SESSION-2022-23

B.Sc. Part I

1. Physics

Scheme

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. 5 Hours Duration	Max. Marks 50	Min. Pass Marks 18

Paper-I (Mechanics)

Work Load: Two hours lecture per week

Examination Duration: 3 Hrs.

Scheme of Examination: Five questions 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 to each question 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 – I

Physical Law and frame of Reference:

Inertial and non-inertial frames: Transformation of displacement, velocity, acceleration between different frames of reference involving translation, Galilean transformation and invariance of Newton's laws.

Special theory of Relativity: Postulates of Special theory of relativity, Lorentz transformation, transformation of velocity and acceleration, Length contraction and time dilation with experimental verification

Coriolis Force: Transformation of displacement, velocity and acceleration between rotating frame, Pseudo forces, Coriolis force, Motion relative to earth, Focult's pendulum.

Unit – II

Centre of Mass:

Introduction about Centre of Mass, Centre of Mass Frame; Collision of two particles in one and two dimensions (elastic and inelastic), Slowing down of neutrons in a moderator, Motion of a system with varying mass, Angular momentum concept, conservation and charge particle scattering by a nucleus.

Rigid body

Equation of a motion of a rotating body, Inertial coefficient, Case of J not parallel to w, Kinetic energy of rotation and idea of principal axes, Determination of moment of inertia of symmetric bodies using inertial coefficients, Precessional motion of a spinning top.

Unit –III

Motion under Central Forces:

Introduction about Central Forces, Motion under central forces, Gravitational interaction, Inertial and gravitational mass, General solution under gravitational interaction, Keplers Laws, Discussion of trajectories, Cases of elliptical and circular orbits, Rutherford scattering.

Elastic Properties of Matter

Elastic constants and relations among them, Elastic theorems, Bending of beams and cantilever, Torsion of a cylinder, Experimental determination of Y by bending of beam; η by Maxwell's needle; Y, η and σ by Searle's method & η by static method

Unit – IV

Damped Harmonic Oscillations:

Introduction about oscillations in a potential well, Damped force and motion under damping, Damped Simple Harmonic Oscillator, Power dissipation, Anharmonic oscillator and simple pendulum as an example.

Driven Harmonic Oscillations

Driven harmonic oscillator with damping, Frequency response, Phase relation, Quality factor, Resonance, Series and parallel of LCR circuit, Electromechanical system-Ballistic Galvanometer.

Coupled Oscillations

Equation of motion of two coupled Simple Harmonic Oscillators, Normal modes, motion in mixed modes, Transient behaviour, Dynamics of a number of oscillators with neighbour interactions.

Reference Books:

1. Mechanics: Berkeley Physics Course Vol- I, Charles Kittel
2. Mechanics: H S Hans S P Puri, Tata McGraw-Hill
3. The Physics of Waves & Oscillations. N.K. Bajaj, Tata McGraw-Hill
4. Analytical Mechanics L.N. Hand, J.D. Finch (Cambridge University Press).

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Paper - II (Electromagnetism)

Work Load: Two hours lecture per week

Examination Duration: Three hours

Scheme of Examination: Five questions 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 to each question 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 I

Scalar and Vector Fields

Concept of Field, Scalar and Vector Fields, Gradient of scalar field, Physical significance and formulism of Gradient, Divergence and Curl of a vector field in Cartesian co-ordinates system, Problems based on Gradient, Divergence and curl operators.

Concept of Solid angle, Gauss's divergence and Stokes theorem, Differential and integral form of Gauss's law, Ampere's law and Faraday's law.

Unit II

Fields of stationary and moving charges

Potential energy of system of (i) Discrete N-charges (ii) Continuous charge distribution. Energy required to build a uniformly charged sphere, classical radius of electron, Electric field due to a short electric dipole, Interaction of electric dipole with external uniform and non-uniform electric field, potential due to a uniformly charged spherical shell.

Poisson's and Laplace equations in Cartesian co-ordinates and their applications to solve the one dimensional problems of electrostatics.

Invariance of charge, Electric field measured in moving frames, Electric field of a point charge moving with constant velocity.

Unit III

Electric field in matter

Multipole expansion, definition of moments of charge distribution, Dielectrics, Induced dipole moments, polar & non polar molecules, Free and bound charges, Polarization, Atomic polarizabilty, electric displacement vector, electric susceptibility, dielectric constant, relation between them.

Electric potential and electric field due to a uniformly polarized sphere (i) outside the sphere (ii) at the surface of the sphere (iii) inside the sphere, Electric field due to a dielectric sphere placed in a uniform electric field (a) outside the sphere (b) inside the sphere, Electric field

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due to a charge placed in dielectric medium and Gauss law, Clausius-Mossotti relation in dielectrics, Transient behaviour of series R-C Circuit with a DC Source.

Unit IV

Magnetostatics and magnetic field in matter

Lorentz force, properties of magnetic field, Ampere's law, magnetic field due to a current carrying solid conducting cylinder (i) outside (ii) at the surface and (iii) inside the cylinder. Ampere's law in differential form, Introduction of Magnetic Vector potential, Poisson's equation for vector potential, Deduction of Bio-Savart law using Magnetic Vector potentials, Differential form of Ampere's law, Transient behaviour of series L-R Circuit with a DC Source.

Atomic magnet, Gyromagnetic ratio, Bohr-magneton, Larmor frequency, induced magnetic moment and dia-magnetism, spin magnetic moment, para and ferro magnetism, Intensity of Magnetization, Magnetic permeability and Susceptibility, free and bound current densities, Magnetic field due to a uniformly magnetized material and Non-uniformly magnetized material.

Reference Books:

1. Electricity & Magnetism; AS Mahajan & Abbas A Rangwala, Tata McGraw-Hill
2. Introduction to electrodynamics; David J. Griffith. Prentice Hall
3. Berkley Physics Course. Vol II
4. Fundamental University Physics Vol II: Fields and Waves. M. Alonso and EJ Finn: Addrson-Wesley Publishing Company.

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Paper III OPTICS

Work Load: Two hours lecture per week

Examination Duration: Three hours

Scheme of Examination: Five questions 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 to each question 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 question will have 100% internal choice.

Unit-I

Interference:

Concept of Spatial and Temporal Coherence, coherence length, coherence time, Types of interference, interference by division of wave fronts: Fresnel's Biprism, Measurement of wavelength λ and thickness of a thin transparent sheet, Interference by division of amplitude: Interference in thin films of constant thickness in transmitted and reflected waves. Interference produced by a wedge shaped film, Newton's rings, Determination of wavelength λ and refractive index μ by Newton's Rings: fringes of equal inclination (Haidinger fringes) and equal thickness (Fizeau fringes), Michelson's Interferometer, shape of fringes. Measurement of wavelength, difference between two spectral lines and thickness of a thin transparent sheet.

Unit - 2

Diffraction:

Fresnel's diffraction, Half period zones, Fresnel's diffraction at a circular aperture, straight edge and a rectangular slit, Zone plate, Multiple foci of zone plate, comparison between zone plate and convexlens, Fraunhofer diffraction by single slit and a circular aperture, Fraunhofer diffraction by N parallel slits with two slits as a special case, Missing order, Plane diffraction grating and its use in determining wavelength, Dispersion by a grating, Rayleigh's criterion of resolution, Resolving power of a Telescope and a Grating.

Unit - 3

Polarization:

Polarization, Plane, Circular and Elliptically Polarized light, Polarization by reflection, Double refraction and Huygens explanation of double refraction, Production and detection of Plane, Circular and Elliptically Polarized light; Quarter wave and Half wave plates, optical activity. Specific rotation, Biquartz and half shade Polarmeters and their comparison.

(i) **Laser:** Spontaneous and Stimulated emission Einstein's A&B coefficients. Energy density of radiation as a result of stimulated emission and absorption, population Inversion. Methods of Optical pumping, Energy level schemes. He-Ne, Ruby, CO_2 lasers.

(ii) **Holography:** Basic concepts of holography, Principle, Theory. Construction and reconstruction of image. Application of holography.

Unit -4

Wave motion:

1D and 3D wave equation, Transverse waves in a stretched string. Elastic waves in solids. Pressure waves in a gas column, spherical waves. Fourier's Theorem and its application to square and saw-tooth waves, Phase and group velocities, Dispersion of waves. Electromagnetic waves, Energy density of Electromagnetic waves, Electromagnetic waves in an Isotropic and Dispersive medium, Spectrum of Electromagnetic waves

Reference Books:

1. Optics by Brij Lal & Subramanium, S. Chand.
2. Optics by D. P. Khandelwal.
3. Principles of optics by B. K. Mathur.
4. Introduction to Modem Optics by A. K. Ghatak.
5. An introduction to Modem Optics by G. R. Fowels.
6. Essentials of Lasers by Allen.

Practical

Work Load: Four hours laboratory work per week

Examination Duration: Four hours

Minimum Experiments: Total sixteen taking eight from each section.

Section A

1. To study the variation of power transfer by two different loads by a DC source and to verify maximum power transfer theorem.
2. To study the variation of charge and current in a R-C circuit with a different time constant (using a DC source).
3. To study the behaviour of a R-C circuit with varying resistance and capacitance using at mains as a power Source and also to determine the impedance and phase relations.
4. To study the rise and decay of current in an L-R circuit with a source of constant emf.
5. To study the voltage and current behaviour of an L-R circuit with an AC power source. Also determine power factor, impedance and phase relations.
6. To study the characteristics of a semi- conductor 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 radius of the circular coil.
8. To determine the specific resistance of a material and determine difference between two small resistance using Carey Fosters Bridge
9. To convert a galvanometer into an ammeter of a given range
10. To convert a galvanometer into a voltmeter of a given range.

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Section B

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 the damping using compound pendulum.
4. To study the excitation of normal modes and measure frequency splitting using two coupled oscillators.
5. To study the frequency of energy transfer as a function of coupling strength using coupled oscillators,
6. To study the viscous fluid damping of a compound pendulum and determining damping coefficient and Q of the oscillator.
7. To study the electromagnetic damping of a compound pendulum and to find the variation of damping coefficients with the assistance of a conducting lamina.
8. To find J by Calendar and Barne's Method
9. To determine Youngs modulus by bending of beam.
10. To determine Y, σ and η by Searle's method.
11. To ensure Curie temperature of Monel alloy.
12. To determine modulus of rigidity of a wire using Maxwell's needle.
13. 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,
14. To study variation of surface tension with temperature using Jaegger s method.
15. To study the specific-rotation of sugar solution by polarimeter

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First question is compulsory and is of 9 marks. This question contains 12 short answer type questions of one mark each. Candidates have to attempt any 9 questions with answer not more than 50 words. Second to fifth questions are of six marks each with internal choice.

प्रथम प्रश्न अनिवार्य है और यह 9 अंक का है। इस प्रश्न के अन्तर्गत 12 लघुत्तरात्मक प्रश्न हैं, जिनमें से कोई भी 9 प्रश्न हलं करने है, जिनका उत्तर 50 शब्दों से अधिक न हो। प्रश्न संख्या 2 से 5 तक प्रत्येक प्रश्न 6 अंक का है, जिसमें आन्तरिक विकल्प है।

1. पचास शब्द सीमा में नौ भागों के उत्तर दीजिए।

(i)	(ii)	(iii)	(iv)
(v)	(vi)	(vii)	(viii)
(ix)	(x)	(xi)	(xii)

Unit – I प्रथम इकाई

2 (a)
(b)

Or / अथवा

(a)
(b)

Unit – II द्वितीय इकाई

3 (a)
(b)

Or / अथवा

(a)
(b)

Unit – III तृतीय इकाई

4 (a)
(b)

Or/ अथवा

(a)
(b)

Unit – IV चतुर्थ इकाई

5 (a)
(b)

Or/ अथवा

(a)
(b)

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Blueprint for setting question *paper III* for B.Sc. part I Physics Examination - 2018

First question is compulsory and is of ten marks. This question contains 12 short answer type questions of one mark each. Candidates have to attempt any 10 questions with answer not more than 50 words. Second to fifth questions are of six marks each with internal choice.

प्रथम प्रश्न अनिवार्य है और यह 10 अंक का है। इस प्रश्न के अन्तर्गत 12 लघुत्तरात्मक प्रश्न है, जिनमें से कोई भी 10 प्रश्न हल करने है, जिनका उत्तर 50 शब्दों से अधिक न हो। प्रश्न संख्या 2 से 5 तक प्रत्येक प्रश्न 6 अंक का है, जिसमें आन्तरिक विकल्प है।

1. पचास शब्द सीमा में दस भागों के उत्तर दीजिए।

(i)	(ii)	(iii)	(iv)
(v)	(vi)	(vii)	(viii)
(ix)	(x)	(xi)	(xii)

Unit – I प्रथम इकाई

2 (a)
(b)

Or / अथवा

(a)
(b)

Unit – II द्वितीय इकाई

3 (a)
(b)

Or / अथवा

(a)
(b)

Unit – III तृतीय इकाई

4 (a)
(b)

Or/ अथवा

(a)
(b)

Unit – IV चतुर्थ इकाई

5 (a)
(b)

Or/ अथवा

(a)
(b)

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1. B.Sc. Part II Physics

Scheme: Max. Marks: 100

Min. Pass Marks: 36

Paper I	3 hrs. Duration	Max. Marks: 33	Min. Pass marks 12
Paper II	3 hrs. Duration	Max. Marks: 33	Min. Pass marks 12
Paper III	3 hrs. Duration	Max. Marks: 34	Min. Pass marks 12
Practical	5 hrs. Duration	Max. Marks: 50	Min. Pass marks 18

Paper-I: Thermodynamics and Statistical Physics

Work Load: 2 hrs. Lecture /week

Examination Duration: 3 Hrs.

Scheme of Examination: Five questions 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 to each question not exceeding 50 words. Candidates have to attempt any 9 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

Thermal and adiabatic interactions: Thermal interaction: Zeroth law of thermodynamics; System in thermal contact with a heat reservoir (canonical distribution): Energy fluctuations: Entropy of a system in a heat bath; Helmholtz free energy: Adiabatic interaction and enthalpy; General interaction and First law of thermodynamics: Infinitesimal general interaction; Gibb's free energy, Phase transitions: Clausius Clapeyron equation: Vapour pressure curve: Heat engine and efficiency of engine. Carnot's Cycle; Thermodynamic scale as an absolute scale; Maxwell relation and their applications.

Unit-2

Production of low temperatures and applications: Joule Thomson expansion and JT coefficients for ideal as well as Vander Waal's gas, porous plug experiment, temperature inversion, Regenerative cooling, Cooling by adiabatic expansion and demagnetization; Liquid Helium. He I and He II, superfludity, Refrigeration through Helium dilution: Quest for absolute zero. Nernst heat theorem

The distribution of molecular velocities: Distribution law of molecular velocities, most probable, average and r.m.s. velocities: Energy distribution function: effusion and molecular beam, Experimental verification of the Maxwell velocity distribution, the principle of equi-partition of energy.

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Unit -3

Transport phenomena: Mean free path, distribution of free path, coefficients of viscosity, thermal conductivity, diffusion and their interaction.

Classical Statistics: Validity of Classical approximation; micro and macro states, Thermodynamic probability, relation between entropy and thermodynamic probability, Monoatomic ideal gas; Barometric equation; Specific heat capacity of diatomic gas; Heat capacity of solids.

Unit – 4

Quantum Statistics: Black body radiation and failure of classical statistics; Postulates of quantum statistics, indistinguishibility, wave function and exchange degeneracy, equal a prior probability; Bose-Einstein statistics and its distribution function; Planck 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. Tretise on heat by Shah & Srivastave
2. Thermodynamics by DP Khandelwal
3. Heat & Thermodynamics – Brijlal Subrahium

Paper- II: Mathematical Physics and Special Theory of Relativity

Work Load: 2 hrs. Lecture/week
Examination Duration: 3 Hrs.

Scheme of Examination: Five questions 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 to each question not exceeding 50 words. Candidates have to attempt any 9 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

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, 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-2

Lorentz transformation and rotation in space-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.

Transformation between laboratory and center of mass system, four momentum conservation, kinematics of decay products of unstable particles and reaction thresholds: Pair production,inelastic collision of two particles, Compton Effect.

UNIT - 3

(A) Transformation of electric and magnetic fields between two inertial frames.

(B) The second order linear differential equation with variable coefficient and singular points, series solution method and its application to the Hermite's, Legendre's and Laguerre's differential equations; Basic properties like orthogonality, recurrence relation, graphical representation and generating function of Hermite, Lagendre, Leguerre and Associated Legendre function (simple applications).

UNIT-4

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

Reference Books:

1. Mathematical Physics – Satyaprakash
2. Mathematics for physics & Engee. – Pipes & Horwill
3. Mathematical Physics – B.S. Rajput

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Paper III: Electronics and Solid State Devices

Work Load: 2 hrs. Lecture/week
Examination Duration: 3 Hrs.

Scheme of Examination: Five questions 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 to each question 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 1

Circuit analysis and PN junctions

Circuit analysis: Networks- some important definitions, loop and nodal equation based on D.C. and A.C. circuits (Kirchhoffs Laws). Four terminal network: Ampere volt conventions, open, close and hybrid parameters of any four terminal network, Input, output and mutual impendence for an active four terminal network. Various circuit theorems: Superposition, Thevenin, Norton, reciprocity, Compensation, maximum power transfer and Miller theorems.

PN junction: Charge densities in N and P materials Conduction by drift and diffusion of charge carriers, PN diode equation; capacitance effects.

Unit 2

Rectifiers and transistors

Rectifiers: Half-wave, full wave and bridge rectifier calculation of ripple factor, efficiency and regulation; Filters: series inductor, shunt capacitor. L-section and T-section filters. Voltage regulation: Voltage regulation and voltage stabilization by Zener diode, voltage multiplier.

Transistors: Notations and volt-ampere characteristics for bipolar Junctions transistor, Concept of load line and operating point Hybrid parameters. CB, CE, CC configurations. Junction field effect transistor (JEFT) and metal oxide semiconductor filed effect transistor (MOSFET). Circuit symbols, biasing and volt-ampere characteristic, source follower operation of FET as variable voltage resistor.

Unit 3

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Transistor biasing and amplifiers

Transistor biasing: Need of bias and stability of Q point, stability factors, and various types of bias circuits for thermal bias stability fixed bias, collector to base feedback bias and four resistor bias.

Amplifiers: Analysis of transistor amplifiers using hybrid parameters and its gain-frequency response, Cascade amplifiers, basis idea of direct coupled and R.C. coupled amplifiers. Differential amplifiers, Amplifier with feedback: Concept of feedback, positive and negative

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Unit 4

Oscillators and Logic Circuits

Oscillators: criteria for self-excited and self-sustained oscillation, circuit requirement tor buildup of oscillation, basic transistor oscillator circuit and its analysis, Colpitt's and Hartely oscillator- R.C Oscillators, crystal oscillators and is advantages

Logic circuits: Logic fundamentals: AND, OR, NOT, NOR, NAND, XOR gates, Boolean algebra, De Morgan's theorem, positive and negative logic, logic gates circuit realization using DTL and TTL logic, simplification of Boolean expressions

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 Christose Hailkias, Integrated ' Electronics. Analog and Digital Circuits and systems: McGraw Hill Ltd:(1972)
4. Albert Paul Malvino, Digital Computer Electronics, TataMcGraw- Hill-Pub. Co. Ltd., New Delhi (1983).
5. Kumar & Gupta Hand book of Electronics.
6. G.K. Mithal, Hand Book of Electronics.
7. G.K. MithalElectronics Devices and Applications:
8. R.P. Jain, Digital Electronics.

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PRACTICAL

Teaching: 4 hrs/week
Min Pass Marks: 18

Examination Duration : 5hrs.
Max Pass Marks: 50

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

Section-A

1. Study of dependence of velocity of wave propagation on line parameter using torsional wave apparatus.
2. Study of variation or reflection coefficient of nature of termination using-torsional wave apparatus.
3. Using platinum resistance thermometer: 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 wavelength of sodium light using grating.
8. To determine wavelength of sodium light using Biprism.
9. Determine the thermodynamic constant $\gamma = C_p/C_v$ using Clement's & Desorme's method.
10. To determine thermal conductivity of a bad conductor by Lee's method.
11. Determination of ballistic constant of aballistic galvanometer.
12. Study of variation of total thermal radiation with temperature.

Section B

1. Plot thermo emf versus temperature graph and find the neutral temperature (Use sand bath)
2. Study of Power supply using two diodes/bridge rectifier with various filter circuits.
3. Study of half wave rectifier using single diode & 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 ($\cos\theta$) 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 Alderson's bridge.
11. Measurement of capacitance and dielectric constant of a liquid and gang condenser by de-Sauty bridge.

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Blueprint for setting question *paper I &II* for B.Sc. part II Examination - 2018

First question is compulsory and is of 9 marks. This question contains 12 short answer type questions of one mark each. Candidates have to attempt any 9 questions with answer not more than 50 words. Second to fifth questions are of six marks each with internal choice.

प्रथम प्रश्न अनिवार्य है और यह 9 अंक का है। इस प्रश्न के अन्तर्गत 12 लघुत्तरात्मक प्रश्न है, जिनमें से कोई भी 9 प्रश्न हल करने है, जिनका उत्तर 50 शब्दों से अधिक न हो। प्रश्न संख्या 2 से 5 तक प्रत्येक प्रश्न 6 अंक का है, जिसमें आन्तरिक विकल्प है।

1 पचास शब्द सीमा में नौ भागों के उत्तर दीजिए।

(i)	(ii)	(iii)	(iv)
(v)	(vi)	(vii)	(viii)
(ix)	(x)	(xi)	(xii)

Unit – I प्रथम इकाई

2 (a)
(b)

Or / अथवा

(a)
(b)

Unit – II द्वितीय इकाई

3 (a)
(b)

Or / अथवा

(a)
(b)

Unit – III तृतीय इकाई

4 (a)
(b)

Or/ अथवा

(a)
(b)

Unit – IVचतुर्थ इकाई

5 (a)
(b)

Or/ अथवा

(a)
(b)

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भरतपुर (राज.)

अकादमिक प्रभारी

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Blueprint for setting question *paper III* for B.Sc. part II Examination - 2018

First question is compulsory and is of ten marks. This question contains 12 short answer type questions of one mark each. Candidates have to attempt any 10 questions with answer not more than 50 words. Second to fifth questions are of six marks each with internal choice.

प्रथम प्रश्न अनिवार्य है और यह 10 अंक का है। इस प्रश्न के अन्तर्गत 12 लघुत्तरात्मक प्रश्न है, जिनमें से कोई भी 10 प्रश्न हल करने है, जिनका उत्तर 50 शब्दों से अधिक न हो। प्रश्न संख्या 2 से 5 तक प्रत्येक प्रश्न 6 अंक का है, जिसमें आन्तरिक विकल्प है।

1 पचास शब्द सीमा में दस भागों के उत्तर दीजिए।

(i)	(ii)	(iii)	(iv)
(v)	(vi)	(vii)	(viii)
(ix)	(x)	(xi)	(xii)

Unit – I प्रथम इकाई

2 (a)
(b)

Or / अथवा

(a)
(b)

Unit – II द्वितीय इकाई

3 (a)
(b)

Or / अथवा

(a)
(b)

Unit – III तृतीय इकाई

4 (a)
(b)

Or/ अथवा

(a)
(b)

Unit – IV चतुर्थ इकाई

5 (a)
(b)

Or/ अथवा

(a)
(b)

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भरतपुर (राज.)

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PHYSICS

B.Sc Part-III

Scheme			
Paper I	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 33
Paper II	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 33
Paper III	Exam: 3 hours duration	Min Pass marks: 12	Max. Marks : 34
Practical	Exam: 4 hours duration	Min Pass marks: 18	Max. Marks : 50

Paper I: Quantum Mechanics and Spectroscopy

Work Load: Two hours lecture per week

Examination Duration: 3 Hrs.

Scheme of Examination: Five questions 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 to each question 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 fitin questions will have 100% internal choice.

Unit – I : Evolution of quantum physics

1. Difficulties of classical mechanics to explain: the black-body emission spectrum, specific heat of solids. Plank quanta concept and radiation law, Photo electric effect and Einstein's explanations. Compton effect, De-Broglie hypothesis, diffraction and interference experiments of particle (Davisson–Germer experiment).

2. Uncertainty principle: position and momentum, angle and angular momentum, energy and time. Application of uncertainty principle: (i) Ground state energy of hydrogen atom, (ii) ground state energy 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 functions and eigen values, orthogonal wavefunctions. Hermitian operators, their eigenvalues, Hermitian adjoint operators,

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eigenvalues and eigenfunctions; expectation values of operators: position, momentum, energy; Ehrenfest theorem and complementarity, Concept of group and phase velocity, wave packet, Gaussian wave packet, bra-ket notation.

Unit – II : Schrödinger wave equation and its solutions

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

2. Time independent Schrödinger equation, stationary state solution, one dimensional problem: particle in one dimensional box, eigenfunctions and eigenvalues, 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, barriers with special shapes (graphical representation), quantum mechanical tunneling (alpha decay).

Unit – III : Schrödinger equation solutions 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 eigenvalues and eigenfunctions, transcendental equation and its solution; Simple harmonic oscillator, Schrödinger equation for simple harmonic oscillator and its solution, eigenfunction, eigenvalues, zero point energy, quantum and classical probability density, parity, symmetric and antisymmetric wave functions with graphical representation.

2. Schrödinger equation in spherical coordinates, Schrödinger equation for one electron atom in spherical coordinates, separation into radial and angular variables, solution of radial equation and angular equation, qualitative discussion of spherical harmonics, series solution and energy eigenvalues, stationary state wavefunction. Wave-functions of H-atom for ground and first

excited states, average radius of H-atom, Bohr correspondence principle, 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

moment, spin-orbit coupling, qualitative explanation of fine structure, Franck–Hertz experiment, Zeeman effect, normal Zeeman splitting, Qualitative understanding about Stark effect.

2. Absorption and emission spectroscopy, its block diagram, brief explanation about function of each elements and it's limitations; single beam spectrophotometer.

3. 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, vibrational–rotational spectra of CO and HCl molecules.

Reference books

1. David J. Griffiths, Introduction to Quantum Mechanics, 2nd edition.
2. R. Shankar, Principles of Quantum Mechanics, 2nd edition.
3. Arthur Beiser, Perspective of modern Physics, 6th edition.
4. AK 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. H.E. White, Intoduction to atomic physics,

Paper II: Nuclear and Particle Physics

Work Load: Two hours Lecture per week

Scheme of Examination: First question will be of nine marks comprising of six short answer type parts each with answer not exceeding half a page. Remaining four questions will be set with one question from each of the unit and will be of six marks each. Second to fifth question will have two parts namely (A) and (B) each carrying three marks. Part (A) of second to fifth question shall be compulsory and Part (B) of these questions will have internal choice.

UNIT - I

Properties of Nucleus : Discovery of Nucleus, Rutherford Scattering, Constituents of the Nucleus; Mass, Charge, Size, Nuclear Density, Charge Distribution, Hofstadter's experiment,

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, Fermi Gas Model, Evidence for Nuclear Shell Structure, Nuclear Magic Numbers and Basic Assumptions of the Shell Model.

UNIT - 2

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

Beta Decay- Energy Kinematics for β-Decay, β-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 Liquid 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.

Nuclear Reactions: Types of Reactions, Conservation Laws, Kinematics of Reactions, Q-Value, Threshold Energy, Reaction Rate, Reaction Cross-Section.

UNIT - 3

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

Radiation Detectors: Gas filled detector, Avalanche, Geiger Discharge, Ionization Chamber, Proportional Counter, Geiger Muller Counter, Current mode and Pulse Mode Operation of Detector.

Particle Accelerators: Ion source, Van-de-Graff Accelerator (Tandem Accelerator), Linear Accelerator, 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 vector bosons, bottom quark, top quark and Higgs 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 Conservation Laws, Diescrete symmetries C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction, CP violation.

Quark Model : Flavor symmetries, Gellmann-Nishijima formula, the eightfold way, Quark model, Octet Diagram for Mesons and Baryons, Concept of Quark model, the November Revolution, Baryon Decuplet, Color Quantum Number and Gluons.

Suggested Books:

1. Nuclear and Particle Physics, W. E. Burcham and M Jobes, 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 Modern Physics, A. Beiser, McGraw-Hill Book Company.

Paper III: Solid State Physics

Work Load*: *Two hours Lecture per week

Scheme of Examination: First question will be of ten marks comprising of five short answer type parts each with answer not exceeding half a page. Remaining four questions will be set with one question from each of the unit and will be of six marks each. Second to fifth question will have two parts namely (A) and (B) each carrying three marks. Part (A) of second to fifth question shall be compulsory and Part (B) of these questions will have internal choice.

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Unit I

Bonding in Solids and Crystal structure:

Force between atoms, Ionic 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, planes and miller indices in a crystal lattice, Reciprocal lattice and its significance, Conversion of SC and FCC structures in reciprocal lattice frame, Concept of crystalline, polycrystalline and amorphous materials, X-ray diffraction by solids: Laue and Braggs equation, Study of crystals by X-rays: FWHM, Sherrer formula and Lattice Constants (for simple cubic structure), Electron and Neutron diffraction (qualitative).

Unit II

Band theory of solids:

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

Semiconductors:

Energy band Structures in Insulators, Conductors, Semiconductors, Concept of Direct and Indirect band gap in semiconductors, Generation and recombination of charge carriers, Mobility of current carriers, Hall Effect in semiconductors: Hall coefficient, Mobility, Charge carrier concentration, Conductivity and Hall angle.

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, concept of Thermoelectric Power.

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Electrical Properties of Materials:

Drude-Lorentz theory, Sommerfeld's Model, Thermal conductivity, Electrical conductivity, Widemann-Franz relation, Thermionic Emission, Escape of electrons from metals, Hall Effect in Metals, Density of states.

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. Concept of Domain Wall, Magnetostriction, Heisenberg's Exchange Interaction, Relation between Exchange Integral and Weiss Constant.

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. Idea of BCS theory (No derivation); Cooper Pair and Coherence length. Josephson Effect (No derivation)

Reference Books

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