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NORTH - EASTERN HILL UNIVERSITY

Headquarter :: Shillong

No. F.6-1/Ex-Con/2016- 1165 Dated 5th Feb 2021

To,

The Principal
Tura Govt College
Tura

Sub : Revised Under-graduate Syllabus in Physics.

Sir/Madam,

With reference to the subject cited above, I am directed to forward herewith copy of the Revised Under-graduate Syllabus in Physics, duly approved by appropriate authorities of the University to be implemented from the 1st semester students of the current Academic session 2020-21 and onwards.

This may kindly be brought to the notice of all concerned.

Thanking You,

Yours faithfully,

Supervisor 2/6/20
Confidential Section
Examinations Department
NEHU Shillong

Copy forwarded for information to:

1. The Head Department of Physics, NEHU, Shillong.
2. The Director, CDC NEHU, Shillong.
3. The Deputy Registrar (Conference), NEHU, Shillong.
4. Assistant Registrar, (U.G), Examination Deptt. NEHU, Shillong

Tura Government College, Tura
Serial No. 358
Date. 15/2/21
File No. TEB-3
Subject.

15/02/2021

Approved by 102nd Academic Council

GENERAL NOTES ON THE SYLLABUS

1. The duration of examination for each theory paper will be of three hours.
2. Marks distribution for different papers will be as follows:

Paper	Marks	Questions
PHY01(T)	FULL MARKS: 100 END SEMESTER EXAMINATION : 75 INTERNAL ASSESMENT :25	10 OUT OF 15 QUESTIONS (EACH CARRYING 7½ MARKS)
PHY02(T) PHY03(T) PHY04(T)	FULL MARKS: 75 END SEMESTER EXAMINATION : 56 INTERNAL ASSESSMENT : 19	8 OUT OF 12 QUESTIONS (EACH CARRYING 7 MARKS)
PHY02(P) PHY03(P) PHY04(P)	FULL MARKS: 25 END SEMESTER EXAMINATION: 19 INTERNAL ASSESSMENT : 06	ONE EXPERIMENT TO BE PERFORMED
PHY05(T-A) PHY05(T-B) PHY06(T-A) PHY06(T-B)	FULL MARKS: 75 END SEMESTER EXAMINATION : 56 INTERNAL ASSESSMENT : 19	ONE COMPULSORY PROBLEM ORIENTED QUESTION CARRYING 8 MARKS AND 4 OTHER QUESTIONS FROM THE REMAINING 7 QUESTIONS EACH CARRYING 12 MARKS.
PHY05(P) PHY06(P)	FULL MARKS: 50 END SEMESTER: 37 INTERNAL ASSESSMENT: 13	ONE EXPERIMENT TO BE PERFORMED

3. The Practical Examination for II-IV semesters i.e. PHY02(P), PHY03(P) and PHY04(P) will be of **four hours** duration and each student has to perform one experiment in the examination. Practical Examination for V and VI semesters i.e. PHY05(P) and PHY06(P) will be of **six hours** duration and each student has to perform one experiment in the examination.
4. Internal Assessments: Internal Assessments in theory paper will be based on (i) sessional test, (ii) assignments or any other method of evaluation such as study tour/field trip, wherever possible.
5. Internal Assessments in practical paper will be based on (i) performance in the laboratory work and (ii) number of practical completed during class hours.
6. Preferably SI system should be followed. However, in Nuclear Physics the relevant units may also be followed.
7. One tutorial class per week to develop problem solving skill.
8. Error calculations to be used in experiments where ever applicable.
9. ~~Questions to be set in proportion to the number of lectures assigned in the syllabus~~.

1. SEMESTER-I

(i) PHY01(T): Mathematical Physics-I, Mechanics, Waves and Acoustics (Lectures:120: Full Marks:100)

2. SEMESTER-II

(i) PHY02(T): Electromagnetism, Electronics – I (Lectures:90; Full marks:75)
(ii) PHY02(P): Experimental Physics-I (Full Marks:25)

3. SEMESTER-III

(i) PHY03(T): Thermal Physics, Optics (Lectures:90; Full marks:75)
(ii) PHY03(P): Experimental Physics-II (Full Marks:25)

4. SEMESTER-IV

(i) PHY04(T): Special Theory of Relativity, Quantum Mechanics –I, Atomic Physics-I, Nuclear Physics-I and Solid State Physics-I (Lectures:90; Full marks:75)
(ii) PHY04(P): Experimental Physics-III (Full Marks:25)

5. SEMESTER-V

(i) PHY05(T-A): Mathematic Physics-II, Quantum Mechanics-II (Lectures:120; Full marks:75)
(ii) PHY05(T-B): Classical Mechanics, Electrodynamics, Statistical Physics, Energy Sources (Lectures:120; Full Marks:75)
(iii) PHY05(P): Experimental Physics-IV (Full Marks:50)

6. SEMESTER-VI

(i) PHY06(T-A): Solid State Physics-II, Electronics-II and Fortran Programming (Lectures:120; Full marks:75)
(ii) PHY06(T-B): Atomic Physics-II, Molecular Spectroscopy, Nuclear Physics –II, Astrophysics (Lectures:120; Full Marks:75)
(iii) PHY06(P): Experimental Physics-V (Full Marks:50)

PHY01(T)

SEM Mathematical Physics-I, Mechanics, Waves and Acoustics

ESTE (Lectures:120)

R-I (Full Marks: 100)

UNIT-I (15 Lectures)

Vectors: Vector and Scalar product. Gradient, divergence, curl and their significance. Gauss' divergence theorem, Stokes' theorem, Green's theorem and their significance. (without proofs), unit vectors in polar coordinate.

Ordinary Differential Equations: 1^{st} order homogeneous differential equations, 2^{nd} order differential equations with constant coefficients.

Unit II (25 Lectures)

Inertial and Non-inertial frames: Components of velocity and acceleration in different co-ordinate systems (2D motion only). Uniformly rotating frame, centripetal force and coriolis force with applications.

Central forces: Conservative nature of central forces, Gravitational Force. Newton's Law of Gravitation. Satellite in circular orbit and applications. Geosynchronous Satellite. Basic idea of Global Positioning System (GPS).

Systems of particles: Centre of Mass(CM) and CM frame of reference. Motion of the centre of mass, linear momentum and angular momentum of system of particles. Elastic and inelastic collisions, loss of kinetic energy due to direct impact of inelastic collision of two rigid bodies.

UNIT-III (30 Lectures)

Rigid body motion: Moment of inertia – parallel and perpendicular axes theorems, moment of inertia of a shell, solid sphere, disk and cylinder about axis of symmetry. Euler's equations for force free motion of rigid bodies.

Elasticity: Hooke's law, elastic constants for an isotropic solid, inter relationship of elastic constants, torsion of cylinder, bending of beams, cantilever (weightless) supporting weights at free ends, beam supported at both ends.

Fluids: Equation of continuity for fluids, Bernoulli's theorem (with proof and applications), fluid motion through a capillary tube (streamline flow), Poiseuille's equation, surface tension, capillarity and formation of droplets, pressure on the curved surface of a liquid, excess pressure inside an air bubble.

UNIT IV (30 Lectures)

Simple harmonic motion: Superposition of two SHM's acting at right angles to each other having (a) same frequencies and (b) different frequencies in the ratio 1:2. Lissajous figures and their uses. Oscillations of two masses connected by a spring.

Damped and forced oscillations: Damped SHM, energy of damped SHM, Q-value of damped oscillations, forced vibrations with one degree of freedom, transient and steady state oscillations, power in forced vibrations, sharpness of resonance and quality factor.

Waves: Representation of plane progressive wave, classical wave equation of a plane progressive wave and its general solution. Representation of spherical waves. Energy and energy density of plane progressive waves.

Waves in continuous media: Speed of transverse waves on a uniform string, interference of sound waves. Group velocity and phase velocity.

UNIT V (20 Lectures)

Ultrasonics: Properties, production, detection and applications of ultrasonic waves. Principle of ultrasonography.

Sound: Intensity and loudness of sound, bel and decibel, intensity levels, limit of human audibility.

Acoustics of buildings: Requirements of good auditorium, reverberation, reverberation time, absorption coefficient, Sabine's formula for reverberation time, live and dead room.

Text Books:

1. **A Treatise on General Properties of Matter**: Chatterjee and Sengupta, New Central Book Agency, Kolkata, 2008
2. **Mechanics**: JC Upadyaya, Ram Prasad and Sons, Agra, 1999
3. **Principle of Accoustics**: B. Ghosh, Shreedhar Publisher, Kolkata, 2004

Reference Books

1. **Undergraduate Physics Vol-I**: AB Bhattacharya and R Bhattacharya, New Central Book Agency, Kolkata, Reprint, 2013.
2. **College Physics Vol-I**, AB Gupta, Book and Allied (P) Ltd., Kolkata, Revised Reprint, 2005.
3. **Physics for Degree Students**: C.L Arora and Dr. P.S Hemne, S Chand, New Delhi, 2012.
4. **Mechanics**, DS Mathur, S Chand, New Delhi, 2012.
5. **Acoustics, Waves and Oscillations**: S.N Sen, New Age International, 2002.
6. **Waves and Oscillation:** RN Choudhuri, New Age International, 2010.

SEMESTER –II

PHY02(T)

Electromagnetism, Electronics – I

(Lectures:90)

(Full Marks: 75)

UNIT- I (30 Lectures)

Electric field due to a continuous charge distribution. Gauss' law in electrostatics (both differential and integral form). application of Gauss' law: Electric field due to a point charge, uniformly charged rod, uniformly charged spherical shell and solid sphere, uniformly charged infinite plane sheet. Dielectric medium, Polarization, Displacement vector, Gauss' law in a dielectric medium.

Work done in electrostatic field expressed as line integral, conservative nature of electrostatic field. Electrostatic potential and potential energy due to a charge distribution, calculation of potential and field of an electric dipole, charged circular discs, charged hollow and solid spheres. Method of electrical images. Electric field near the surface of a grounded conducting plane using method electrical images.

Vector form of Biot-Savart law; calculation of magnetic field due to a straight conductor carrying current, circular coil carrying current and a solenoid.

Magnetic dipole moment and its relation to angular momentum, gyromagnetic ratio, magnetization vector, magnetic susceptibility and permeability (linear cases only), hysteresis, B-H curve.

UNIT-II (20 Lectures)

Non-steady currents and continuity equation, rise and decay of current in LR and CR circuits, time constants, transients in LCR circuit.

Alternating current: Complex impedance, reactance; impedance of LCR series and parallel circuits, resonance, Q-factor, power dissipation, power factor.

Power supply: Single phase and three phase electrical power supply, delta and star connections.
Integral and differential forms of Faraday's law, mutual and self inductance and their relation for a solenoid, transformer, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations in free space and in a medium with deduction.

UNIT-III (20 Lectures)

Basic circuit analysis: Kirchhoff's laws and applications. Superposition theorem, Thevenin's theorem and Norton's theorem. Two port analysis of an electrical network, hybrid parameters and hybrid parameter equivalent diagram.

Rectifier: Full wave rectifier, calculation of ripple factor, and rectification efficiency, filter circuits.

BJT: Characteristics of BJT, CB and CE configurations, active and saturation regions, load line analysis, Q point. Current amplification factors in CB and CE configuration, h parameters of transistors and h-parameter equivalent diagram (CB and CE).

UNIT IV (20 Lectures)

Analog and Digital signals, binary system, binary to decimal and decimal to binary, binary arithmetic-addition and subtraction, signed binary numbers, two's complement scheme.

Logic gates: OR, AND, NOT gates and their realisation with diodes and transistor, NOR and NAND as universal gates.

Boolean algebra (elementary aspects only), de' Morgans theorems.

Text Books:

1. **Eectromagnetics**: BB Laud, New Age International Publishers, Latest edition.
2. **Electricity and Magnetism**: DC Tayal, Himalayan Publisher, Latest edition.
3. **Basic Electronics**: DC Tayal, Himalayan Publishers, Latest edition.

Reference Books:

1. **Electricity and Magnetism**- K.K. Tewari, S Chand, New Delhi, 2011.
2. **Basic Electronics: Devices, Circuits and Its Fundamentals**: S Kal, Prentice Hall India, New Delhi, First Edition, 2002.
3. **Principles of Electronics**: V. K. Mehta and R. Mehta, S. Chand & Co., New Delhi, 2005.
4. **Fundamental principles electronics**: B.Ghosh, Books and Allied (P) LTD, Kolkata , Latest edition.
5. **Undergraduate Physics Vol-II**: AB Bhattacharya and R Bhattacharya, New Central Book Agency, Kolkata, Reprint, 2008.

SEMESTER –II

PHY02 (P)

Experimental Physics-I

(Full Marks : 25)

(Minimum eight experiments to be performed)

List of experiments:

1. Determination of the value of acceleration due to gravity ('g') by using bar pendulum pendulum.
2. Determination of the value of acceleration due to gravity ('g') by using Kater's pendulum
3. Determination of the moment of inertia of a regular solid (called unknown body) about its axis through its centre of gravity by using torsional pendulum.
4. Determination of the rigidity modulus of a cylindrical body by static torsion apparatus.
5. Determination of the co-efficient of viscosity of liquid by capillary tube method.
6. Determination of the surface tension of a liquid by Jaeger's method.
7. Determination of the frequency of a tuning fork by Melde's method.
8. To verify the inverse square law in magnetism.
9. Determination of the resistance per unit length of the potentiometer wire by Carey-Foster method.
10. Determination of the value of the capacitance of an unknown capacitor by using the de-Sauty's bridge.

Text Books

1. B.Sc. Practical Physics, C.L. Arora, S Chand and Co., 2005.
2. A Text Book of Practical Physics, S. Ghosh, New Central Book Agency, Kolkata, 2004.
3. A Text Book on Practical Physics, K.G. Mazumdar, Shreedhar publisher,kolkatta. 2006.

SEMESTER-III

PHY03(T)

Thermal Physics, Optics

(Lectures: 90)

(Full Marks: 75)

UNIT I (25 Lectures)

Review of kinetic theory of gases. Limitations of the perfect gas equation PV=RT. Van der Waals correction, Van der Waals equation and evaluation of critical constants of a gas. Law of equipartition of energy (without proof) and its application to obtain γ ($=C_P/C_V$) of monatomic and diatomic gases.

Transport phenomena: Concept of calculation of mean free path, Claussius mean free path and estimation of molecular diameter. Viscosity and thermal conductivity of a gas. Einstein theory of Brownian motion.

Laws of thermodynamics: The zeroth law, indicator diagram, work done, the first law, internal energy. Reversible and irreversible changes, Carnot cycle, Carnot theorem, second law of thermodynamics, entropy as thermodynamic variable, principle of increase of entropy, entropy of a perfect gas, entropy and unavailable energy. Thermodynamic scale of temperature and its identity with perfect gas scale. Impossibility of attaining absolute zero, third law of thermodynamics.

UNIT II (10 Lectures)

Liquefaction of gases: Adiabatic expansion, Joule Thomson effect, Boyle temperature and inversion temperature. Principle of regenerative cooling and cascade cooling.

Black body radiation: spectral distribution of black body radiation, Planck's quantum postulates, derivation Planck's Law, Rayleigh Jeans law, Stefan-Boltzmann law, and Wein's displacement law from Planck's law.

UNIT III (20 Lectures)

Fermat's principle: Principle of extremum path. Application of Fermat's principle to reflection and refraction at plane and curved boundaries.

General theory of image formation: Cardinal points of an optical system, refraction through a thick lens, relation between the distances of cardinal points, combination of thin lens separated by a distance.

Ideas of matrix optics, lens formula by matrix method.

Aberration in images: Chromatic aberration, achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reductions, aplanatic points of a sphere with proof, oil immersion objectives.

Optical instruments: eyepieces- Ramsden and Huygens eyepieces and their cardinal points. Relative merits and demerits of Ramsden and Huygen's eyepiece.

UNIT IV (26 Lectures)

Interference of light: Condition for sustained interference, Fringes produced by a wedge-shaped thin film, fringes of equal thickness and equal inclination, Haidinger fringes. Theory of Newton's rings and experimental determination of wavelength of monochromatic light.

Michelson interferometer, construction and production of fringes, its applications for the determination of wavelength, wavelength difference.

Intensity distribution in multiple beam interference. Fabry-Perot interferometer, construction and production of fringes.

Diffraction of light: Fresnel diffraction, Fresnel half period zones, zone plates, straight edge, rectilinear propagation. Fraunhoffer diffraction: Diffraction from a double-slit, N slits, theory of plane diffraction grating. Resolution of images, resolving power of Fabry-Perot interferometer and plane transmission gratings.

Polarization: Methods of polarization, methods of producing elliptically and circularly polarized light. Quarter wave plate and half wave plate, double refraction in uniaxial crystals (qualitative idea). Rotation of plane of polarization, Fresnel's theory of optical rotation.

Unit V (9 Lectures)

Absorption bands, normal and anomalous dispersion. Qualitative idea of Rayleigh's scattering

Laser: Condition for laser action, existence of metastable state, population inversion by pumping and cavity. He-Ne laser (basic principle).

Fibre Optics: Basic principle and its applications.

Text Books:

1. **Heat and Thermodynamics**: Brij Lal and N. Subrahmanyam and P.S. Hemne, S Chand, New Delhi, 2012.
2. **A text Book of optics**: D.N. Subrahmanyam, Brij Lal and M.N. Avadhanulu, S Chand, New Delhi, 2012.

Reference Books:

1. A.K.Ghatak, Physical Optics, Tata McGraw Hill of India, 2nd Edition, 1997.
2. A.B. Gupta, Modern Optics, Books and Allied (P) Ltd., 2006.
3. M.W. Zemansky & R.H. Dittman, Heat and Thermodynamics, McGraw Hill, Singapore, 7th Edition, 1997.

SEMESTER-III

PHY03(P)

Experimental Physics-II

(Full Marks : 25)

(Minimum eight experiments to be performed)

List of experiments

1. Determination of the co-efficient of linear expansion of a solid by using Pullinger's apparatus and optical lever.
2. Determination of the specific heat of a liquid by the method of cooling.
3. Determination of the co-efficient of thermal conductivity of a good conductor by Searle's method.
4. Determine the mechanical equivalent of heat by Joule's calorimeter.
5. Determination of the refractive index of a prism by a spectrometer using monochromatic light.
6. Determination of the radius of curvature of a lens by Newton's ring method.
7. Determination of the grating constant by using a spectrometer.
8. Determine the wavelength of a laser beam using plane diffraction grating.
9. Determination of the refractive index of the materials of convex lens by measuring its focal length (displacement method) and radii of curvature (using spherometer).
10. To study the frequency response of a series and parallel LCR circuit.

Text Books:

1. **B.Sc. Practical Physics**, C.L. Arora, S Chand and Co., 2005.
2. **A Text Book of Practical Physics**, S. Ghosh, New Central Book Agency, Kolkata, 2004.
3. **A Text Book on Practical Physics**, K.G. Mazumdar, Shreedhar publisher, Kolkata, 2006.

SEMESTER –IV

PHY04(T)

Special Theory of Relativity, Quantum Mechanics-I, Atomic Physics-I, Nuclear Physics-I, and Solid State Physics-I

(Lectures: 90)

(Full Marks: 75)

Unit I (10 Lectures)

Relativity: Galilean relativity and its failure. Galilean transformations. Michelson-Morley experiment. Basic postulates of special relativity. Lorentz transformation, length contraction, simultaneity, time dilation, velocity addition rule. Variation of mass with velocity, mass energy equivalence.

UNIT II (12 Lectures)

Failure of Classical physics, old quantum theory, wave nature of matter and de-Broglie relation. Statement and significance of Heisenberg uncertainty principle and illustration of this principle by a single-slit electron diffraction and Heisenberg's microscope. Application of uncertainty principle to prove the non-existence of electron in the nucleus and calculation of binding
energy of electron in hydrogen atom.

Concept of wave function and physical interpretation of the wave function. Normalization of a wave function with examples. Time-dependent and time-independent Schrodinger
equations, particle in a 1-D box

Unit III (18 Lectures)

Atomic structure: Methods of producing ionization in atoms. Excitation and ionization potentials. Mobility of ions, determination of e/m by Thomson's method, measurement of electric charge e by Millikan's oil-drop experiment. Measurement of mass of the electron, principle of cathode ray oscilloscope.

Positive ray analysis and mass-spectrographs: Thomson mass spectrograph, Bainbridge mass-spectrograph. Review of Bohr's theory of hydrogen atom and its spectral series. Introduction of quantum numbers with their significance, Pauli's exclusion principle, maximum number of electrons in an orbit.

X-rays: Principle of production of x-rays, hard and soft-x-ray, continuous spectrum and characteristic spectrum of x-rays, Moseley's law, Duane-Hunt law, Absorption of x-ray and exponential law, Compton scattering of x-rays and expression for wavelength change due to scattering.

Unit IV (30 Lectures)

Review of natural radioactivity, mean life, Basic ideas of α, β and γ decay. Interaction of γ rays with matter: photo electric effect, Compton scattering, pair production. Applications of radioactivity: radiography, radioactive tracers, radioactive dating.

Basic properties of a Nucleus-Composition, stability, charge, size, mass, binding energy and its calculation. Nuclear Reaction: Discovery of neutron, properties of neutron, Artificial transmutation (neutron and alpha particle induced transmutation), nuclear reaction energy, endothermic and exothermic processes.

Nuclear fission: Discovery, energy released in fission, chain reaction, secondary neutrons and their importance, multiplication factor (elementary idea), concept of critical size, nuclear reactor, types of reactors.

Nuclear fusion: Origin of stellar energy, calculation of fusion energy.

Cosmic rays and elementary particles: General characteristics, hard and soft component of cosmic rays, primary and secondary cosmic rays, altitude effect, Effect of Earth's magnetic field on cosmic ray: latitude effect and east-west effect, extensive air showers, origin of cosmic rays.

Classification of elementary particles and their properties.

Unit V (20 Lectures)

Crystal structure: Lattice translation vectors, crystal structure with basis and Bravais lattice, primitive cell and unit cell. Symmetry in crystals: viz translational, rotational, inversion symmetry and crystal types in 2- and 3-dimensions allowed by symmetry; sc, bcc, and fcc crystals and their coordination numbers and nearest neighbour distances. Closed-packed crystals and packing fraction of sc, bcc, and fcc lattices, Miller indices and inter planar spacing.

Free electron theory of solids: Classical treatment and Drude's theory of electrical conductivity, relation between electrical and thermal conductivity, inadequacy of free electron model. Qualitative explanation of energy band and band gap, distinction between conductors, semiconductors and insulators in terms of band gap.

Superconductivity: Discovery of superconductivity in Hg by Kamerlingh Onnes, persistent current, behaviour of a superconductor in a magnetic field, Meissner effect, destruction of super-conductivity by a magnetic field, critical fields, type-I and type-II superconductors.

Text Books:

1. **Introduction to Special Relativity:** Robert Resnick, Wiley, New Delhi, 2014.
2. **Atomic and Nuclear Physics:** A.B. Gupta And Dipak Ghosh, Book and Allied (P) Ltd, Kolkata, Latest edition.
3. **Quantum Mechanics:** G. Arun Das, Latest edition.
4. **Quantum Mechanics:** A.K. Ghatak and S. Lokanathan, Mac Muller, Latest edition.
5. **Fundamentals of Solid State Physics**: Saxena, Gupta and Saxena, Pragati Prakashan, Meerut, 17th Edition, 1999.

Reference Books:

1. **Modern Physics** : R .Murugeshan, Kiruthiga Sivaprasath, S. Chand and Co., New Delhi, Latest edition.
2. **Modern Physics**: G Aruldhas and P. Rajagopal, Prentice Hall India Private Limited, New Delhi, 2008.
3. **Undergraduate Physics Vol-II**: AB Bhattacharya and R Bhattacharya, New Central Book Agency, Kolkata, Reprint, 2008.
4. **Solid State Physics**: S.O. Pillai, New Age International Publishers, New Delhi, Sixth Edition, 2005.
5. **Quantum Physics:** Stephen Gasiorowicz, Wiley-India, New Delhi, 3rd Edition, 2009.

SEMESTER –IV

PHY04(P)

Experimental Physics-III

(Minimum eight experiments to be performed)

(Full Marks : 25)

List of experiments

1. Determination of the energy gap of a semiconductor diode.
2. To draw the characteristics of a LDR
3. To draw the characteristics of a photo-diode.
4. Measurement of current in an external circuit by using Potentiometer.
5. Use of a multimeter to measure the output voltages of half wave and full wave rectifiers and find the value of ripple factors.
6. Determination of Planck's constant by photocell or by heating method.
7. Determination of the specific charge (e/m) of an electron by magnetron/Thomson's method.
8. Determination of the value of an unknown low resistance by using potentiometer.
9. Determination of the emf of a battery by using potentiometer.
10. Verification of Thevenin's theorem.
11. Verification of Norton's theorem.
12. Verification of Superposition theorem.

Text Books

1. **B.Sc. Practical Physics**, C.L. Arora, S Chand and Co., 2005.
2. **A Text Book of Practical Physics**, S. Ghosh, New Central Book Agency, Kolkata, 2004.
3. **A Text Book on Practical Physics**, K.G. Mazumdar, Syndicate Press, 2006.

Semester –V

PHY05(T-A)

Mathematical Physics-II, Quantum Mechanics-II

(Lectures: 120)

(Full Marks: 75)

UNIT I (35 Lectures)

Curvilinear co-ordinates, orthogonal curvilinear co-ordinates. Conditions for orthogonality. Gradient in terms of curvilinear co-ordinates, divergence and curl in terms of curvilinear co-ordinates. Laplacian in terms of orthogonal curvilinear co-ordinates, cylindrical and spherical polar co-ordinates as a special curvilinear system.

Matrices: Different types of matrices, properties of symmetric, skew- symmetric, hermitian and skew-hermitian matrices. Characteristic equation, eigenvalues and eigenvectors of a matrix and diagonalization of matrix (only for 2x2 matrices).

Complex variables: Preliminary ideas of Complex number, functions of complex variables, analytic functions, Cauchy-Riemann conditions, Cauchy's theorem (with proof), Cauchy's integral formulae (with proof), simply and multiply connected regions. Taylor series and Laurent series (both without proof), poles and residues, Cauchy residue theorem (with proof), application of residue theorem in integrals of functions having simple poles.

UNIT II (25 Lectures)

Ordinary differential equations: General method of solutions of second order linear equations, meaning of ordinary point, singular point and regular singular point. Frobenius method of solution.

(a) Legendre polynomial: Convergent solution of Legendre differential equation, its transformation to polynomial solution $P_n(x)$. Generating function of $P_n(x)$, recurrence relation for $P_n(x)$, Rodrigue's formula for $P_n(x)$, orthogonality of $P_n(x)$. Calculation of potential and intensity at a point for an electric dipole with the help of Pn(x).

(b) Hermite Polynomial: Convergent solution of Hermite differential equation, its transformation to polynomial solution $H_n(x)$. Generating function, recurrence relations, Rodrigue's formula, orthogonality of $H_n(x)$.

Partial differential equations: Solutions of partial differential equations by the method of separation of variables. Application to solution of : heat flow equation in one dimension, equation of vibrating string, Laplace's equation in two dimension (Cartesian and polar co-ordinates).

UNIT III (15 Lectures)

Gamma and Beta functions: Definition of gamma and beta functions as definite integrals, recursion formula for gamma functions, evaluation of $\Gamma(1/2)$. Relationship between gamma and beta functions, Legendre Duplication formula, Evaluation of definite integrals using gamma and beta functions.

Tensor analysis: Concept of tensor with examples, contravariant and covariant tensors up to rank 2, mixed tensors, addition and subtraction, outer and inner products of tensors, contraction of a tensor, symmetric and anti-symmetric tensors, the Kronecker delta.

UNIT IV (20 Lectures)

Particle as a wave packet, Gaussian wave packet, phase velocity and group velocity, velocity of wave packet, spreading of a wave packet, probability density, probability current density, conservation of probability density.

Postulates of quantum mechanics, quantum mechanical operators, eigenvalues and eigenvectors of an operator, Schrodinger equation as an operator equation, Hamiltonian operator, Hermitian operator and its

properties, adjoint of an operator, linear operator, commutation and anti-commutation of operators, momentum operator, energy operator, matrix representation of an operator.

Expectation values of an operator with examples, Ehrenfest theorem. Derivation of Heisenberg's uncertainty relation by operator method

UNIT-V (25 Lectures)

One-dimensional applications of time independent Schrodinger equations: particle in an infinitely-deep potential well, quantum tunnelling through a potential barrier, step potential-reflection and transmission coefficients, particle in a shallow well and linear harmonic oscillator.

Angular momentum: Orbital angular momentum operators in Cartesian coordinates and their commutation relations, e.g. and Angular momentum operators in spherical polar coordinates; eigenvalues and eigenvectors of and spin operators and their eigenvalues and eigenvectors, Pauli's spin operators and their properties. Schrodinger equation for hydrogen atom in spherical polar coordinates, separation into radial part and angular part, solution of the radial equation for obtaining energy

Text Books:

1. B.D. Gupta, Mathematical Physics, Vikash Publishing House, 2002.
2. Quantum Mechanics, H.C. Verma, Surya publication, 2009.

Reference Books:

1. **Mathematical Physics**: H.K. Dass, S Chand and Co., New Delhi, 2005.
2. **Matrices and Tensors**, A.W. Joshi, Wiley Eastern, 2004.
3. **Quantum Mechanics**, A.K. Ghatak and S. Lokanathan, Mc Millan, 1992.
4. **Quantum Mechanics**, G. Aruldhas, Prentice Hall of India, 2002.
5. **Mathematical methods for Physicists**, G.Arfken, Academic Press Inc.(Indian edition- Prism Book Pvt. Ltd. 53/2 Bull Temple Road, Basabanagudi, Bangalore, India), 2005.
6. **Schaum's outline series**: Vector Analysis and an introduction to Tensor Analysis: Murray R Spiegel, Mc Graw Hill,2002.
7. **Schaum's outline series**: Complex Variables : Murray R Spiegel, Mc Graw Hill, 2002.
8. **Introduction to Mathematical Physics**: C. Harper, Prentice Hall of India Pvt. Ltd., 1993.
9. **Quantum Physics**: Stephen Gasiorowicz, Wiley India, New Delhi, 2009.
10. **A Textbook of Quantum Mechanics**: PM Mathews and K Venkatesan, Tata McGraw-Hills, New Delhi, 1994.
11. **Quantum Mechanics (An Introduction):** W. Greiner, Springer, 2001.
12. **Perspective of Quantum Mechanics,** S.P. Kuila, New Central Book Agency, Kolkata, Latest edition.

PHY05 (T-B)

Classical Mechanics, Electrodynamics, Statistical Physics, Energy Sources

(Lectures: 120)
(Full Marks: 75)

UNIT I (15 Lectures)

Classical mechanics: Limitations of Newtonian formulation, Constraints, Generalised coordinate, Virtual Work, Principle of Virtual Work, d' Alembert principle, Lagrangian and Lagrange's equation of motion, Hamiltons Principle and Langrage's equation of motion, Generalised momentum, Hamiltonian and Hamilton's equations of motion.

UNIT II (22 Lectures)

Differential form of Gauss' law, Poisson and Laplace's equations, Uniqueness theorem (with proof). Maxwell's equations for time dependent electromagnetic field in vacuum and in material media, boundary conditions.

Electric field inside matter: Polarization and polarization vector, potential and field due to polarized matter, applied to sphere. Gauss' Law in dielectric and the displacement field, electric susceptibility and dielectric constant, boundary conditions satisfied by E and D at the interface between two homogeneous dielectrics, dielectric sphere in a uniform field, capacitor filled with dielectrics, polar and non-polar molecules, induced dipoles, Clausius-Mossoti relation.

UNIT III (18 Lectures)

Electromagnetic Potentials: Magnetic vector potential **A** and scalar potential Φ, Poisson's equation for **A** in terms of current density, solution for line and surface current, calculation of vector potential for an infinitely long solenoid. Gauge transformations: Coulomb and Lorentz gauge.

Electromagnetic waves: The wave equation, plane wave solution for Maxwell's equations, orthogonality of E, B and propagation vector. Poynting vector, energy and momentum propagation, reflection and transmission at dielectric boundaries.

UNIT-IV (27 Lectures)

Thermodynamics relations: Thermodynamic variables, extensive and intensive variables. Maxwell's relations and applications, TdS equations, heat capacity equations, internal energy equations. Joule-Thomson cooling, thermodynamic potentials. Clausius-Clapeyron equation. Equilibrium of thermodynamical variables.

Statistics and Probability: Fundamental probability laws. The binomial distribution, calculation of mean; Stirling approximation (up to second order). The Gaussian or normal distribution, calculation of mean and variance; the Poisson's distribution.

Density distribution in phase space and applications to one-dimensional harmonic oscillator and free particles, principle of equal a prori probability, ergodic hypothesis, Liouville theorem (with proof). Statistical equilibrium, probability calculations, behaviour of the density of states, sharpness of the probability distribution; probability distribution in microcanonical, canonical and grand-canonical ensembles.

UNIT-V (26 Lectures)

Thermal equilibrium between two systems, β parameter and its identity with probability and entropy, and their relation

Statistical interpretation of second law of thermodynamics. Partition function and its relation with thermodynamic quantities like free-energy, entropy and specific heat, law of equipartition of energy and its applications. Derivation of Maxwell-Boltzmann distribution function and its application to a perfect gas and derivation of Maxwell's distribution of molecular speeds with calculation of mean velocity, r.m.s. velocity and most probable velocity, Maxwell's mean free path.

Quantum statistics: Indistinguishability of particles, Bose-Einstein (BE) and Fermi-Dirac (FD) distributions. Classical limit of quantum statistics, application of BE statistics to a photon gas and FD statistics to free electron in metals and calculation of Fermi energy.

UNIT-VI (12 Lectures)

Fossil fuels and alternate sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. Qualitative idea of Wind energy, Tidal energy, Wave

energy, Wave energy systems, Ocean Thermal Energy conversion, Solar energy, Biomass, Biochemical conversion, Biogas Generation, Geothermal energy, Hydroelectricity.

Solar Energy: Solar energy and its importance, storage of solar energy, solar pond, non-convective solar pond, application of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green house, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) system, PV models and equivalent circuits and tracking systems.

Text Books:

1. **Classical Mechanics**: Gupta, Kumar and Sharma, Pragati Prakashan, Meerut, 27th Edition, 2015.
2. **Introduction to Electrodynamics**: D.J. Griffith, Pearson, 3rd edition, 2004.
3. **Electromagnetics**: B.B. Laud, New Age Pub. 2nd edition, (1987) reprint, 2005.
4. **Electricity & Magnetism**: D.C. Tayal, Himalaya Pub., 1998.
5. **Statistical Mechanics**: B.K. Agarwal and M. Eisner, New Age International Publishers, 2nd edition, 1998.
6. **Non-Conventional Energy Sources**: GD Rai, Khanna Publishers, New Delhi, Latest edition.

Reference Books:

1. Classical Mechanics: N.C. Rana, P.S. Joag, Tata Mc Graw Hill Education Pvt Ltd, 2010.
2. Classical Mechanics: Herbert Goldstein, Charles P. Poole, and John Safko, Pearsons, 2016.
3. **Heat and Thermodynamics**: M.W. Zemansky & R.H. Dittman, McGraw Hill, Singapore, 1997.
4. **Fundamental of Statistical and Thermal physics**: F. Reif, McGraw Hill Singapore, 1985.
5. **Fundamental Statistical Mechanics**: B.B. Laud, New Age International Publishers, 1994.
6. **Statistical Mechanics**: R.K. Pathria, Butterworth-Heinemann, Oxford, Indian Edition Reprint, 2009.
7. **Berkeley Physics Course**: Electricity and magnetism, E. M. Purcell, McGraw Hill, 1965.
8. **Electromagnetic waves and Radiating systems**: Edward C. Jordan & Keith G. Balmain, Prentice Hall of India Pvt. Ltd. (Eastern Economy Edition- 2000 Indian reprint)
9. **Foundations of Electromagnetic theory**: J. R. Reitz, F. J. Milford and R. W. Christy, Narosa Publishing House, 3rdedition,1993.

PHY05(P)
Experimental Physics-IV
(Full Marks: 50)

(Minimum ten experiments are to be performed)

List of experiments

1. Measurement of temperature (e.g. melting point/boiling point of a substance) by using a thermocouple.
2. Determination of wavelength of the spectral lines of an element (e.g. hydrogen/mercury) by using a plane diffraction grating and spectrometer.
3. Determination of electrical conductivity of solid electrolyte by Kaulrauch method.
4. Determination of the co-efficient of thermal conductivity of a bad conductor by Lee's method.

5. Determination of the specific rotation of solution using polarimeter.
6. Determination of Young's modulus (Y) of glass using Cornu's Method.
7. To draw the angle of incidence-deviation angle (i-δ) curve for a prism using spectrometer and hence to find out the angle of minimum deviation and the refractive index of the materials of the prism.
8. To measure the width of single slit from the study of its Fraunhoffer diffraction.
9. Determination of the wavelength of sodium light using biprism.
10. Determination of the monochromatic wavelength by Michelson interferometer.
11. Determination of the reduction factor of a tangent galvanometer and also the value of horizontal component of earth's magnetic field by electrolysis method.
12. Determination the velocity of ultrasonic waves in liquid.

Text Books

1. **B.Sc. Practical Physics**, C.L. Arora, S Chand, 2005.
2. **A Text Book of Practical Physics**, S. Ghosh, New Central Book, 2001.
3. **A Text Book on Practical Physics**, K.G. Mazumdar, Syndicate Press, 2006.
4. **A Text Book of Advanced Practical Physics**, S. Ghosh, New Central Book, 2001.
5. **A laboratory manual of Physics for Undergraduate classes**, D.P. Khandelwal, Vani Publication House.,1985.
6. **Advanced Practical Physics**, Chauhan & Singh, Pragati Prakashan., 2002.
7. **Physics through experiments** Vol I & II, B. Saraf et al,1975.

Semester – VI

PHY06(T-A)

Solid State Physics-II, Electronics-II and FORTRAN Programming

(Lectures: 120)
(Full Marks: 75)

UNIT I (35 Lectures)

Crystal structure: Symmetry in crystals, point groups, space groups. Structure of sodium chloride, cesium chloride, diamond and zinc sulfide.

Diffraction by crystals: Bragg's law; Laue's treatment of diffraction and Laue's equations, need for reciprocal lattice vectors, Wigner-Seitz cell.

Brillouin zones. Reciprocal lattice of sc, bcc and fcc structures. Fourier analysis of basis, structure factor of bcc and fcc, atomic form factor. Experimental techniques, Laue method, powder method, neutron diffraction methods.

Crystal binding: Bonding in covalent crystals, ionic crystals, inert gas crystals, metallic crystals and hydrogen-bonded crystals, and properties of these crystals; Madelung energy and Madelung constant in ionic crystals, London-London interaction in inert gas crystals and cohesive energy.

Lattice vibration, quantization of lattice vibration, vibration of monatomic and diatomic chain of atoms. Lattice heat capacity, phonon density of states, Einstein and Debye theories of heat capacity.

UNIT-II (27 Lectures)

Free electron model: Quantum mechanical treatment of free electrons in metals, concept of Fermi level, density of states, heat capacity of the electron gas, experimental heat capacity of metals, electrical

conductivity, experimental electrical resistivity of metals, Matthiessen's rule, plasma frequency, Hall effect, thermal conductivity of metals, Wiedemann-Franz law.

Band Theory: Nearly free electron model, origin of the energy gap, magnitude of the energy gap, concept of bands and band gap; equations of motion; effective mass, effective mass in semiconductors, silicon and germanium, intrinsic carrier concentration, intrinsic mobility; impurity conductivity.

Magnetism: Langevin theory of diamagnetism and paramagnetism; Weiss theory of ferromagnetism; anti-ferromagnetism and ferri-magnetism.

Properties of Superconductor: Heat capacity, energy gap, isotope effect. Thermodynamics of the superconducting transition. Elementary ideas of BCS theory. High temperature superconductivity.

UNIT III (40 Lectures)

FET: Similarities and dissimilarities of FET and BJT, JFET, static and transfer characteristics of JFET, pinch off voltage, idea of MOSFET.

OPAMP: Ideal OPAMP, Inverting and non-inverting OPAMP, differential amplifier, transfer characteristics of OP AMP, offset parameters, differential gain, CMRR. Applications of OP AMP as adder, integrator and differentiator.

Amplifiers: Transistor biasing, Self biasing circuit, Analysis of CE single stage amplifier using h-parameter, multistage amplifiers, analysis of two stage RC coupled and transformer coupled amplifier, feedback amplifiers, gain with feedback.

Osillators: Positive feedback and condition for sustained oscillation, Analysis of Colpitt's and Hartley's oscillators.

Elements of communication systems, features of radio communication.
TTL Logic families, multiplexer, demultiplexer, digital comparator.

UNIT IV (18 Lectures)

Classification of computers: analog and digital. Flowchart and algorithm with examples, FORTRAN (77) characters: integer, constant, real constant, complex constant, logical constant. FORTRAN variables: real variables, double precision, logical variables, subscripted variables, arrays. Library functions. FORTRAN expressions. FORTRAN statements :

(A) Executable statements :(with illustration):
(i) Assignment statement
(ii) Input statement: formatted and unformatted
(iii) Control statement and its classification, i.e.
(a) GOTO statement, unconditional GOTO statement, computed GOTO statement and assigned GOTO statement
(b) IF statement: arithmetic IF, logical IF, IF THEN, ELSE, ENDIF.
(c) DO statement: DO loop, ENDDO.
(d) CONTINUE statement

(e) STOP statement
(f) PAUSE
(iv) Output statement: formatted and unformatted
(v) RETURN statement (related to subprogram)

(B) Non-executable statement (with examples and illustration) DIMENSION statement

IMPLICIT statement
EXPLICIT statement
FORMAT statement
NAMELIST statement
COMMON statement
EQUIVALENCE statement
EXTERNAL statement
END statement
OPEN FILE statement

Text Books:

1. **Fundamentals of Solid State Physics**: Saxena, Gupta and Saxena, Pragati Prakashan, Meerut, 17th Edition, 1999.
2. **Handbook of Electronics**: S.L. Gupta & V. Kumar, Pragati Prakashan, Latest edition.
3. **FORTRAN 77 and NUMERICAL ANALYSIS:** C. Xavier, New Age International, 2001.

Reference Books:

1. **Solid State Physics**: S.O. Pillai, New Age International Publishers, New Delhi, Sixth Edition, 2005.
2. **Solid State Physics**: A.J. Dekker, McMillan,1969.
3. **Introduction to Solid State Physics**: C Kittel, John Wiley-India, New Delhi, Seventh Edition.
4. **Elements of Solid State Physics**: J.P. Srivastava, Prentice Hall of India, 2001.
5. **Introductory Solid State Physics**: H. P. Myers, Viva Book,1998.
6. **Fundamentals of Solid State Physics**: J. R. Chrisman, John Wiley.1988.
7. **Elementary Solid State Physics**: M.A Omar, Addison Wesley, 1993.
8. **Electronics**: Fundamentals and Applications: D Chattopadhyay and PC Rakshit, New Age International, 6th Edition, 2005.
9. **Basic Electronics**: B.L. Theraja, S. Chand & Co., 2005.
10. **Basic Electronics**: D.C. Tayal, Himalaya Publications, 2005.
11. **Electronics Fundamentals and Applications**: J. D. Ryder, Prentice Hall of India Pvt. Ltd., 2003.
12. **Fundamental Principle of Electronics**: B Ghosh, Book and Allied (P) Ltd., Latest edition.
13. **Solid State Electronic Devices**: B.G. Streetman, Prentice Hall of India Pvt. Ltd., 2004.
14. **Computer Programing in Fortran 77**: V. Rajaraman, PHI, 2001.

PHY06 (T-B)

Atomic Physics-II, Molecular Spectroscopy, Nuclear Physics-II, Astrophysics

(Lectures: 120)
(Full Marks: 75)

UNIT I (25 Lectures)

Vector atom model: Space quantization and spinning electron, Stern Gerlach experiment, quantum numbers associated with vector atom model and their physical significance; spin – orbit interaction and its explanation of fine structure. Spectral terms - s,p,d,f notation, magnetic moment due to orbital motion and spin, Bohr magneton, Lande g- factor, Larmor's theorem, gyromagnetic ratio.

Zeeman Effect: Experimental observation, classical and quantum theory of normal Zeeman effect, quantum theory of anomalous Zeeman effect for one electron system only.

Spectrum of Alkali elements: Alkali spectrum and effect of screening on their spectrum, screening constant.

Two electrons system: L-S coupling, j-j coupling, Pauli's exclusion principle, spectra of helium atom and alkaline earth atoms, singlet and triplet fine structure, selection rules.

UNIT II (25 Lectures)

Introduction: Types of molecular spectra – rotational, vibrational and electronic spectra. Pure rotational spectra of a diatomic rigid body rotator – quantum mechanical derivation of energy levels of rigid body rotator, frequency of spectral lines, selection rule and the spectrum.

Vibrating diatomic molecule as a harmonic oscillator – frequency, energy levels, selection rules, spectrum, vibrational – rotational spectra, selection rules.

Electronic spectra: Electronic band systems, sequence and progression, Frank Condon principle.

Raman effect and its brief quantum mechanical explanation, Raman shifts, Stokes and anti-Stokes lines, selection rules, comparison of Raman and IR spectra.

Fundamental ideas of UV and IR spectroscopy, Atomic Emission Spectroscopy (AES), Atomic Absorption Spectroscopy (AAS) and basic ideas about X-ray Fluorescence (XRF) and its applications.

UNIT III (40 Lectures)

Basic properties of nucleus: Brief review, spin and magnetic moment, electric quadruple moment, binding energy, binding energy per nucleon and its variation with mass number of the nucleus. Coulomb energy, volume energy, surface energy, other corrections, explanation of B-E curve

Nuclear models: Liquid drop model, Shell model, Schmidt lines.

Nuclear Forces: Properties of nuclear forces, two nucleon system, square well solution of the deuteron problem.

Radioactivity: Geiger – Nuttal law, Gamow's theory of α decay, Fermi's theory of β - decay (qualitative treatment), neutrinos and anti neutrinos, nuclear radiation, energy levels, biological effects of nuclear and electromagnetic radiations, Maximum permissible radiation levels for safety, precaution against radiation hazards.

Nuclear Reactions: Rutherford's experiments on artificial transmutations, conservation theorems, Q- value, threshold energy, cross section of nuclear reactions.

Nuclear Fission: nuclear fission, Bohr Wheeler theory of nuclear fission, condition of spontaneous fission, four factor formula for a nuclear multiplication factor, chain reaction, criticality, moderators, types of reactors – power, breeder reactor.

Nuclear fusion: Nuclear fusion, fusion reaction in the plasma, condition for maintaining fusion reaction, Tokamak experiment in fusion systems.

UNIT IV (20 Lectures)

Elementary Particles: Discovery of muon, pion, heavy mesons and hyperons in cosmic rays. Concept of antiparticles.

Fundamental interactions, forces and fields.

Associated pair production, strangeness, conservation and violation of strangeness in particle interacttions, isospin, hypercharge. Symmetries and Conservation laws, Baryon and Lepton number conservation.

Resonant particles: discovery and important properties

Gell-mann Nishijima scheme, quark model, colour quantum number, and experimental discoveries of quarks, generations of quarks and leptons

UNIT V (10 Lectures)

Stellar evolution: Life of a star, proto star, stellar processes (nuclear), red giant, red super giant, neutron star, black hole, Chandrasekhar limit.

Spectral Classification of stars: O, B, A, F, G, K, M.

Star systems: Binaries/ Cepheids. HR diagram.

Significance of Sun: Solar cycles, Activity, Butterfly diagram, Photosphoric phenomena.

Text Books:

1. **Elements of Spectroscopy**, Gupta, Kumar & Sharma, Nineteenth edition, Pragati Prakashan, 2008.
2. **Introduction to Atomic Spectra**, H.E. White, Mc Graw Hill, 1934.
3. **Atomic and Nuclear Physics**, A.B. Gupta and Dipak Ghosh, Books and Allied (P) Ltd., 2000.
4. **Perspectives of Modern Physics**, A Beiser, Mc Graw Hill, 1969.
5. **Atomic and Nuclear Physics**, Vols 1 & 2, S.N. Ghoshal, S.Chand and Co. Ltd., 1994.
6. **Spectroscopy**, B.K. Sharma, 17th Revised and enlarged edition, , Krishna Prakashant Media (P) Ltd., 2005.
7. **Astronomy,** Dinah L. Moche, John Wiley and Sons, 2004.
8. **Introduction to elementary particles:** David Griffith, latest edition.

Reference Books:

1. **Molecular Spectroscopy,** G.M. Barrow, McGraw Hill, 1962.
2. **Atomic spectra and atomic structure,** G. Herzberg, Dover Publications, 1944.
3. **Spectra of Diatomic Molecules,** Van G. Herzberg, Nostrand Reinhold Company, 1950.
4. **Principle of Instrumental Analysis,** , Brooks Cole, Latest edition.
5. **Atomic and Nuclear Physics,** T.A. Littlefield and N. Thorley, E.L.B.S. Publications, 1980.

6. **Molecular Spectroscopy,** J.D. Graybeal, Mc Graw Hills International Edition, 1988.
7. **Molecular Structure and Spectroscopy,** G. Aruldhas, Eastern Economy Edition, Prentice Hall of India, Pvt. Ltd., 2004.
8. **Basic Nuclear Physics and Cosmic Rays,** B.N. Srivastava, Pragati Prakashan, 1993. 9. B.L. Cohen, Concepts of Nuclear Physics, Tata Mc Graw Hill, 1990.
9. **Nuclear Physics,** R.R. Roy, B.P. Nigam, New Age International (P) Limited, Publishers., 1996.
10. **Introductory Nuclear Physics,** R.K. Puri, B.K. Babbar, Narosa Publishing House, Delhi., 2005.
11. **Nuclear Physics : An Introduction ,** S.B. Patel, New Age International Pvt.Ltd, 1996.
12. **Introductory Nuclear Physics,** Kenneth S. Krane, John Wiley & Sons, 1988.
13. **Physics of Atoms and Molecules B. H.** BrandSen & C. J. Coachein, Pearson & Co., 2009.
14. **Radiation Detection and Measurement,** Glenn F Knoll, John Wiley and Sons, 4th Edition.
15. **Astrophysics: Star and Galaxies**, KD Abhyankar, University Press (India) Private Ltd, 2009.
16. **Astrophysics: A Modern Perspective**, KS Krishna Swamy, New Age International Publishers, 2010.

PHY06(P)
Experimental Physics-V
(Full Marks : 50)

(Minimum ten experiments to be performed)

List of experiments

1. To study the ripple factor of a full wave rectifier fitted with filter circuits (without filter, Capacitor filter, Inductor filter, L-section filter, π-section) and load regulation (with π-section filter only) .
2. To study the characteristics of a transistor in CB configuration and determine α.
3. To study the characteristics of a transistor in CE configuration and determine β.
4. To study the characteristics of JFET.
5. To design and study AND, OR, NOT and NAND/NOR gates using NOR/NAND gates ICs and to verify their truth tables.
6. To study Lissajous figures using C.R.O. and determine the frequency of an unknown source.
7. To study the frequency response of RC coupled amplifier.
8. To compute the roots of a quadratic equation by using FORTRAN programming.
9. To multiply two given matrices by using FORTRAN programming.
10. To find the sum of an arithmetic series using FORTRAN programming.
11. Study of plateau region of a GM counter.

Text Books:

1. C.L. Arora, B.Sc. Practical Physics, S Chand, 2005.
2. S. Ghosh, A Text Book of Practical Physics, New Central Book, 2001.
3. K.G. Mazumdar A Text Book on Practical Physics, Syndicate Press, 2006.
4. S. Ghosh, A Text Book of Advanced Practical Physics, New Central Book, 2001.
5. C. Xavier, Fortran 77 and Numerical Analysis, New Age International, 2001.
6. V. Rajaraman, Computer Programing in Fortran 77, PHI, 2001.
7. Nuclear radiation detectors: SS Kapoor and VS Ramamurthy, latest edition.