EWING CHRISTIAN COLLEGE, ALLAHABAD

(An Autonomous Constituent P.G.College of Allahabad University)

Lecture List of B.Sc. Part I

DEPARTMENT OF PHYSICS

SEMESTER 1 : PAPER I

Mechanics and Relativity **Max. Marks: 70 (60+10)**

Unit I: Vector and Gravitation

- Polar and axial vectors, Dot and Cross product of vectors; gradient of scalars, divergence and curl of vectors.
- Integral (line, surface, and volume) of vectors, Gauss and Stoke's theorem, Solenoid and Lamellar Vectors, Conservative and non-conservative forces.
- Hydro dynamical Equations (Conservation of mass, momentum and energy)
- Central forces and its characteristics, reduction of two body problem to one body problem, reduced mass.
- Motion under inverse square force, Communication Satellites

Unit II : Fundamental of Dynamics

- Centre of mass and centre of gravity, centre of mass and laboratory frame of references.
- Linear momentum, angular momentum, Kinetic energy, potential energy, mechanical energy & their conservation laws for a system of particles.
- Equation of rotational motion, moment and product of inertia, Inertia Tensor.

Unit III : Elasticity:

- Behaviors of loaded wire, Load & extension graph.
- Hook's Law, Elastic constants (Y, η K & σ) and relations among them.
- Torsion of cylinder, Angle of Twist and angle of Shear, Torsion rigidity.
- Bending of light beams, bending moment, Geometrical moment of Inertia, Cantilever.

Unit IV : Relativity

- Frame of Reference (Inertial and Non-inertial Frames of Reference), Events (Co-local, Simultaneous & Coincident)
- Galilean Transformation, Galilean Variant and Invariant, Michelson Morley Experiment and its significance.
- Postulates of special theory of relativity, Lorentz transfonnation, Length contraction, Time Dilation, Relativity of Simultaneity, Relativistic Velocity addition Theorem, Einstein's mass-energy equivalence relation, Variation of mass with velocity (qualitative), Aberration of stars, Relativistic Doppler effects.
- Fundamental equation of Relativistic Motion, Longitudinal and Transverse masses.

Books Recommended :

1. Mechanics - Saxena, Prasad Singh
2. Mechanics - J. K. Ghose
3. Mechanics - D.S. Mathur
4. Elements of Mechanics - J.C. Upadhyay

5. An Introduction to Mechanics - R. B. Singh

6. Introduction to special Relativity- Robert Resnick

7. Introduction to special Relativity- Bergmann

8. Relativistic Mechanics - Gupta & Prakash

9. Theory of Relativity - Ugarov

Semester I : Paper II

Oscillations and Network Analysis **Max. Marks: 70 (60+10)**

Unit I: Mechanical Oscillator

- Undamped oscillations and its characteristics, Electrical analogue of mechanical vibration, derivation of differential equation using energy consideration and its solution, motion of extended spring.
- Damped oscillations and its Characteristics, Derivation of differential equation using energy consideration and its solution, logarithmic decrement, Q factor and relaxation time.
- Forced vibrations and its examples, Differential equation and steady state solution, amplitude & velocity resonance, mechanical impedance.
- Power absorption & power dissipation, Quality factor and band width, Sharpness of Resonance.

Unit II: Transient Phenomenon

- Transient state and steady state, transient response of LR, CR, LCR and LC circuits.
- Theory of moving coil galvanometers (dead beat and ballistic), Critical resistance, Current and charge sensitivity, Applications to measurement of high resistance by leakage method.

Unit III : Alternating Current

- j-operator and phasor notation, Reactance, Impedance, Susceptance, Admittance, Instantaneous, peak, RMS, Average value of voltage and current, Form Factor.
- Wattful and Wattless current, Average power (active, reactive and apparent), Power factor.
- Phasor and vector diagram of CR, LR, LCR series and LCR parallel, LR in series and C in parallel circuit.
- Parallel and series resonance, Sharpness of resonance, Q-factor and bandwidth.

Unit IV : Network Analysis (For both AC & DC)

- T and Pi (TT) network and their equivalence.
- Kirchhoffs law, mesh and nodal analysis of electrical circuits (matrix and determinant method).
- Concept of constant current and constant Voltage sources, Thevenin theorem, Norton theorem, Maximum power transfer theorem.
- Balance and sensitivity conditions of DC and AC bridges, Maxwell, Wien's and Schering bridges .

Books Recommended :

1. Physics of Vibrations and waves - H. J. Pain
2. Physics of oscillations and waves - R. B. Singh
3. Waves and Oscillations - D.N. Tripathi
4. Waves and Oscillations - Dongre & Bhattacharya
5. Electrical Circuits and Introductory Eletronics - Vinod Prakash
6. Electricity and Magnetism - K. K. Tiwari
7. Electricity and Magnetism - D.C. Tayal
8. Fundamentals of Electricity and Magnetism - R.B. Singh & A.K. Shukla

Semester 2: Paper I

Thermal Physics **Max. Marks: 70 (60+10)**

Unit I: Fundamentals of Thermodynamics

- Thermodynamical Systems and Variables. Macroscopic, Microscopic, extensive and intensive variables.
- Theromodynamics equilibrium, equation of state and constraints, Zeroth law of thermodynamics and concept of Temperature.
- Point functions and path functions, Quasi-static and non-quasi static processes, reversible and irreversible processes, Internal Energy.
- First law of thermodynalllics (Statement Limitations and its application), degree of freedom, Atomic Heat ratio, P- V indicator diagram.

Unit II: Second law of Thermodynamics:

- Need of Second Law, Camot cycle (P- V and T -S Diagram), Carnot heat engine and refrigerators, Thermal Efficiency and coefficient of performance.
- Carnot theorem, Statements of Second law of thermodynamics, Absolute scale of temperature.
- Entropy (Need and Characteristics), Clausius Theorem and inequality, entropy change (Mixture, change of state and perfect gas).
- Available and non available energy, the principle of increase of entropy, Nernst heat Theorem.

Unit III: Thermodynamic Relations

- Thermodynamical Potentials, Maxwell's thermodynamical relations, TdS equations and their applications.
- Phase changes (First and Second order), Clausius-Clapeyron latent heat equations, Difference and ratio of specific heat capacities.
- Joule Expansion, Joule- Thomson Expansion and Comparison with adiabatic expansion.
- Energy equation, Joule Coefficients, Enthalpy equation, Joule-Kelvin Coefficient, Inversion Temperature.

Unit IV: Transfer of heat

- Steady and Variable states, Thermal Conductivity and Thermal Diffusitivity, Temperature gradients.
- Formation of ice layer, Fourier equation of heat, Periodic flow of heat (qualitative)
- Natural and forced convection (qualitative).
- Radiant energy, Kirchhoff law, Black body radiation and its Characteristics (qualitative).

Books Recommended :

1. Thermal Physics : B. K. Agarwal
2. Heat and Themodyamics - M. W. Zemansky
3. Tratise on Heat - M.N. Saha and B. N. Srivastava
4. Heat and Thermodynamics - B.L. Kulshrestha and R.P. Goyal
5. Heat - D.S. Mathur
6. Heat and Thermodynamics - Brijlal & N. Subrahmanyam
7. Termodynamics - Singhal, Prasad, Agarwal
8. Thermal Physics - Singh, Prasad, Saxena
9. Thermal Physics - Garg, Bansal, S. Ghosh
10. Thermodynamics - A.K. Saxena.

Semester 2: Paper II

Analog and Digital Electronics **Max. Marks: 70 (60+10)**

Unit I: Semi conducting devices I

- Band theory of solids, Semiconductor (intrinsic, extrinsic), Hall Effect.
- P-N Junction formation, Drift and diffusion motion in semi-conductor, charge depletion region and potential barrier. Forward and Reverse biasing Diode equation and diode characteristics, Breakdown mechanisms (Zener & Avalanche), Transition and storages capacitances.
- Zener diode and its characteristics, Regulated and non-regulated power supply Half wave, full wave and bridge rectifier and their mathematical analysis.
- Fourier series (Half wave, full wave and bridge rectifier), Filtering by RL, RC and LC circuits (only qualitative).

Unit II: Semi conducting devices II

- NPN and PNP transistors and their action. Thermal runways Characteristics and parameters in CE, CB and CC configuration of transistor.
- FET (construction, principle of operation, characteristics, parameters and applications), External and internal biasing.
- MOSFET (enhancement and depletion) modes. MOS and CMOS as switches.
- Storage and transition time. BJT as switch, Schottky diode and schottky transistor.

Unit III : Number system and Logic Gates

- Number Systems: (Decimal, binary, octal and hexadecimal numbers) and their interconversion. 1's and 2's Copmplements,

- Different types of codes (Excess-3 code, Grey code, ASCI code, EBCDIC code, Error code and BCD code)
- Primary gates (AND, OR, NOT), Universal gates (NAND NOR) and Exclusive gate (XOR, XNOR).
- Truth Table, Venn diagram, Boolean function and Switchin Circuits.

Unit IV: Combinational logic circuits

- De-Morgan's laws, Commutative laws associative· law distribution laws, Absorptive laws, Dual and complement o Boolean functions.
- SOP and POS, Minterms and Maxterm, Karnaugh's Mappin (For 2, 3 and 4 variables)
- Simplification of Boolean expression by Boolean laws and mapping.
- Combinational Logic circuits (Half adder, Full adder, Ha subtractor, Full subtractor).

Books Recommanded :

1. Integrated Electronics - J. Millman and C. Halkias
2. Electronic Principles - Albert Paul Maevino
3. Hand book of Electronics - Gupta and Kumar
4. Principles of Electronics - V. K. Metha
5. Solid State Devices and Circuits - Kshitiz and Singhals
6. Electronic Devices and Circuits - Allen Mottershead
7. Introductory circuit Analysis - Bolyested
8. Basic Electronics - Bhargava Kulshreshta & Gupta
9. Electronics - B. L. Thereja
10. Principles of Modern Physics - A.K. Saxena.

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Lecture List of B.Sc. Part II

DEPARTMENT OF PHYSICS

Semester - III
Paper I

Wave motion and Wave Optics **Max. Marks: 70 (60+10)**

Unit I: Wave motion

- Differential equation of wave motion, wave front, Plane progressive wave in fluid and stretched string, Displacement wave and pressure wave
- Intensity and energy transport in wave. Specific and acoustic impendence. Characteristic impedance. Reflection and transmission coefficient of amplitude and energy at joint of two media / strings.
- Principle of superposition. Stationary wave and its characteristics.SWR Fundamental frequency, harmonics and overtones. Mode of natural oscillation of stretched string.

Unit II: Interference

- Essential conditions for observation. Shape and visibilities of fringes, Division of Wavefront (Fresnel's Biprism, Lloyd's Single Mirror and Fresnel's Bimirror), achromatic Fringes.
- Division of Amplitude (Colour of thin Films, Newton's Rings, Michelson's Interferometer).

- Multiple Beam Interferometry (Fabry Perot Interferometer, L G Plate).

Unit III: Diffraction

- Fresnel class of Diffration (Half Period Zones, Zone Plate, Diffraction at a Straight Edge, Carn's Spiral, Circular aperture).
- Fraunhofer Class of Diffraction [Single Slit, Double Slit & Grating (Plane and Concave)].
- Rayleigh Criteria for Resolution, Resolving Power of Grating, Prism, Telescope and Microscope

Unit IV : Polarization

- Basics of Polarisation, Polarisation by reflection and refraction, Brewster's law, Double refraction (E & O rays) by uniaxial crystals, Huygens theory of double refraction, Law of Malus. Nicol Prism and dichroism.
- Retardation plate (Quarter and Half wave plates), Production and detection of plane, circularly and elliptically polarized light, Babinet Compensator.
- Optical rotation and Optical activity, Fresnel's theory of optical rotation, Half-shade and Biquartz polarimeters.

Books Recommended :

1. Waves & oscillations - Dongre & Bhattacharya
2. Waves & oscillations - H. J. Pain

3. Optics : A. K. Ghatak

4. Principles of optics : B. K. Mathur

5. Optics & atomic Physics : D.P. Khandelwal

Paper II

Geometrical and Quantum Optics **Max. Marks: 70(60+10)**

Unit 1: Co-axial system of lenses

- Cardinal Points of Coaxial System of Lenses (The matrix method for its analysis), Problems on Combination of thin Lenses,
- Eye-pieces (Ramsden and Huygen's), Aplanatic Points & its applications.

Unit 2 : Laser and Holography

- Coherence (Temporal and Spatial), stimulated and spontaneous emission, Einstein coefficient and their inter relationship.
- Pumping and population inversion, basic idea about laser, characteristics of laser light, Ruby, He-Ne laser & semiconductor laser and its applications.
- Theory of Holography (recording and reconstruction of hologram) & applications. Comparison with photography.

Unit 3: Fiber Optics :

- Principle of Fiber Optics, construction and material used in Fiber, Propagation of light in fibers, Advantages and

Disadvantages, numerical aperture and acceptance angle, Meridional and skew rays.

- Type of fibers (SIF, GIF, single and multimode), Fiber profile, Attenuation and Dispersion. Qualitative discussion of Coupler, Splices and connectors.

Unit 4: Photonics

- LED optical sources(Laser and LED)
- Photodiode, photo transistors and their characteristics, Detectors (PIN and Avalanche)
- Photoconductivity, solar cell (Principle, construction, characteristics, parameters and its applications).

Books Recommended :

1. Optics : A. K. Ghatak
2. Lasers : A. K. Ghatak
3. Principles of optics : B. K. Mathur
4. A text book of optics : Brijlal and Subramanyam
5. Optical Fibre : G. Keiser
6. Optics Fibre : J. M. Senior
7. Photonic Devices : S.M. Sze.

Semester 4
Paper I

Electromagnatism

Max. Marks: 70 (60+10)

Unit I: Electrostatics

Electric Flux

- Gauss law (Integral & differential form) and its application for linear cylindrical and spherical charge distributions. Electric flux, Laws of electrostatics.
- Electric field and potential gradient and their relationship. Electric field and potential due to a spherical charge distribution. Electrostatic potential energy and self energy.
- Dipole in uniform and non-uniform electric field, Electric field and potential due to an electric dipole at a point in Cartesian and polar coordinates.
- Capacity and Principal of Capacitor, Capacity of partially filled parallel plate, spherical plate and cylindrical plate capacitors.

Unit II: Magnetostatics

- Magnetic field due to current, magnetic force between current elements. Definition of $\vec{B}$ & $\vec{H}$, Biot- Savart law and its applications to straight, circular solenoidal & Toroidal current carrying conductors.
- Lorentz force, Cyclotron (Principle, construction, working, limitations and modifications)
- Ampere's circuital law and its applications (hollow and solid rods), Laws in magnetostatics.
- Vector potential and its expression due to a straight conductor and circular loop.

Unit III : Electromagnetic induction

- Magnetic flux, Faraday's law of electromagnetic induction (integral and differential form), induced voltage, current, charge and power.
- Self and mutual inductions, Reciprocity theorem and Neumanes' relation.
- Relation between self and mutual induction between two coils. Energy of coupled circuits.
- Transformer and its equivalent circuit, efficiency and voltage gain of ideal transformer. Transformer losses.

Unit IV : Dielectrics and Magnetic Materials

- Electric susceptibility, dielectric constants, dielectric strength, three electric vectors ($\vec{P}$, $\vec{E}$ & $\vec{D}$).
- Polarization, surface and volume charge density, Gauss' law in dielectrics.
- Magnetization and magnetization currents, magnetic susceptibility, relative and absolute permeability
- Three magnetic vectors ($\vec{M}$, $\vec{H}$ & $\vec{B}$), Curl of $\vec{M}$.

Books Recommended :

1. Electromagnetics : B. B. Laud
2. Electromagnetic Waves & Radiating Systems : Edward C. Jordan

   Keith G. Balmain

3. Schaum's Series : Joseph A. Edminister
(Theory & Problems of Electromegnetics)
4. Introduction to electrodynamics : David J. Griffiths.
5. Field wave Electromagnetics : David K. Cheng.

Paper II

Atomic Physics **Maximum Marks: 70 (60+10)**

Unit I: Optical and X-ray spectra

- Spectrum of hydrogen atom and effect of Nuclear Motion. Ground, excited and ionized energy states. Bohr's correspondence principle and Rydberg's constant, Excitation, resonance and ionization potentials, Binding energy and ionization energy
- Continuous and characteristic X-rays. Duane-Haunt law. Moseley law, Emission and absorption spectra, Hydrogen like atoms, Comparisons of optical spectra, and X-ray spectra.

Unit II: Atomic structure

- Need and statement of Vector atom model, Space quantization and concept of electron spin. Quantum Numbers, Stem & Gerlach experiment, Magnetic moment of atom, Bohrs magneton, Larmour precession and frequency,
- Spectral terms. Na D1 and D2 lines. Fine structure of Ha. lines, L-S and J-J coupling schemes for two valence electron, spectra of alkali and alkaline earth elements.

Unit III: Dualism in Nature

- Planck's quantum theory of radiation, and Einstein's Modifications. Photoelectric effect, Compton Effect, Non relativistic particles and relativistic particles.
- de-Broglie hypothesis, wave-particle duality, comparisons of matters wave , electromagnetic wave and mechanical wave, Davisson-Germer experiment, wave packets, uncertainty principle. Phase and group velocity.

Unit IV: Wave mechanics

- Need of Quantum mechanics, Schrodingers equation for wave mechanics, Max-Born and Schrondiger interpretation of wave function, Separation of variables, Probability density and equation of continuity, stationary states. Probability current density.
- Normalization, orthogonality, orthonormality and completeness of wave function, Dirac-Delta functions. Kronecker delta function. Applications of Schrodinger equation to Free particle, particle in a box, potential step, potential barrier(tunneling), potential well.

Books Recommended :

1. Concepts of Modern Physics : Arthur Beiser
2. Modern Physics : R. Murugeshan
3. Fundamental of Modern Physics : H. B. Lal
4. Fundamental of Modern Physics : Ashok Sharma & R. B. Singh
5. Quantum Mechanics : B. K. Agarwal

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Lecture List of B.Sc. Part III

DEPARTMENT OF PHYSICS

Semester - V

Paper I

Quantum Mechanics and Spectroscopy Max. Marks: 70 (60+10)

Unit I: Operator and its Algebra

- Non- degenerate and degenerate states, Normalizable and unnormalizable wave functions. Ehrenfest theorem, Hermitian operator & its properties, Comparison of wave mechanics and matrix mechanics.
- Commutation, anti commutation and non- commutation relations, Uncertainty principle, Simultaneous wavefunction, angular momentum in Cartesian and polar coordinates, Eigen values of L^2 & Lz, Raising and Lowering operator.

Unit II: Applications of Schrodinger's equation

- Potential step, potential barrier (tunneling) and potential well.
- Harmonic oscillator (Classical and quantum) values and eigen functions, Hermite polynomials, Zero point energy, Parity.
- Schrodinger equation for rotator with free axis and its series solution, Spherical harmonics.
- Schrodinger equation for H- atom, solution of R equation, theta equation and phi equation. Eigen function and Eigen value Degeneracy and quantum number. Comparison of Schrodinger model with Bohr's Model.

Unit III: Identical Particles and Perturbation

- Identical particles, Concept of Spin, Pauli matrices, Spin wave functions, Symmetric and anti-symmetric wave functions, Exchange degeneracy, Pauli exclusion principle.
- Time independent non-degenerate and degenerate first order and second order Perturbation corrections, Helium atom, Anharmonic oscillator, Zeeman Effect and Stark Effect.

Unit IV: Molecular Spectroscopy

- Types of Spectroscopy (Electronic, Rotational; Vibrational and pure vibrational). Energy and frequency of rotational spectra. Raman Effect, stokes and anti-stokes line, Fluorescence and Phosphorescence.
- Electronic Spectra: Frank-Condon Principle, electronic transition, singlet and triplet states, Hyperfine structure, Principles of NMR, ESR (Qualitative).

Books Recommended :

1. Quantum Mechanics : B. K. Agarwal
2. Quantum Mechanics : S. N. Srivastava
3. Quantum Mechanics : Schiff
4. Quantum Mechanics : Satya Prakash
5. Quantum Mechanics : Gupta, Kumar

Paper II

Advanced Electronics **Max. Marks: 60**

70 (60+10)

Unit I : Amplifier

- Eber's moll model for PNP and NPN transistors, saturation parameter condition for cut off, saturation and active mode.
- Hybrid paramters and their inter-relationship. Small Signal hybrid equivalent circuits, Voltage divider baising of transistor. AC and DC load lines.
- Amplification, Classification of amplifiers, Audio amplifier, RC Coupled amplifier, Analysis of Frequency (Low, Medium and high) Response Curve with the help of equivalent circuits. Voltage and Power gain. Negative and Positive feedback amplifiers.
- Operational Amplifier : Basics of Op-amp, input and output impedance, voltage gain, CMRR, inverting amplifiers, voltage follower.

Unit II : Oscillator

- Barkhausen Criteria for Sustained oscillation. Components of Oscillator and their functions. Hartley, Colpit's and Crystal controlled oscillators.
- Piezoelectric and Magnetostriction effects. Production, Detection and Properties of Ultrasonics. Block diagram of CRO and its applications.

Unit III : Communication

- Elements of Communication, Statement and need of Modulation, Three type of modulation (AM, FM and Phase), Circuit of Modulator, Frequency spectrum and power in typical AM Circuit.
- Statement and need of demodulation, Linear diode detector.

Unit IV : Digital Electronics

- Logic families : RTL, DTL and TTL gates, input and output characteristics, Fan-in, Fan-out, Noise Margin, Noise Immunity, Rise and Fall time.
- Integrated circuits : Introduction and comparison discrete circuits. Classfication (on the basis of constructions and operations), monolithic IC (Basic structure and fabrication of components)
- Sequential logic circuits : Introduction to sequential circuits (Flip flop, Counter register, Convertors etc.)

Integrated Electronics	:	Milman, Halkias
Digital Electronics	:	Taub, Schilling
Digital Electronics	:	R. P. Jain
Electronics	:	Sanjeev Gupta
Electrical Circuits and		
Introductory Electronics	:	Vinod Prakash
Foundation of Electronics	:	Anil Kr. Singh
An Illustration		Prem P. Singh

Paper - III

Statistical and Classical Mechanics **Max. Marks 70**
(60+10)

Unit - 1

- Phase space and its classifications, phase cell and energy states (Macro & Micro), Concept of Probability (ghermodynamical, A priori), and total postulates of statistical Mechanics, Denmsity distribution function, Liouvive's theorem, Ergodic hypothesis.
- Entropy and probability, partition function connection between statistical and thermodynamical properties, Gibb's Paradox, Sackur- Tetrode equation.
- Micro-Canonical, Gibb's Canonical and Grand-Canonical Ensembles and their' comparison.

Unit II : Distribution Laws

- Condition for applicability of Classical and quantum statistics, Classical distribution (Maxwell-Boltzmann), Quantum Distribution (Bose-Einstein and Fermi-Dirac), Comparison among M-B, B-E & F-D Distributions,
- Need and derivation of Planck's Law. Derivation of Wien's Law, Rayleigh-Jean's Law, Stefan's Law, Wien's displacement Law, Wiens constant, Stefan's law and constant from Planck's law, and Wien's constant. Ultraviolet catastrophe.
- Fermi Energy, Total energy and Electronic specific heat at absolute zero.

Unit III : Energy distribution

- Maxwell's derivation of speed (velocity) distribution, Root mean square (rms) velocity, Average velocity and Most Probable velocity, Graphical analysis of distribution.

- Mean free path, (Qualitative), Transport phenomenon (Viscosity, Thermal Conductivity and self diffusion of gases), Relationship among them.
- Non-renewable and renewable energy, Solar Energy, ,Wind Energy, Hydro-Electric energy, Geo-thermal energy and their applications.

Unit IV : Classical Mechanics

- Generalised Co-ordinates, Degrees of freedom, Constraints (holonomic and non-holonomic)
- D Alembert's principle, Lagrangian and Hamiltonion Formulations: Lagrange's equations & its application,Hamilton Equations & their applications.
- Calculus of Variations: Hamiltonian Principle, Eulers Lagrangian Equations and its applications.
- Canonical Transformation, generating functions, Poisson Bracketts & Lagranges's bracketts & their Applications.

Books Recommended :

1. Statistical Mechanics : Agarwal, Eisner
2. Thermal Physics : Kittel
3. Statistical Physics : Kittel
4. Classical Mechanics : Goldstein
5. Classical Mechanics : J. C. Upadhyay
6. Classical Mechanics : Gupta, Kumar

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Lecture List of B.Sc. Part III

DEPARTMENT OF PHYSICS

Sesmester VI

Paper I

Electromagnetic Theory and Nuclear Physics Max. Marks: 60

Unit I : Electromagnetic waves

- Maxwell's equations Statement, significance and their general plane wave solution in source free space and simple dielectrics, characteristics of electromagnetic waves, plane wave propagation in metals and plasma, elementary theory of dispersion.
- Poynting theorem and conservation of energy & momentum for a system of charge particles and electromagnetic fields, Maxwell stress tensor.

Unit II: Electromagnetic waves at boundary

- Boundary conditions at discontinuity, Fresnel's formula, Total internal reflection, Brewster's Law, degree of polarisation, metallic reflection, skin depth.

Unit III : Nuclear Energy

- Kinematics of nuclear reactions, artificial nuclear trammutaion, Mass defects, Packing fraction and Binding energy curve and explanation of nuclear fission and fusion.
- Nuclear Model (Liquid drop and shell model)..Semi-empirical binding energy formula, magic number, Bohr- wheeler model, meson (Yukawa) theory of nuclear forces.

Unit IV : Elementary Particles

- Classification of elementary particles on the basis of mass, spin and interactions. Particle and anti particle.

- Conservation laws. Elementary particle quantum number (Lapton number Bayron numbers, Iso-spin number, Hyper Charge Number and strange number), elementary ideas of quarks, field bosons.

Books Recommended :

1. Nuclear Physics : D C Tayal
2. Modern Physics : Arthur Beiser
3. Nuclear Physics : S. P. Khare
4. Modern Physics : S. P. Khare
5. Nuclear Physics: (S. N. Ghoshal)
6. Nuclear Physics : Evans
7. Fundamentals of Electricity and Magnetism : R. B. Singh, A.K. Shukla
8. Electromagnetic Theory : Ritz, Milford, Christy
9. Electromagnetics - B. B. Laud
10. Electromagnetic waves and Radiating Systems - Jordan, Balmain
11. Electromagnetic Theory : Griffiths
12. Feynman Lecture Series : Volume 2
13. Nuclear and Particle Physics : H. B. Lal, R. B. Singh

Semester 6: -Paper II

Solid State Physics **Max. Marks: 60**

Unit I: Crystal & its Structure

- The crystalline and amorphous state of solids. Liquid crystal and its characteristics (qualitative).
- Simple crystal structures (sc, fcc & bcc), Unit cells and Bravais lattice.
- Lattice, translational vector, reciprocal lattice, X-ray diffraction, Bragg's Law.

- Generalized Hook's Law for anisotropic body, elastic constants of cubic crystals.

Unit II: Band theory of Solids

- Need of quantum Free electron theory of metals, Sommerfeld-Fermi model, Band theory of solids, one dimensional motion of electron in a periodic potential (Bloch Theorem), Kronig-Penney model.
- Fermi surface, effective mass of charge carriers, Intrinsic carrier concentration in semiconductors. Hall Effect (qualitative).

Unit III: Lattice Vibrations

- Inter atomic force and classification of solids, lattice energy of ionic crystals, Vibration of monatomic and diatomic linear chains, acoustic and optical modes. phonons
- Thermal Capacity of Solids, Classical theory of Specific Heats (Dulong and Petite Law), Quantum Theory (Einstein theory and Debye Theory).

Unit IV: Magnetism and superconductivity :

- Comparison of dia magnetic and para magnetic materials: Curie law and Curie Wiess law.
- Qualitative discussion of ferromagnetism, anti ferromagnetism and ferrimagnetisms. Hysteresis loss and Hysteresis curve.
- Superconductivity and its characteristics. Magnetic Behaviour of superconductor, Meissner effect BCS theory (Qualitative), flux quantization, Josephson Effect, Quantum Hall effect, Types of superconductor & their applications.

Books Recommended :

1. Solid State Physics : C Kittel
2. Solid State Physics : A. J. Dekker
3. Solid State Physics : Puri, Babbar

4. Solid State Physics : Wahab
5. Numerical Problems on Solid State Physics, Narosa Pub.
6. Solid State Physics : Gupta & Kumar.

Semester 6 : Paper III

Mathematical Physics and Computational Physics **Max. Marks: 60**

Unit I : Differential Equation

- Legendre, Bessel, Hermite and Lagurres differential Equations, series solution and Polynomial, Generating function, Recurrence Relations (only relations & proof not needed), Orthogonality Conditions.

Unit II : Mathematical Functions

- Fourier Series, Fourier and Laplace Transform. Beta and Gamma function and tensor notation.

Unit III: Computer Programming

- Fundamental of Computer Programming, Computer Fundamentals, Basic of MATLAB, Working in Command window, display format, Useful commands for Managing variables, creating one and two dimensional array.

Unit IV: MATLAB

- Programming in MATLAB, Script Files, Function and Function Files, logical operators, Conditional statements, coding of Differential Equations and their three dimensional Plots.

Books Recommended :

1. Mathematical Physics : Arkin
2. Mathematical Physics : B.S. Rajput
3. Mathematical Physics : H. K. Das
4. Introduction to MATLAB : Rudra Pratap
5. Introduction to MATLAB : Amos