FIRST SEMESTER

PHYSICS G- 101

Mechanics & Thermodynamics.

Total Marks: 80 **Internal Assessment: 20**

The knowledge of the mechanical properties of the solid and the liquid state is essential for every student of physics. A good foundation of the concepts of mechanical and thermal properties of matter helps in better understanding of several other branches of modern physics. Thermal Physics is concerned with transformation of energy of one kind into another. Actually, relation of heat to other forms of energy such as magnetic, electrical, etc., also come under the scope of thermal physics.

Unit I: (No. of lectures 13: Marks 20)

Laws of conservation of linear momentum and angular momentum of a system of particles, torque, moment of inertia of a rigid body and its physical significance, radius of gyration, kinetic energy of rotation, theorems on moment of inertia, calculation of moment of inertia of uniform rectangular lamina, spherical shell and solid sphere.

Unit I I: (No of lectures 10: Marks 15)

Constraints and their types, D' Alembert' s principle, Lagrangian and its application, simple pendulum, symmetry and conservation laws, Hamiltonian on total energy.

Unit I I I: (No of Lectures 10: Marks 15)

Stress & strain, Young's modulus, Bulk modulus, modulus of rigidity, Poisson's ratio. Relation among the constants, work done in twisting a wire, Surface tension of a liquid, surface energy, excess pressure inside a curved surface, rise of liquid in a capillary tube.

Unit IV: (No. of Lectures 12: Marks 20)

Zeroth and first law of thermodynamics, adiabatic and isothermal changes, second law of dynamics, reversible and irreversible process, Carnot's engine, definition of entropy.

Unit V: (No. of Lectures 5: Marks 10)

Kirchhoff's law, Stefan- Boltzmann law, Spectral distribution, Wien's displacement law, Rayleigh-Jean's law and ultra violet catastrophe, Planck's hypothesis, Planck's black body distribution law.

Suggested Readings

For Units I, II. & III

1. Elements of Properties of matter. D. S. Mathur, S. Chand & Company Ltd.
2. Classical Mechanics ,H. Goldstein, Narosa Publishing House
3. Classical Mechanics, Gupta, Kumar and Sharma, Pragati Prakashan
4. Elements of Mechanics, Gupta, Prakash, Agarwal, Pragati Prakashan

For Units IV& V

1. Heat, Thermodynamics and Statistical Physics, Brijlal, N. Subrabmanyam

&P. S Hemne, S. Chand & Company Ltd

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PHYM-101

Mechanics and Properties of matter

Total Marks: 80 **Internal Assessment: 20**

Total No. of Lectures: 50

Unit- I: Newtonian mechanics (No of Lectures: 15) (Marks: 25)

Concept of frame of references (inertial and non inertial), transformation of space and time in Galilean Relativity, two- body problem, reduction of two-body problem to one body problem, angular momentum, angular momentum of a system of particles about their center – of-mass.

Unit- II: Forces and Collisions (No of Lectures: 10) (Marks 10)

Conservative force , central force , conservation of angular momentum , the inverse square law , Kepler's laws of planetary motion , gravitational field and potential , gravitational field and potential at a point due to a spherical shell and solid sphere .

Elastic and inelastic collisions, laboratory and center of mass reference frames, kinematics of elastic collisions.

Unit III; properties of matter (no. of lectures: 15) (Marks 20)

Equation of motion of rotating rigid bodies, moment of inertia, theorem on moment of inertia, calculation of moment of inertia of a circular lamina, a solid cylinder, a hollow sphere and a solid sphere, Elasticity, Young's modulus, Bulk modulus, Modulus of rigidity, Poisson's ratio, relation between the elastic constants, bending of beams, the cantilever, Surface tension, Pressure inside a curved surface, rise of a liquid in a capillary tube.

Unit IV: Classical Mechanics (No. of Lectures: 10) (Marks: 25)

Elements of classical mechanics, constrained motion, constraints, degrees of freedom, generalized coordinates, virtual work, D' Alembert's principle, Lagrange's equation of motion, simple harmonic oscillator and simple pendulum ,Accelerated frames and fictitious forces, rotating frames and Coriolis force, components of Coriolis force at any latitude when velocity is horizontal, deviation of freely falling bodies from the vertical, and the Foucault's pendulum.

Suggested readings:

1. Classical Mechanics, H. Goldstein, Narosa publishing House.
2. Classical Mechanics, Rana and Joag, Tata McGraw Hill.
3. Classical Mechanics, Gupta, Kumar and Sharma, Pragati Prakashan.
4. Elements of properties of Matter, D. S. Mathur, S. Chand and Company.
5. Mechanics, B. S. Agarwal

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SECOND SEMESTER

PHYM - 201

Thermal Physics and Waves and Oscillation

Total marks: 80 **Internal Assessment: 20**

Total No of Lectures: 50

Unit I: Kinetic theory of gases (No of lecturers: 15 Marks: 25)

Maxwell's law of distribution of velocities (derivation not required), law of equipartition of energy, mean free path, transport phenomena (viscosity, conduction and diffusion), Avogadro's no. – Experimental determination by the kinetic theory method, Brownian motion (theory of translational Brownian movement). Compressibility and expansion coefficient of gases, difference between ideal and real gases, Andrews experiment for carbon dioxide, Vander Waal's equation of state, critical constant and law of corresponding states.

Unit II: Thermodynamics (No of lecturers: 15 Marks: 25)

The zeroth law, indicator diagram, work done, first law of thermodynamics, entropy as a thermodynamic variable, entropy changes in reversible and irreversible processes, principle of increase of entropy, thermodynamic temperature, Clausius inequality.

Thermodynamic relationships: Maxwell's relations, Clausius- Clapeyrons equation and some simple application, and Joule- Thomson effect. Thermodynamic potential and its relation to thermodynamic variables.

Unit III: Black Body Radiation (No of lecturers: 8 Marks: 10)

Kirchhoff's law, Stefan- Boltzmann law, spectral distribution, Wien's displacement law, Wien's distribution law, Rayleigh- Jean's law and ultraviolet catastrophe, Planck's hypothesis, Planck's black body distribution law, pressure due to radiation.

Unit IV: Waves and Oscillations (No of lecturers: 12 Marks: 20)

Mechanical waves and its types, propagating waves and wave equation, particle velocity in a transverse wave, wave equation for a vibrating string, plucked string and struck string. Velocity of sound in gaseous media, dispersion relations Lissajou's figures, damped and forced vibration.

Suggested readings:

1. Thermal Physics, Garg, Bansal and Ghosh, Tata Mcgrow Hill
2. A Treatise on Heat, M. N. Saha and B. N. Shrivastava, Indian Press, Allahabad
3. Heat and Thermodynamics, A. W. Zemansky, Mcgrow Hill
4. University Physics, Hugh D, Young, Roger A, Freedman
5. Mathematical Physics, B. S. Rajput
6. Text book of Sound M. Ghosh

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PHYG-201

OPTICS

Total Marks: 56 **Internal Assessment: 14**

Unit I : (No of lecturers : 20 Marks : 25)

Refraction at spherical surfaces, thin lenses, combination of lenses, lenses in contact and separated by a distance, achromatic combination of lenses, spherical and chromatic aberration, eyepieces, telescopes and microscopes, Huygen's theory , reflection and refraction from curved surface, interference of light, Young's double slit experiment, Biprism.

Unit II : (No of lecturers : 10 Marks : 15)

Diffraction of light, Fresnel and Fraunhoffer diffraction, Zone plate, diffraction at a straight edge, single slit, double slit.

Unit III : (No of lecturers : 10 Marks : 16)

Polarization of light, production of polarized light, Brewster's law, double refraction, circular and elliptical polarization, analysis of polarized light, optical rotation.

Suggested readings:

1. Optics- A.B. Gupta, Books and Allied Ltd.
2. Optics- B.K. Mathur.
3. Optics- A.K. Ghatak Tata McGraw Hill.

PHYG-202

Physics Practical-I

Total Marks: 24

Internal assessment: 6

At least 75% of the experiments listed below are required to be performed by each student during the course. The examination should be on one experiment in 4 hrs.

List of experiments:

1. **To determine the acceleration due to gravity at your place with the help of a bar pendulum.**
2. **To determine surface tension of a liquid by Jaeger's method.**
3. **To determine the coefficient of viscosity of water by measuring the flow through a capillary tube.**
4. **To determine the magnetic moment of the given bar magnet.**
5. **To determine the value of horizontal intensity of earth's magnetic field at your place.**
6. **To verify the inverse square law of force in magnetism.**
7. **To determine the angle of the given prism with a spectrometer obtaining the angle of minimum deviation.**
8. **To draw the I-D curve using a spectrometer for two monochromatic radiations.**
9. **To convert a galvanometer in to an ammeter and a voltmeter.**
10. **To compare the emf of two cells using a potentiometer.**

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THIRD SEMESTER

PHYG-301

Electricity, Magnetism and Electromagnetic Theory

Total Marks: 80 **Internal assessment: 20**

Unit I : Electricity (No. of Lectures 20 : Marks 30)

Gauss's law and its application to calculation of fields due to hollow and solid sphere , energy density in electric field ,capacitance and dielectrics, RC-circuits, charging and discharging of a capacitor , time constants, AC through R ,C , and L , L-C- R circuits and resonance.

Unit II: Magnetism (No. of lectures 9: Marks 15)

Magnetic potential, field intensity, magnetic shell magnetic permeability, susceptibility,

Magnetization, magnetic intensity and their relation.

Unit III: Electromagnetic Theory (No. of Lectures 12: Marks 20)

Dielectric medium, displacement current, Biot-Savart law, Ampere's circuital law, vector potential, Maxwell's equations, Pointing vector, energy density in electromagnetic field, electromagnetic waves, Hertz experiments

Unit IV: (No. of lectures 9: Marks 15)

Equation 0f motion of a progressive wave, longitudinal and transverse wave, superposition of waves, standing waves, transverse waves on a string, velocity of sound in a medium(solid, liquid and gas), Doppler effect.

Suggested readings:

For unit I,II,& III

1. Fundamentals of Magnetic and Electricity, D. N. Basudeva,. S. Chand and Company
2. Electricity and Magnetism with Electromagnetic Theory and Special Theory of Relativity, D. Chattopadhyaya, Books and Allied, Kolkata.
3. Electromagnetic B.B Laud, New age International.

Unit IV

1. Waves and oscillations, N. Subrahmanyam, Vani Educational Books, New Delhi

2. Waves and oscillations, Gupta and Verma, ,. S. Chand and Company

PHYM-301

Optics

Total Marks: 60 **Internal Assessment: 15**

Total no. of Lectures: 40

Unit I: Geometrical optics (No. of lectures: 10) (Marks 15)

Aberrations: chromatic aberration, spherical aberration, methods of minimizing the defects of monochromatic images, coma, astigmatism and curvature of field, distortion, achromatic combination of lenses prism, eyepieces-Ramsden and Huygen's, use of different telescopes (Ray diagram for Galilean , Newtonian and Cassegrain telescopes)

Unit II: Interference (No. of lectures: 12) (Marks 24)

Concept of physical optics, coherent source, interference by division of wave fronts, Young's double slit experiment, interference with white light, displacement of fringes, Fresnel bi prism, Lloyd's mirror, Interference by division of amplitude: interference by a plane parallel film, the cosine law, non- reflecting films, expressions for the reflected wave, wedged shaped film, colour of thin films ,Newton's rings, Michelson interferometer ,application in the determination of closely spaced wavelengths, visibility of fringes, Jamin's and Fabry- perot interferometer.

Unit III: Diffraction (No. of lectures: 10 Marks: 10)

Fraunhoffer diffraction: single slit diffraction- circular and rectangular, two slit diffraction, N- slit diffraction, plane diffraction grating, resolving and dispersive power of a plane diffraction grating, secondary maxima.

Fresnel diffraction: Fresnel's integrals, Cornul's spiral, Fresnel diffraction pattern at a straight edge and at a slit, Fresnel's half period zones, zone plate

Unit IV: Polarization and Dispersion (No. of lectures: 8 Marks 11)

Polarization: production of polarized light, Brewster's law, Malus' law, double refraction, circular and elliptical polarization, analysis of polarized light, optical rotation, polarimeter, Dispersion: normal and anomalous dispersion.

Suggested readings:

1. Optics, A. K. Ghatak, Tata Mc-Graw Hill.
2. Optics, B. K. Mathur.
3. Optics. A.B. Gupta, Books and Allied Ltd.
4. Fundamentals of optics, Zenkins and White Tata McGraw- Hill

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PHYM-302

Electricity and Magnetism

Total Marks: 60 **Internal Assessment: 15**

Total No. of Lectures: 40

Unit I: Electrostatics (No. of Lectures: 12, Marks: 22)

Ideas of gradient, divergence and curl, Gauss's theorem, Stoke's theorem, Gauss's law in electrostatics' some applications (spherical shell and infinite sheet of charge) of gauss's law, Laplace.s equation and its application, capacity of various types of condensers- parallel plate, spherical and cylindrical; energy stored in parallel plate capacitor, dielectric- polarization and displacement vector, Clausius- Mosotti equation.

Unit II: Current electricity (No of Lectures: 10 ; Marks : 10)

Kirchhoff's law and its applications, moving coil and moving magnet galvanometers, dc bridges, Kelvin's double bridge, measurement of high resistance, measurement of very low emfs, thermoelectric effects, Seebeck effect, Peltier effect, Thomson effect, measurement of thermo emf, growth and decay of current in L-R, C-R and LCR circuit

Unit III: Magnetism (No. of Lectures: 8; Marks 11)

Magnetic field due to a circular current loop and solenoid, Gauss' theorem in magnetism and its applications, magnetic permeability and susceptibility, magnetization, magnetic intensity and their relation, dia-, para-, ferromagnetism.

Unit IV: Electromagnetic Induction. (No. of Lectures: 10 ; Marks 17)

Electromagnetic induction, Faraday's law and Lenz's law, self and mutual inductance, methods of measuements.

AC and DC generators and motors, transformer, relation between maximum, average and virtual or effective (rms) values of current, AC through resistance(R), inductance (L) and capacitance (C) , AC through RL, RC and LCR circuits, phasor diagrams, measurements of self inductance by Anderson's bridge, measurements of mutual inductance by ballistic galvanometer, Power in AC circuits.

Suggested readings:

1. Fundamentals of Magnetism and Electricity, D. N. Basudeva, S. Chand and Company.
2. Electricity and Magnetism, Khere and Shrivastava, Atmaram and Sons.
3. Electricity and Magnetism, D.C. Tayal, Himalaya Publication.
4. Electricity and Magnetism, Brijlal and Subramanyam, S. Chand.

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PHYM- 303

Laboratory

Total Marks: 40 **Internal Assessment : 10**

At least 75% of the experiments listed below are required to be performed by each student during the course. The examination should be on one experiment in 6 hrs.

List of experiments:

M I. Determine the value of g with the help of Kater's reversible pendulum. Obtain true length and time period of the equivalent simple pendulum with the help of graphical plot of distance between knife edges and the time periods

M II. To determine Young's modulus of a material in the form of a rectangular beam by bending. Show graphically that the depression is directly proportional to the cube of its length.

M III: To determine the surface tension of a liquid by capillary tube method and to verify Jurin's law graphically.

MIV. To determine coefficient of viscosity of water by capillary flow method.

MV. To draw the I-D curve using a spectrometer and hence determine the refractive index of the prism used.

MVI. To determine the wavelength of the monochromatic radiation using Newton's ring method.

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FOURTH SEMESTER

PHYG- 401

Quantum Mechanics & Mathematical Physics

Total Marks: 56 **Internal Assessment: 14**

Unit I (No. of Lectures 12: Marks 16)

Inadequacy of classical physics, wave particle duality of matter, de-Broglie hypothesis, experimental verification of wave nature of particle (Davision –Germer experiment), Heisenberg's uncertainty principle with examples, gamma ray experiment, Bohr's complimentary principle.

Unit II: (No. of lectures 12: Marks 16)

Schrodinger's equation, interpretation of wave function, probability density and probability current density, concept of wave packet, expectation values of physical variables, operators, particle in a one- dimensional box.

Unit III: (No. of Lectures 10: Marks 14)

Scalar and vector fields, Gradient of scalar field, Divergence of a vector field, curl of a vector field, idea of line, surface and volume integration, Gauss' and Stokes' theorems.

Unit IV: (No. of Lectures 10: Marks 10)

Classifications of differential equations, Variables are separable, homogeneous equations, linear equations, simple cases of ordinary differential equation of second order.

Suggested Readings:

For Units I& II

1. Quantum Mechanics: G. Aruldhas, Prentice Hall of India.
2. Quantum Mechanics : S. P. Kuila,New Central Book Agency P Ltd.
3. Quantum Mechanics: A. K. Ghatak and S Lokanathan, Mc Graw Hill.

For Units III & IV

1. Mathematical Physics , B S Rajput, Pragati Prakashan.

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PHY G- 402

Physics Practical II

Total Marks: 24 **Internal Assessment: 6**

At least 75% of the experiments listed below are required to be performed by each student during the course. The examination should be on one experiment in 4 hrs.

List of experiments:

1. **To determine the wave length of a monochromatic radiation using Newton's ring.**
2. **To determine the thermal conductivity of a metallic rod by Searle's method.**
3. **To determine the resistance of a galvanometer by half deflection method.**
4. **To determine the current in an external circuit by potential drop method using a potentiometer.**
5. **To study the static characteristics of a junction transistor in common emitter configuration.**
6. **To study a junction diode as a rectifier and to draw the I-V characteristics**
7. **To determine the ratio of two specific heats of a gas by Clement and Desorme's method.**
8. **To determine the moment of inertia of a given body about an axis passing through its center of gravity by the torsional oscillation method.**
9. **To determine the angular magnifying power of a telescope.**

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PHYM- 401

Mathematical Physics I

Total Marks: 60 **Internal Assessment: 15**

Total No. Of Lectures: 40

Unit I: Vector calculus (No. of Lectures:13 Marks: 22)

Scalar and vector fields, differentiation of a vector with respect to a scalar, unit tangent vector, normal vector.

Derivatives of vectors: gradient of a scalar, flux of a vector field, divergence and curl of a vector field, ideas of line, surface and volume integration, Gauss's Stoke' s Laplacian in Cartesian, spherical and cylindrical co-ordinate system.

Unit II: Tensor Algebra (No. of Lectures: 7; Marks: 10)

Introduction, transformation of Coordinates, scalars, contravarient vector, covariant vector, transformation rules for tensor of arbitrary rank (Contravarient and covariant), symmetric and antisymmetric tensors, contraction, Kronecker Delta, Levi- Civita tensor.

Unit III: Matrices (No. of Lectures: 8; Marks: 17)

Definition, types of matrices, transformation of matrices, characteristic equation, solution of inhomogeneous linear equations, eigen values and eigen vectors, diagonalization of matrices.

Unit IV: Calculus of variation (No. of Lectures: 12 ; Marks: 11)

Variational principle, Euler- Lagrange equation, geodesics on a plane, cylindrical and spherical surface, Brachiostochrone problem, constrained maxima and minima, method of Lagrange undetermined multipliers and its application to one or two simple problems (e. g. the isoperimetric problem)

Suggested readings:

1. Mathematical Physics B. D. Gupta Vikash Publishing House
2. Mathematical Physics B. S. Rajput Pragati Prakashan
3. Essentials of mathematical methods for physicists

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PHYM- 402

Quantum Mechanics

Total Marks: 60 **Internal Assessment: 15**

Total no of Lectures: 40

Unit I: Introduction (No. of Lectures: 14 Marks: 22)

Inadequacies of classical physics, Planck's quantum hypothesis, wave particle duality, photoelectric effect, Compton effect, de – Broglie hypothesis, phase and group velocity of de-Broglie waves, experimental verification of de- Broglie hypothesis, (Davison- Germer experiment),Bohr's complementary Principle, Young's double slit experiment- electron interference, Heisenberg's uncertainty principle, gamma ray microscope experiment to illustrate the uncertainty principle.

Unit II: Wave equation (No. of Lectures: 13 Marks: 22)

Schrodinger's equation for a free particle and for a particle in a field, physical interpretation of the wave function, equation of continuity and probability current density ,separation of Schrodinger's equation into space and time parts, time independent Schrodinger's equation, stationary states, Applications of Schrodinger's equation to simple problems: 1) free particle, 2) particle in a one- dimensional box with rigid walls, 3) step potential, calculation of transmission and reflection coefficients.

Unit III: Operator formalism (Introduction) (No. of Lectures: 13 Marks:16)

Operators in Quantum mechanics, Linear, Hermitian and unitary operators, eigen values and eigen functions of an operator, orthonormality of eigenfunctions of a hermitian operator, expectation values of an observable, Ehrenfest's theorem.

Suggested readings:

1. Quantum Mechanics P. M. Mathews & K. venkateshan Tata McGraw Hill.
2. Quantum Mechanics A. K. Ghatak McMillan
3. Quantum Mechanics V. Thankappan New Age International
4. Principles of Quantum Mechanics S. P. Kuila New Central Book Agency P Ltd.
5. Quantum Mechanics G. Aruldhas, Prentice Hall Of India
6. Advanced Quantum Mechanics

PHYM-403

Physics Practical

Total Marks: 40 **Internal Assessment:10**

List of experiments:

1. **Verification of the laws of transverse vibrations of a string by Melde's Experiment.**
2. **To determine the Cauchy's constants**
3. **To determine the modulus of rigidity of a given specimen by Static method.**
4. **To determine the modulus of rigidity of a given specimen by Maxwell's needle method.**
5. **To measure the width of a double slit by diffraction of monochromatic radiation and verify the result by microscopic measurement.**
6. **To determine the wavelength of the given monochromatic radiation using a Biprism /Lloyd's mirror.**

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FIFTH SEMESTER

PHYM-501

Mathematical Physics- II

Total Marks: 60 **Internal Assessment: 15**

Total No. of Lectures: 40

Unit 1: Differential equations and special functions (No .of Lectures: 15: Marks:29)

Classification of differential equations, homogeneous and non- homogeneous equations, solution in simple cases of ordinary differential equation s of second order, linear differential equations with constant and variable coefficients, Forbenius' method.

Special functions: Legendre's polynomials, beta, gamma and error functions and their inter relations.

Unit II: Complex variables (No .of Lectures: 15: Marks 15)

Graphical representation of complex numbers, functions of complex variables, limit and continuity, analytic functions, Cauchy- Riemann conditions and applications, singularities, contour integration, Cauchy's theorem, Cauchy's integral formula, Taylor's and Laurent's expansion, residue theorem and its applications in evaluation of integrals.

Unit III: Fourier series (No .of Lectures: 10: Marks: 16)

Fourier series: Fourier sine and cosine series, determination of coefficients, applications to analysis of saw tooth and square waves

Suggested readings:

1. Mathematical Physics. B. D. Gupta; Vikash Publishing House
2. Mathematical Physics B. S. Rajput. Pragati Prakashan
3. Complex Variables M. Spiegel. McGraw Hill.
4. Mathematical Physics H. K. Dass &Rama Verma S. Chand & Company.
5. Applied Mathematics for Engineers and Physicists. L. A. Pipes and L. R. Harvill, McGraw Hill.
6. Mathematical methods for Physicists, G. B. Arfken, H. J. Weber Academic Press.

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PHYM-502

Electrodynamics and Special Relativity

Total Marks: 60 **Internal Assessment: 15**

Total No. of Lectures: 40

Unit I: Electromagnetic fields (No. of Lectures: 15 ; Marks: 24)

Electromagnetic induction, displacement current, Maxwell's field equations and their interpretations (integral and differential forms), electromagnetic potentials (scalar and vector potential), Derivation of Maxwell's wave equations, waves in free space, relation between wave vector an fields, Lorentz and Coulomb gauge, field energy and field momentum (Poynting vector and Poynting theorem), Radiation from accelerated charge, radiation from electric dipole.

Unit II: Propagation of electromagnetic waves (No. of Lectures: 10; Marks: 20)

Plane wave in non- conducting media, polarization, plane waves in a conducting medium, skin effect, Boundary conditions, Reflection and refraction of a plane wave at a plane interface (normal and oblique incidence) between two dielectrics, Fresnel's formula, total internal reflection, Brewster's angle.

Unit III: Special Relativity (**No. of Lectures: 15 ; Marks:16)**

Problem of absolute motion in classical physics, Ether hypothesis, nullity of ether hypothesis, Michelson- Morley experiment, Einstein's postulates of special relativity, Lorentz transformation, length contraction, time dilation, twin paradox, relativistic mass, mass energy relation.

Suggested readings:

1. Introduction to Electrodynamics D. J. Griffiths'. Pearson Education.
2. Electromagnetics; B. B. Laud. New Age International.
3. Electromagnetic Waves and Radiating Systems. Jordan and Balmain, Prentice Hall of India.
4. Mathematical Physics, B. S. Rajput, Pragati Prakashan.
5. Modern Physics, A. Beiser, Tata McGraw Hill.
6. Introduction to Classical Mechanics, R. G. Takwale and P. S. Puranik; , Tata McGraw Hill
7. Classical Mechanics, H. Goldstein, Narosa Publishing House.

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PHYM-503

Atomic and Molecular Physics

Total Marks: 60 **Internal Assessment: 15**

Total No. of Lectures: 40

Unit I. Quantum Theory of Atoms (No. of Lectures: 15: Marks: 24)

Background of Quantum Theory: Bohr's model of the hydrogen atom, origin of spectral lines, Bohr's correspondence Principle, Somerfield's atom model, designation of spectral term symbol.

Vector atom model, space quantization, Larmor precession, the four quantum numbers, spectral terms arising from L- S coupling and J-J coupling, selections rules

Unit II: Fine structure of atoms: (No. of Lectures: 11: Marks: 15)

Fine structure of hydrogen spectra, doublet spectra of Na atom, Gyromagnetic ratio for orbital and spin motion, Lande's g' factor, strong and weak field effects, Zeeman effect (normal and anomalous), qualitative ideas of Stark effect.

Unit III: **Molecular Spectra and Lasers (No of Lectures: 14) (Marks: 21)**

Molecular spectra: Pure rotation spectra, theory of pure rotation spectra, selections rules, vibration spectra and selection rules, theory of rotation- vibration spectra, P and R branches, Rayleigh and Raman scattering, Raman effect, classical theory of Raman effect, Introduction to Lasers; Spontaneous and stimulated emission, Einstein's A & B coefficients, qualitative ideas of Ammonia beam maser, ruby laser, He- Ne laser.

Suggested readings:

1. Atomic Physics; J. B. Rajam; S. Chand & company.
2. Fundamentals of Molecular Spectroscopy; Banwell and McCash, Tata McGraw Hill
3. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice Hall of India.

Additional references:

1. Atomic spectra. H. E. White, McGraw Hill
2. Modern physics, G. Aruldhas and P. Rajagopal; Prentice Hall of India

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PHYM- 504

Electronics

Total marks: 60 **Internal Assessment: 15**

Total No. of Lectures: 40

Unit I: Semiconductors (No. of Lectures: 13; Marks: 20)

Charged particles, electronic structure of elements, energy band theory of crystals, conductors, semiconductors and insulators, electrons and holes in semiconductor, donor and acceptor impurity, generation and recombination of charge, diffusion, continuity equation, Junction diode characteristics; the open circuited P- N junction, I- V characteristic of P-N diode, breakdown diodes, diode as a rectifier, half- wave and full- wave rectifier with resistance load, ripple factor, smoothing filters, DC power supply.

Unit II: Transistor and amplifiers (No. of Lectures: 10; Marks: 15)

Transistors; NPN and PNP transistors, transistor action, common emitter, common base and common collector connections, transistor biasing (fixed bias, base resistor, voltage divider) and thermal stabilization, amplifier equivalent circuits, hybrid parameters, small signal transistor voltage amplifier, RC coupled, LC coupled amplifier, power amplifier (class A and class B), distortion in amplifier, amplifier with negative feedback, effect of negative feedback on gain, output impedance and distortions.

Unit II1: Oscillators and integrated circuits (No. of Lectures: 8; Marks: 12)

Oscillators: transistor as sinusoidal oscillator, Barkhausen criterion, tuned collector, Hartley, RC, Wein Bridge and crystal oscillator.

Integrated circuit: basic ideas, differential amplifier, operational amplifiers, common mode rejection ratio, inverting, non- inverting, basic mathematical operations- addition, differentiation, integration.

Unit IV: Digital electronics (No. of Lectures: 9 Marks: 13)

Logic gates: binary numbers, decimal to binary and binary to decimal conversion, Logic gates and their realization by PN diodes and transistor, half adder, full adder, NAND, NOR and XOR gates, Boolean algebra, de Morgan's theorem and its applications, K- maps.

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PHYM-505

Physics Laboratory

Total Marks: 80 **Internal Assessment: 20**

List of experiments:

MI **Determination of thermal conductivity of a material by Searle's method.**

MII Determine the ratio of two specific heats of a gas by Clement and Desorme's method.

MIII Determine the boiling point of the given liquid using platinum resistance thermometer.

MIV Determine the melting point of a solid by means of a thermocouple.

MV Determine the constant of a given ballistic galvanometer by passing a steady current through it.

MVI Determine the E. C. E. of copper (using a potentiometer).

MVII: To find the optical rotation produced by solution of the given optically active substance at different concentrations with the help of a polarimeter. Hence to determine the specific rotation and the unknown concentration of the given solution.

MVIII To measure the self induction of a given solenoid using Anderson's bridge method and compare the result with theoretical result.

MIX To study a series and parallel resonant circuit and to determine the Q- factor.

MX To study half wave and full wave rectifier and to determine the ripple factor.

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PHYG- 501

Atomic and Nuclear Physics

Total Marks: 80 **Internal Assessments: 20**

UNIT I: (No. of Lectures 18: Marks 30)

Cathode rays, Franck- Hertz experiment, determination of e/m by Thomson's Method, Millikan's oil-drop experiment, Production and properties of X-rays, Characteristic and continuous X- ray spectrum, Photoelectric effect and its properties, Einstein's photoelectric equation, determination of Planck's

UNIT II: (No. of Lectures 14: Marks 20)

Bohr atom model, Origin of spectral lines, Bohr's Correspondence principle, Somerfield's relativistic atom model, designation of spectral term symbol, Atomic spectra, atomic transition and origin of spectral lines, fine structure, L- S Coupling, j- j Coupling, Zeeman effect, Stark effect.

UNIT III: (No. of Lectures 18: Marks 30)

Qualitative introduction to the nature of nuclear forces, Bohr- Wheeler theory, energy released in fission, liquid drop model of the nucleus, Nuclear reactions and cross- sections, induced radioactivity, nuclear fission and fusion, Accelerators: Van- de- Graff generator, linear accelerator, cyclotron.

Suggested Readings:

1. Atomic Physics: J. B. Rajom, S Chand & Company Ltd.
2. Nuclear Physics; D. C. Tayal, Himalaya Publishing House.
3. Atomic and Nuclear Physics: S Chand & Company Ltd.

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SIXTH SEMESTER

PHYM - 601

Statistical Mechanics

Total Marks: 60 **Internal Assessments: 15**

Total No. of Lectures: 40

Unit I: Classical statistical physics (No. of Lectures: 10) (Marks: 15)

Postulates of classical statistical mechanics, phase space, Liouville's theorem, Ensembles: micro canonical, canonical and grand canonical, Maxwell-Boltzmann (MB) distribution laws, thermodynamic interpretation of the Lagrange's undetermined multiplier appearing in the distribution laws.

Unit II: Entropy and partition function (**No. of Lectures: 8) (Marks: 10)**

Statistical definition of entropy, Boltzmann relation between entropy and probability, Equilibrium condition, Partition function, thermodynamic variables in terms of partition function, calculation of partition function for an ideal monatomic gas.

Unit III: Quantum statistical physics (No. of Lectures: 10) (Marks: 24)

Limitation of Maxwell- Boltzmann distribution law, basic postulates of quantum statistical mechanics, classical limit symmetry of wave function of two particles, distribution laws for distinguishable and un distinguishable particles, Fermi-Dirac(FD) and Bose-Einstein(BE) distribution functions, reduction of FD and BE statistics to MB statistics.

Unit IV: Application of quantum statistical mechanics (No. of Lectures: 12) (Marks: 11)

Application of Bose- Einstein distribution law to an ideal Bose gas, photons as an ideal Bose gas, derivation of Planck's law of black body radiation and Stefan's law, Bose- Einstein condensation, application of Fermi-Dirac statistical to white dwarf stars, Chandrasekhar limit.

Suggested readings:

1. Statistical Mechhanics
   K. M. Khanna, Today and Tomorrow, New Delhi
2. Statistical Mechhanics
   R. K. Patharia, Butterwork Heinemann
3. Statistical Mechhanics
   K. Huang, John Wiley and Sons
4. Statistical Mechhanics
   B. K. AgarwaL, M. Eisner, New Age International Publishers.
5. Fundamentals of Statistical Mechanics, B. B. Laud,
   New Age International Publishers.

6. A Primer of Statistical Mechanics
R. B. Singh, New Age International Publishers.

PHYM - 602

Condensed Matter Physics

Total Marks: 60 **Internal Assessments: 15**

Total No. of Lectures: 40

Unit I: Crystal structure (No. of Lectures: 13) (Marks: 20)

Crystal structure, idea of a lattice, unit cell, Bravaic' lattice, primitive lattice vectors, translational lattice, Wigner – Seitz cell, Miller indices, some simple crystal structures (sc, bcc, fcc, hcp, diamond, zink blend, NaCl, CsCl structure).

X-ray diffraction, Bragg's equation, reciprocal lattice for sc, bcc and fcc lattice, concept of Brillouin zone, lattice energy of ionic crystals, Born's theory, Madelung constant.

Unit II: Properties of solids (No. of Lectures: 12) (Marks: 24)

Electrical and thermal conductivity of metals from classical free electron theory, Ohm's law, Wiedemann – Franz's law , free electron Fermi gas, electron gas in one dimension and three dimensions, density of states, E-k diagram, Fermi – Dirac distribution and Fermi level of energy.

Band theory of solids, formation of bands in a solid, classification of solids into metal, insulator and semiconductor, crystal potential due to periodic array of atoms, one dimensional bloch theorem, Kronig- Penney model (qualitative idea only), important conclusions from the model, energy band diagram in reduced zone representation, effective mass.

Unit II: Semiconductor materials and Superconductivity (No. of Lectures: 15) (Marks: 16)

Semiconductor materials, intrinsic and extrinsic superconductors, carrier concentration in an intrinsic and extrinsic semiconductor (qualitative idea only), conductivity in semiconductor in terms of mobility.

Superconductivity: electrical and magnetic properties in the superconducting state, Meisner effect, type I and type II superconductors.

Suggested readings:

1. Solid State Physics, A. J. Dekker, McMillan

2. Solid State Physics, C. Kittel, John Wiley and Sons

3. Elementary Solid State Physics, M. Ali Omar, Pearson Education

4. Solid State Physics, S. O. Pillai, New Age International

5. Introduction to Condenced Matter Physics, K. C. Barua, Narosa Publishind House Pvt Ltd.

PHYM - 603

Nuclear Physics

Total Marks: 60 **Internal Assessments: 15**

Total No. of Lectures: 40

Unit I: Properties of atomic nuclei (No. of Lectures: 10) (Marks: 15)

Introduction, nuclear size and its determination, hypotheses of nuclear composition (proton-electron and proton-neutron hypotheses), mass of nucleus and nuclear atoms, quantum numbers of individual nucleus, quantum properties nuclear states, nuclear angular momentum, nuclear magnetic dipole moment, binding energy of nucleus, mass defect, packing fraction, disintegration energy, semi-empirical mass formula.

Unit II: Nuclear models (No. of Lectures: 15) (Marks: 10)

Qualitative introduction to the nature of nuclear forces, qualitative discussion of the liquid drop model of the nucleus in relation to the semi-empirical mass formula, qualitative discussion on the Shell model of the nucleus.

Unit III: Nuclear reactions and cosmic rays (No. of Lectures: 10) (Marks: 22)

Nuclear reactions, qualitative discussion on induced radioactivity, spontaneous and proton induced reaction, alpha induced reaction, sustained nuclear chain reaction, nuclear fission and fusion, particle accelerators- van de Graph generators, linear accelerators, cyclotron.

Unit IV: Elementary particles (No. of Lectures: 5) (Marks: 13)

Cosmic ray and elementary particles: discovery and properties of cosmic rays, classification of elementary particles, qualitative introduction to leptons, quarks and gauge bosons.

Suggested readings;

1. Nuclear Physics D. C. Tayal Himalaya Publishing House
2. Concepts of Nuclear Physics I. B. Cohen Tata McGraw Hill
3. Atomic and Nuclear Physics K. Gopalkrishnan McMillan
4. Atomic Physics, J. B. Rajam S. Chand& Co.
5. Nuclear Physics, Irving Kaplan Narosa Publishing House
6. Modern Physics, A. Beiser, Tata McGraw Hill

PHYM - 604

(C) Laser and its Applications
(Optional Course)

Total Marks: 60 **Internal Assessments: 15**

Total No. of Lectures: 40

Unit I: Introduction to Lasers: (No. of Lectures: 12) (Marks: 20)

Absorption and emission of radiation, spontaneous emission of radiation, stimulated emission, Einstein coefficients, significance of Einstein coefficients, Basic Laser system requirements, Method of creation of population inversion, optical resonator, Q factor, optical cavity, Standing wave, Thresold condition for laser oscillator.

Unit II: Laser system: (No. of Lectures: 8) (Marks: 10)

Description of Ammonia beam Maser, Ruby Laser, He- Ne Laser, Semi conductor Laser.

Unit III: Properties of Laser radiation: (No. of Lectures: 8) (Marks: 10)

Intensity, Monochromaticity, Coherence properties of Laser radiation, Spatial and Temporal Coherence, Purity of spectral line and Temporal Coherence relation with Coherence, visibility of fringes and degree of coherence relation between visibility and coherence.

Unit IV: Laser Applications: (No. of Lectures: 6) (Marks: 10)

Introduction: Basic principles of fiber optics, structure and classification, acceptance angle and numerical aperture, Intermodel dispersion in a step index fiber, Ray path in index fiber, Advantages of fiber optics communication.

Unit V: Magneto- Optics and Electro- Optics: (No. of Lectures: 6) (Marks: 10)

Faraday effect, Determination of magnetic rotation, Classical theory of Faraday effect, Kerr electro Optic effect, Harmonic generation, second harmonic generation.

References:

1. Modern Optics: Dr. A. B. Gupta, Books and Allied Pvt Ltd. Kolkata.
2. Opto electronics: J. Wilson and J. F. B. Hawkes, Prentice Hall of India
3. Lasers (Theory and applications): K. Thyagarajan and A. K. Gatak, Macmillan India
4. Lasers and Nonlinear Optics: B. B. Laud, New Age International, Delhi
5. Lasers and Nonlinear Optics: G. D. Baruah, Pragati Prakashan Meerut.

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B. Sc Sixth Semester(Major) Practical

PHYM- 605

Total Marks: 80 **Internal Assessment: 20**

List of experiments:

MI Compare two high resistances using mirror galvanometer method.

MII Determine the current in an external circuit by potentiometer and to compare emfs of two cells.

MIII To study the basic logic gates using the NAND gate.

MIV To fabricate half-adder using NAND gate.

MV To determine the number of rulings per meter in a diffraction grating using a beam.

MVI To study the characteristic curve of a Zener diode and to study it as a voltage regulator.

MVII To determine Planck constant by using photocell.

MVIII To determine the energy band gap of a junction diode or LED.

MIX To study frequency response curve of an RC couple amplifier using transistor.

MX To study the characteristics of full wave bridge rectifier and determine ripple factor and rectifier efficiency.

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LPHYG- 601

Electronics & Solid State Physics

Total Marks: 56 **Internal Assessment: 14**

UNIT I: (No. of Lectures 10: Marks 15)

Semiconductor and insulators, electrons and holes in semiconductors, donor and acceptor impurity, generation and recombination of charge, diffusion, equation of continuity, Junction diode characteristics: The open circuit P- N junction, I- V characteristics P- N junction diode, breakdown diodes, diode as rectifier, half wave and full wave rectifier with resistance load, ripple factor, smoothing filters.

UNIT II: (No. of Lectures 10: Marks 13)

Transistor: PNP and NPN transistor, transistor as an amplifier, common emitter, common base and common collector connections, transistor biasing and thermal stabilization, amplifier, equivalent circuits, small signal transistor, voltage amplifier, R- C coupled, L- C coupled amplifier, Oscillator: Transistor as sinusoidal oscillator, Barkhausen criterion, tuned oscillator, Hartley, RC oscillator.

UNIT III: (No. of Lectures 10: Marks 13)

Basic ideas of lattice and crystals, primitive lattice vectors, unit cell, translational lattice vectors, two and three dimensional Bravais lattices, some simple crystal structures (sc, bcc, fcc, hcp, Nacl), Miller indices and lattice planes, packing fraction for cubic crystal structure, Braggs law of diffraction by crystal planes.

UNIT IV: (No. of Lectures 10: Marks 15)

Free electron theory of metals, electrical and thermal conductivity, Wiedmann-Franz law, Band theory of solids, Classification of solids, metals, semiconductor, and insulator, Phenomenon of superconductivity, critical temperature, Meissner effect, Type I and type II superconductors.

Suggested reading:

1. Principles of electronics: V. K. Mehta, S. Sand and Company Ltd.
2. Hand Book of Electronics: S. L. Gupta and V. Kumar, Pragati Prakashan
3. Introduction to solid state Physics, C, Kittel, Wiley Eastern.
4. Introduction to condensed Matter Physics, K. C. Barua, Narosa Publishing House
5. Solid State Physics, S. O. Pillai, New Age International.

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B. Sc Sixth Semester (General) Practical

PHYG- 602

Total Marks: 24 **Internal Assessment: 6**

At least 75% of the experiments listed below are required to be performed by each student. The examination should be on one exp. in 4 hrs.

List of experiments:

1. **To determine the value of g using Kater's pendulum.**
2. **To determine the surface tension of a liquid by the capillary rise method and Verify Jurin's law.**
3. **To verify the laws of transverse vibration of string by Melde's method.**
4. **To find the optical rotation produced by an optically active solution using a polarimeter and then determine its specific rotations.**
5. **To determine the number of rulings per cm. of a plane diffraction grating.**
6. **To study the Network Theorems.**
7. **To determine the modulus of rigidity using Maxwell's needle method.**
8. **To determine the resistivity of a wire using meter bridge.**

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