for unit gate voltage measurement.

अकादमिक प्रभारी
महाराजा सूरजमल बृज विश्वविद्यालय
भरतपुर (राज.)