Department of Physics
Chaudhary Devi Lal University, Sirsa

(Established by the State Legislature Act.9 of 2003)

No. Physics/2023/2530 Dated: 08.05.2023

9/5/23

To

The Controller of Examinations,
Ch. Devi Lal University,
Sirsa

AR(SECY)
09/05/23

A-2

Sub: Regarding Post Graduate Admission in Academic Session 2023-24

Sir/Madam,

With reference to letter No. Acad./AC-1/101/2023/10245-10274 dated 03.05.2023 on the subject cited above to conduct the Entrance Test for M.Sc. Physics programme, please find the required information given is as under:

1. Please find attached authentic copy of syllabus for Entrance Test for Post Graduate programme (M.Sc. Physics) in English language.
2. Language of the Entrance Test is English only.
3. The Entrance Test will be multiple choice questions having 50 questions and 2 marks for each question. The time for Entrance Test will be 90 Minutes. There is no negative marking in the Entrance Test.
4. The Entrance Test syllabus should comprise of 50:30:20 (syllabi of Physics B.Sc. Part-III, II, I respectively) or as recommended by the Chairperson.

This is for your kind information and further necessary action.

08/05/23

CHAIRPERSON

Chairperson
Department of Physics
Ch. Devi Lal University
SIRSA-125055 (Haryana)

Copy to:

Copy of the above is forwarded to the following for information and necessary action:

1. Dean Academic Affairs, CDLU, Sirsa.
2. D.R. (Academic), CDLU, Sirsa.

SYLLABUS

K.U., Kurukshetra and C.D.L.U., Sirsa

B.Sc. I, Semester-I

PHYSICS : PH-101

Paper - I : Classical Mechanics and Theory of Relativity

Time : 3 Hours *Max. Marks : 40*
Internal Assessment : 10

Note :

1. *Nine Questions will be set in total.*
2. *Question No. 1 will be compulsory and will be based on the conceptual aspects of the entire syllabus. This question may have 5 parts and the answer should be in brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.*

UNIT-I

Basic Concepts of Classical Mechanics : Mechanics of single and systems of particles, Conservation law of linear momentum, Angular momentum and mechanical energy for a particle and a system of particles, Centre of mass and equation of motion, Constrained motion.

UNIT-II

Generalized Notations : Degrees of freedom and Generalized co-ordinates, Transformation equations, Generalized Displacement, Velocity, Acceleration, Momentum, Force and Potential, Hamilton's variational principle, Lagrange's equation of motion from Hamilton's principle, Linear harmonic oscillator, Simple pendulum, Atwood's machine.

UNIT-III

Theory of Relativity : Frame of reference, limitation of Newton's law of motion, Inertial frame of reference, Galilean transformation, Frame of reference with linear acceleration, Classical relativity-Galilean invariance, Transformation equation for a frame of reference inclined to an inertial frame and Rotating frame of reference, Non-inertial frames, The accelerated frame of reference and rotating frame of reference, Effect of centrifugal and Coriolis forces due to Earth's rotation, Fundamental frame of reference, Michelson-Morley's experiment, Concept of Einstein's relativity.

UNIT-IV

Applications of Theory of Relativity : Special theory of relativity, Lorentz coordinate and physical significance of Lorentz invariance, Length Contraction, Time Dilation, Twin Paradox, Velocity addition theorem, Variation of mass with velocity, Mass energy equivalence, Transformation of relativistic momentum and energy; relation between relativistic momentum and energy. Mass, velocity, momentum and energy of zero rest mass.

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SYLLABUS

K.U., Kurukshetra and C.D.L.U., Sirsa

B.Sc. I, Semester-I

PHYSICS : PH-102

Paper II : Electricity, Magnetism and Electromagnetic Theory

Time : 3 Hours

Max. Marks : 40

Internal Assessment : 10

Note :

1. *Nine Questions will be set in total.*
2. *Question No. 1 will be compulsory and will be based on the conceptual aspects of the entire syllabus. This question may have 5 parts and the answer should be in brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.*

UNIT-I

Vector Background and Electric Field : Gradient of a scalar and its physical significance, Line, Surface and Volume integral of a vector and their physical significance, Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss's divergence theorem, Stoke's theorem.

Derivation of field $\vec{E}$ from potential as gradient, Derivation of Laplace and Poisson equations. Electric flux, Gauss's Law, Mechanical force of charged surface, Energy per unit volume.

UNIT-II

Magnetism : Magnetic induction, Magnetic flux, Solenoidal nature of vector field of induction. Properties of $\vec{B}$ (i) $\vec{\nabla} \cdot \vec{B} = 0$ (ii) $\vec{\nabla} \times \vec{B} = \mu j$. Electronic theory of dia and para-magnetism, Domain theory of ferromagnetism (Langevins Theory). Cycle of magnetisation-Hysteresis loop (Energy dissipation, Hysteresis loss and importance of Hysteresis curve).

UNIT-III

Electromagnetism : Maxwell's equations and their derivations, Displacement current, Vector and scalar potentials, Boundary conditions at interface between two different media, Propagation of electromagnetic wave (basic idea, no derivation). Poynting vector and Poynting theorem.

UNIT-IV

A.C. Analysis : A.C. circuit analysis using complex variables with (a) Capacitance and resistance (CR), (b) Resistance and inductance (LR), (c) Capacitance and inductance (LC), (d) Capacitance, inductance and resistance (LCR). Series and parallel resonant circuit. Quality factor (sharpness of resonance).

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SYLLABUS

K.U., Kurukshetra and C.D.L.U., Sirsa

B.Sc. I, Semester-II

PHYSICS : PH-201

PAPER-III : PROPERTIES OF MATTER AND KINETIC THEORY OF GASES

Time : 3 Hours

Max. Marks : 40
Internal Assessment : 10

Note:

1. *Nine Questions will be set in total.*
2. *Question No. 1 will be compulsory and will be based on the conceptual aspects of the entire syllabus. This question may have 5 parts and the answer should be in brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.*
4. *20% numerical problems are to be set.*
5. *Use of scientific (non-programmable) calculator is allowed.*

UNIT-I

Moment of Inertia : Rotation of rigid body, Moment of inertia, Torque, Angular momentum, Kinetic energy of rotation. Theorem of perpendicular and parallel axes (with proof), Moment of inertia of solid sphere, hollow sphere, spherical shell, solid cylinder, hollow cylinder and solid bar of rectangular cross-section, Fly wheel, Moment of inertial of an irregular body, Acceleration of a body rolling down on an inclined plane.

UNIT-II

Elasticity : Elasticity, Stress and Strain, Hooke's law, Elastic constant and their relations, Poisson' ratio, Torsion of cylinder and twisting couple, Determination of coefficient of modulus of rigidity for the material of wire by Maxwell's needle, Bending of beam (Bending moment and its magnitude), Cantilever and Centrally loader beam beam, Determination of Young's modulus for the material of the beam and Elastic constants for the material of the wire by Searle's method.

UNIT-III

Kinetic Theory of Gases – I : Assumption of kinetic theory of gases, Pressure of an ideal gas (no derivation), Kinetic interpretation of temperature, Ideal gas equation, Degree of freedom, Law of equipartition of energy and its application for specific heat of gases, Real gases, Van der Waal's equation, Brownian motion (Qualitative).

UNIT-IV

Kinetic Theory of Gases – II : Maxwell's distribution of speed and velocities (derivation required), Experimental verification of Maxwell's law of speed distribution : Most probable speed, Average and r.m.s. speed, Mean free path, Transport of energy and momentum, Diffusion of gases.

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B.Sc. I, Semester-II

PHYSICS : PH-202

PAPER-IV : SEMI-CONDUCTOR DEVICES

Time : 3 Hours | Max. Marks : 40
Internal Assessment : 10

Note :

1. Nine Questions will be set in total.
2. Question No. 1 will be compulsory and will be based on the conceptual aspects of the entire syllabus. This question may have 5 parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT-I

Semicondutors : Energy bands in solids. Instrinsic and extrinsic semiconductors, carrier mobility and electrical resistivity of semiconductors. Hall effect p-n junction diode and their characteristics. Zener and Avalanche breakdown, Zener diode, Zener diode as a voltage regulator. Light emitting diodes (LED), Photoconduction in semiconductors, Photodiode, Solar cell, p-n junction as a rectifier, Half wave and full wave rectifiers (with derivation), Filters (series inductor, shunt capacitance, L-section or choke, π and R.C. filter circuits).

UNIT-II

Transistors : Junction transistors, Working of NPN and PNP transistors, Three configurations of transistor (C-B, C-E, C-C modes), Common base, Common emitter and common collector characteristics of transister, Constants of transistor and their relation, Advantages and disadvantages of C-E configuration. D.C. load line. Transistor biasing, various methods of transistor biasing and stablization.

UNIT-III

Transistor Amplifiers : Amplifiers, Classification of amplifiers, Common base and common emitter amplifiers, Coupling in amplifiers, Various methods of Coupling Resistance Capacitance (R-C) coupled amplifier (two stage, concept of band width, no derivation). Feed-back in amplifiers, Advantage of negative feedback, Emitter follower, Distortion in amplifiers.

UNIT-IV

Oscillators : Oscillators, Principle of oscillation, Classification of oscillators, Condition for self sustained oscillation : Barkhausen criterion for oscillations. Tuned collector common emitter oscillator. Hartley oscillator, C.R.O. (Principle and working).

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B.Sc. II, Semester-III

PHYSICS : PH-301

Computer Programming and Thermodynamics

Time : 3 Hours *Max. Mar*
Internal Assessmen

UNIT-1 : Computer Programming

Computer organization, Binary representation, Algorithm development, F Charts and their interpretation. FORTRAN Preliminaries : Integer and floating p arithmetic expression, built in functions, executable and non-executable statemer input and output statements, Formats, IF, DO and GO TO statements, Dimensi arrays, statement function and function subprogram.

UNIT-2 : Applications of FORTRAN Programming

Algorithm, Flow Chart and Programming for Print out of natural numbers, Rang of the set of given number, Ascending and descending order, Mean and standarc deviation, Least square fitting of curve, Roots of quadratic equation, Product of two matrices, Numerical integration (Trapezoidal rule and Simpson $\frac{1}{3}$ rule).

UNIT-3 : Thermodynamics – I

Thermodynamic system and Zeroth law of thermodynamics. First law of thermodynamics and its limitations, reversible and irreversible process. Second law of thermodynamics and its significance, Carnot theorem, Absolute scale of temperature, Absolute Zero and magnitude of each division on work scale and perfect gas scale, Joule's free expansion, Joule Thomson effect, Joule-Thomson (Porous plug) experiment, conclusions and explanation, analytical treatment of Joule Thomson effect. Entropy, calculations of entropy of reversible and irreversible process, T-S diagram, entropy of a perfect gas, Nernst heat law (third law of thermodynamics), Liquefaction of gases, (oxygen, air, hydrogen and helium), Solidification of He below 4K, Cooling by adiabtic demagnetization.

UNIT-4 : Thermodynamics – II

Derivation of Clausius-Clapeyron and Clausius latent heat equation and their significance, specific heat of saturated vapours, phase diagram and triple point of a substance, development of Maxwell thermodynamical relations. Thermodynamical functions : Internal energy (U), Helmholtz function (F), Enthalpy (H), Gibbs function (G) and the relations between them, derivation of Maxwell thermodynamical relations from thermodynamical functions. Applications of Maxwell relations : relations between two specific heats of gas. Derivation of Clausius-Clapeyron and Clausius equation, variation of intrinsic energy with volume for (i) perfect gas (ii) Vanderwall gas (iii) Solids and liquids, derivation of Stefans law, adiabatic compression and expansion of gas & deduction of theory of Joule Thomson effect.

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B.Sc. II, Semester-III

PHYSICS : PH-302

WAVE AND OPTICS-I

Time 3 Hours *Max. Marks : 40*

Internal Assessment : 10

Note :

1. *The syllabus is divided into 4 units. 9 Questions will be set.*
2. *Question No. 1 will be compulsory, it contains 6 parts (form all the four units) and answer should be in brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question from each unit. Questions 2-9 may contain two or more parts. All questions carry equal marks.*
4. *20% numerical problems are to be set.*
5. *Use of scientific (non-programmable) calculator is allowed.*

UNIT-1 : Interference I

Interference by Division of Wave front : Young's double slit experiment, Coherence, conditions of interference, Fresnel's biprism and its applications to determine the wavelength of sodium light and thickness of a mica sheet, Lloyd's mirror, Difference between Bi-prism and Lloyd mirror fringes, phase change on reflection.

UNIT-2 : Interference II

Interference by Division of Amplitude : Plane parallel thin film, production of colours in thin films, classification of fringes in films, Interference due to transmitted light and reflected light, wedge shaped film, Newton's rings, Interferometer : Michelson's interferometer and its applications to (*i*) Standardization of a meter (*ii*) determination of wave length.

UNIT-3 : Diffraction I

Fresnel's diffraction : Fresnel's assumptions and half period zones, rectilinear propagation of light, zone plate, diffraction at a straight edge, rectangular slit and circular aperture, diffraction due to a narrow slit and wire.

UNIT-4 : Diffraction II

Fraunhoffer diffraction : single-slit diffraction, double-slit diffraction, N-slit diffraction, plane transmission granting spectrum, dispersive power of grating, limit of resolution, Rayleigh's criterion, resolving power of telescope and a grating. Differences between prism and grating spectra.

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B.Sc. II, Semester-IV

PHYSICS : PH-401 (STATISTICAL PHYSICS)

Time : 3 Hours

Max. Marks : 40
Internal Assessment : 10

Note:

1. *The syllabus is divided into 4 units. Nine Questions will be set.*
2. *Question No. 1 will be compulsory, it contains 6 parts (from all the four units) and answer should be brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question from each unit.*
4. *Questions 2-9 may contain two or more parts. All questions carry equal marks.*
5. *20% numerical problems are to be set.*
6. *Use of Scientific (non-programmable) calculator is allowed.*

UNIT – I : Statistical Physics I : Microscopic and Macroscopic systems, events-mutually exclusive, dependent and independent. Probability, statistical probability, A priori probability and relation between them, probability theorems, some probability considerations, combinations possessing maximum probability, combination possessing minimum probability, Tossing of 2, 3 and any number of Coins, Permutations and combinations, distributions of N (for N = 2, 3, 4) distinguishable and indistinguishable particles in two boxes of equal size, Micro and Macro states, Thermodynamical probability, Constraints and Accessible states, Statistical fluctuations, general distribution of distinguishable particles in compartments of different sizes, Condition of equilibrium between two systems in thermal contact-β parameter, Entropy and Probability (Boltzmann's relation).

UNIT – II : Statistical Physics II : Postulates of statistical physics, Phase space, Division of Phase space into cells, three kinds of statistics, basic approach in three statistics. M.B. statistics applied to an ideal gas in equilibrium-energy distribution law (including evaluation of α and β), speed distribution law and velocity distribution law. Expression for average speed, r.m.s. speed, average velocity, r.m.s. velocity, most probable energy and mean energy for Maxwellian distribution.

UNIT – III : Quantum Statistics : Need for Quantum Statistics : Bose-Einstein energy distribution law, Application of B.E. statistics to Planck's radiation law B.E. gas, Degeneracy and B.E. Condensation, Fermi Dirac energy distribution law, F.D. gas and Degeneracy, Fermi energy and Fermi temperature, Fermi Dirac energy distribution law, Fermi Dirac gas and degeneracy, Fermi energy and Fermi temperature, Fermi Dirac energy distribution law for electron gas in metals, Zero point energy, Zero point pressure and average speed (at 0 K) of electron gas, Specific heat anomaly of metals and its solution. M.B. distribution as a limiting case of B.E. and F.D. distribution, Comparison of three statistics.

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UNIT – IV : Theory of Specific Heat of Solids : Dulong and Petit law. Derivation of Dulong and Petit law from classical physics. Specific heat at low temperature, Einstein theory of specific heat, Criticism of Einstein theory, Debye model of specific heat of solids, success and shortcomings of Debye theory, comparison of Einstein and Debye theories.

PHYSICS : PH-402

WAVE AND OPTICS-II

Max. Marks : 40

Internal Assessment : 10

Time : 3 Hours

Instructions : *Read from Paper - PH-401.*

UNIT – I

Polarization : Polarization by reflection, refraction and scattering, Malus Law, Phenomenon of double refraction, Huygen's wave theory of double refraction (Normal and oblique incidence), Analysis of polarized Light. Nicol prism, Quarter wave plate and half wave plate, production and detection of (*i*) Plane polarized light (*ii*) Circularly polarized light and (*iii*) Elliptically polarized light. Optical activity, Fresnel's theory of optical rotation, Specific rotation, Polarimeters (Half shade and Biquartz).

UNIT– II

Fourier Analysis : Fourier theorem and Fourier series, evaluation of Fourier coefficient, importance and limitations of Fourier theorem, even and odd functions, Fourier series of functions $f(x)$ between (*i*) 0 to $2pi$ (*ii*) - *pi* to *pi*, (*iii*) 0 to *pi*, (*iv*) – L to L, complex form of Fourier series, Application of Fourier theorem for analysis of complex waves : solution of triangular and rectangular waves, half and full wave rectifier output, Parseval identity for Fourier Series, Fourier integrals.

UNIT – III

Fourier Transforms : Fourier transforms and its properties, Application of Fourier transform (*i*) for evaluation of integrals, (*ii*) for solution of ordinary differential equations (*iii*) to the following functions :

1. $f(x) = e^{-x^2/2}$ 2. $f(x) = \begin{cases} 1 & , |X| < a \\ 0 & , |X| > a \end{cases}$

Geometrical Optics I : Matrix methods in paraxial optics, effects of translation and refraction, derivation of thin lens and thick lens formulae, unit plane, nodal planes, system of thin lenses

UNIT – IV

Geometrical Optics II : Chromatic, spherical, coma, astigmatism and distortion aberrations and their remedies.

Fibre Optics : Optical fibre, Critical angle of propagation, Mode of Propagation, Acceptance angle, Fractional refractive index change, Numerical aperture, Types of optics fibre, Normalized frequency, Pulse dispersion, Attenuation, Applications, Fibre optic Communication, Advantages.

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SYLLABUS

K.U., Kurukshetra and C.D.L.U., Sirsa

B.Sc. III, Semester-V

PHYSICS : PH-501

QUANTUM AND LASER PHYSICS

Time : 3 Hours | *Max. Marks* :
Internal Assessment :

Note :

1. *Nine questions will be set in total.*
2. *Question number 1 will be compulsory and will be based on the conceptu aspects of entire syllabus. This question may have five parts and the answ should be in brief but not in Yes/No.*
3. *Four more questions are to be attempted, selecting one question out of tu questions set from each unit. Each question may contain two or more par All questions will carry equal marks.*
4. *20% numerical problems are to be set.*
5. *Use of scientific (non-programmable) calculator is allowed.*

Unit I : Origin Quantum Physics (Experimental basis)

Overview, scale of quantum physics, boundary between classical an quantum phenomena, Photon, Photoelectric effect, Compton effect (theory an result), Frank-Hertz experiment, de-Broglie hypothesis. Davisson and Germe experiment, G.P. Thomson experiment. Phase velocity, group velocity and the relation. Heisenberg's uncertainty principle. Time energy and angula momentum, position uncertainty. Uncertainty principle from de Broglie wav (Wave-particle duality). Gamma Ray Microscope, Electron diffraction from a sli Derivation of 1-D time-dependent Schrodinger wave equation (subject to forc free particle). Time-independent Schrodinger wave equation, eigen values, eige functions, wave functions and its significance. Orthogonality and Normalizatio of function, concept of observer and operator. Expectation values of dynamic quantities, probability current density.

Unit II : Application of Schrodinger wave equation :

(*i*) Free particle in one-dimensional box (solution of Schrodinger wav equation, eigen functions, eigen values, quantization of energy an momentum, nodes and anti nodes, zero point energy).

(*ii*) One dimensional step potential $E > V_0$ (Reflection and Transmissio coefficient).

Chairperson

(iii) One dimensional step potential $E < V_0$ (penetration depth calculation).

(iv) One dimensional potential barrier, $E > V_0$ (Reflection and Transmission coefficient).

(v) One-dimensional potential barrier, $E < V_0$ (Penetration or Tunneling coefficient).

(vi) Solution of Schrodinger equation for harmonic oscillator (quantization of energy, Zero-point energy, wave equation for ground state and excited states).

Unit III : Laser Physics – I

Absorption and emission of radiation, Main features of a laser : Directionality, high intensity, high degree of coherence, spatial and temporal coherence, Einstein's coefficients and possibility of amplification, momentum transfer, life time of a level, kinetics of optical absorption (two and three level rate equation, Fuchbauer Landerburg formula), population inversion : A necessary condition for light amplification, resonance cavity, laser pumping, Threshold condition for laser emission, line broadening mechanism, homogeneous and inhomogeneous line broadening (natural, collision and Doppler broadening).

Unit IV : Laser Physics – II

He-Ne laser and RUBY laser (Principle, Construction and working), Optical properties of semiconductor, Semiconductor laser (Principle, Construction and working), Applications of lasers in the field of medicine and industry.

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B.Sc. III, Semester-V
PHYSICS : PH-502
NUCLEAR PHYSICS

Time : 3 Hours *Max. Marks*
Internal Assessment

Note :

1. *Nine questions will be set in total.*
2. *Question number 1 will be compulsory and will be based on the conceptu aspects of entire syllabus. This question may have five parts and the answe should be in brief but not in Yes / No.*
3. *Four more questions are to be attempted, selecting one question out of tw questions set from each unit. Each question may contain two or more part All questions will carry equal marks.*
4. *20% numerical problems are to be set.*
5. *Use of scientific (non-programmable) calculator is allowed.*

Unit I : Nuclear Structure and Properties of Nuclei

Nuclear composition (*p-e* and *p-n* hypothesis), Nuclear properties; Nuclear size spin, parity, statistics, magnetic dipole moment, quadrupole moment (shap concept). Determination of mass by Bain-Bridge, Bain-Bridge and Jordan mas spectrograph. Determination of charge by Mosley Law. Determination of size o nuclei by Rutherford Back Scattering, mass and binding energy, systematic o nuclear binding energy, nuclear stability.

Unit II : Nuclear Radiation decay Processes

Alpha-disintegration and its theory. Energetics of alpha-decay. Origin o continuous beta spectrum (neutrino hypothesis), types of beta-decay and energetics of beta-decay. Nature of gamma rays, Energetics of gamma rays.

Radiation interaction

Interaction of heavy charged particles (Alpha particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling o alpha particles. Geiger-Nuttal law. Interaction of light charged particle (Beta-particle), Energy loss of beta-particles (ionization), Range of electrons, absorption of beta-particles. Interaction of Gamma Ray; Passage of Gamma

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Department of Physics

radiations through matter (Photoelectric, Compton and pair production effect) electron-positron annihilation. Absorption of Gamma rays (Mass attenuation coefficient) and its application.

Unit III: Nuclear Accelerators

Linear accelerator, Tendem accelerator, Cyclotron and Betatron accelerators.

Nuclear Radiation Detectors

Gas filled counters; Ionization chamber, proportional counter, G.M. Counter (detailed study), Scintillation counter and semiconductor detector.

Unit IV : Nuclear reactions

Nuclear reactions, Elastic scattering, Inelastic scattering, Nuclear disintegration, Photonuclear reaction, Radiative capture, Direct reaction, Heavy ion reactions and spallation Reactions. Conservation laws, Q-value and reaction threshold.

Nuclear Reactors

Nuclear Reactors, General aspects of Reactor Design. Nuclear fission and fusion reactors, (Principle, construction, working and use).

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B.Sc.–III (Physics)

Semester–VI

Subject : Physics

PAPER – XI : Solid State and Nano Physics

Max. Marks : 45

Internal Assessment : 5

Time : 3 hours

NOTE :

1. Nine Questions will be set in total.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/No.
3. For more questions are to be attempted, selecting one question but of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT I : Crystal Structure–I

Crystalline and glassy forms, liquid crystals, crystal structure, [illegible]ficity, lattice and basis, crystal translational vectors and axes. Unit [illegible] and Primitive Cell, Winger Seitz primitive Cell, symmetry operations [illegible] two dimensional crystal, Bravais lattices in two and three dimensions. [illegible]stal planes and Miller indices, Interplaner spacing, Crystal structures of [illegible] Sulphide, Sodium Chloride and Diamond.

UNIT II : Crystal Structure–II

X-ray diffraction, Bragg's Law and experimental X-ray diffraction [illegible]ods. K-space and reciprocal lattice and its physical significance, [illegible]procal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c. [illegible] f.c.c.

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UNIT III : Superconductivity

Historical introduction, Survey of superconductivity, Super conducting systems, High Tc Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, London Theory and Pippards' equation, Classification of Superconductors (Type I and Type II), BCS Theory of Superconductivity, Flux quantization, Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of superconductors.

UNIT IV : Introduction to Nano Physics

Definition, Length scale, Importance of Nano-scale and technology, History of Nan-technology, Benefits and challenges in molecular manufacturing. Molecular assembler concept, Understanding advanced capabilities. Vision and objective of Nano-technology, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine.

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Syllabus

PAPER-XII : PH–602 : ATOMIC AND MOLECULAR SPECTROSCOPY

Max. Marks : 40
Internal Assessment : 10
Time : 3 hours

Note :–

1. Nine Questions will be set in total.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

UNIT–I : HISTORICAL BACKGROUND OF ATOMIC SPECTROSCOPY

Introduction of early observations, emission and absorption spectra, atomic spectra, wave number, spectrum of Hydrogen atom in Balmer series, Bohr atomic model (Bohr's postulates), spectra of Hydrogen atom, explanation of spectral series in Hydrogen atom, un-quantized states and continuous spectra, spectral series in absorption spectra, effect of nuclear motion on line spectra (correction of finite nuclear mass), variation in Rydberg constant due to finite mass, short comings of Bohr's theory, Wilson Sommerfeld quantization rule, de-Broglie interpretation of Bohr quantization law, Bohr's corresponding principle, Sommerfeld's extension of Bohr's model, Sommerfeld relativistic correction, Short comings of Bohr-Sommerfeld theory, Vector atom model; space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, transition probability and selection rules.

UNIT–II : VECTOR ATOM MODEL (SINGLE VALANCE ELECTRON)

Orbital magnetic dipole moment (Bohr magneton), behavior of magnetic dipole in external magnetic field; Larmor's precession and theorem.

Penetrating and non-penetrating orbits, Penetrating orbits on the classical model; Quantum defect, spin orbit interaction energy of the single valance electron, spin orbit interaction for penetrating and non-penetrating orbits, quantum mechanical

relativity correction, Hydrogen fine spectra, Main features of Alkali Spectra and their theoretical interpretation, term series and limits, Rydeburg-Ritze combination principle, Absorption spectra of Alkali atoms, observed doublet fine structure in the spectra of alkali metals and its Interpretation, Intensity rules for doublets, comparison of Alkali spectra and Hydrogen spectrum.

UNIT–III : VECTOR ATOM MODEL (TWO VALANCE ELECTRONS)

Essential features of spectra of Alkaline-earth elements, Vector model for two valance electron atom: application of spectra.

Coupling Schemes : LS or Russel – Saunders Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp, pd configuration), Lande interval rule, Pauli principal and periodic classification of the elements. Interaction energy in JJ Coupling (sp, pd configuration), equivalent and non-equivalent electrons, Two valance electron system-spectral terms of non-equivalent and equivalent electrons, comparison of spectral terms of L-S and J-J coupling. Hyperfine structure of spectral lines and its origin; isotope effect, nuclear spin.

UNIT–IV : ATOM IN EXTERNAL FIELD

Zeeman Effect (normal and Anomalous), Experimental set-up for studying Zeeman effect, Explanation of normal Zeeman effect (classical and quantum mechanical), Explanation of anomalous Zeeman effect (Lande g-factor), Zeeman pattern of D_1 and D_2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak field Stark effect of Hydrogen atom.

Molecular Physics

General Considerations, Electronic States of Diatomic Molecules, Rotational Spectra (Far IR and Microwave Region), Vibrational Spectra (IR Region), Rotator Model of Diatomic Molecule, Raman Effect, Electronic Spectra.

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