MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

COURSE CURRICULAM AND SYLLABII OF THREE YEAR DEGREE COURSE 2006-2009

PHYSICS

Paper Code	Paper & Title	Hrs/week	Max. Marks
1161	I: Mechanics of Particles, Rigid bodies and Continuous Media	2	50
1162	II: Oscillations, Waves and Acoustics	2	50
1163	III: Electricity and Magnetism	2	50
1164	IV: Practical	4	75

Note:

1 Each theory question paper in the annual examination shall have three sections:
Section A shall contain one compulsory question of 5 marks having 10 parts. Two parts shall be set from each unit. The candidate is required to answer each part in one or few words. (Total: 5 Marks)

Section B shall contain five compulsory questions of 5 marks each with internal choice. One question with internal choice will be set from each unit. The answer may be given in approximately 250 words. (Total 25 Marks)
Section C shall contain four descriptive questions covering all units and candidates have to answer any two questions of ten marks each. The answer may be given in approximately 500 words. There can be two parts in a question from this section. (Total 20 Marks)

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FIRST YEAR, T.D.C., SCIENCE 2006-2007

Paper-I: Mechanics of Particles, Rigid Bodies and Continuous media

UNIT – I

Laws of motion, conservation of energy and momentum, transformation equations for rotating frame, centripetal and Coriolis accelerations, Coriolis force, Coriolis force due to earth's rotation – experimental demonstration by Focualt pendulum.

Motion under a central force, conservation of angular momentum, Kepler's laws.

UNIT – II

Fields and potential, gravitational field and potential due to spherical bodies, Gauss's and Poisson's equations, gravitational self energy.

Two body problems reduced mass, scattering and scattering cross sections, illustrations, Rutherford scattering by hard spheres, centre of mass and laboratory reference frames, binary stars.

UNIT – III

System of particles, centre of mass, calculation of centre of mass of regular bodies, angular momentum, equations of motion, conservation theorems for energy, momentum and angular momentum, system of variable mass, elastic and inelastic collisions, rigid body, degrees of freedom, Euler's theorem.

UNIT – IV

Molecular rotations (as rigid bodies), moment of inertia, di and tri atomic molecules, intrinsic spin, processional motion, motion of top, gyroscope.

Elastic constants for an isotropic solid, their inter relation, torsion of a cylinder, bending of beam, applications to cantilever.

UNIT – V

Kinematics of moving fluid, equation of continuity, Euler's law for fluidity.

Viscous fluids, streamline and turbulent flow, flow through a capillary tube, Poisvilles law, Reynold's number, Stoke's law, theory of rotation viscometer, effect of temperature and pressure on the viscosity of liquids.

Text and Reference books:

1. E.M. Purcell, Editor, Berkeley Physics Course, Vol. 1, Mechanics, McGraw Hill.

2. R.P. Feynmann, R.B. Lighton, M. Sands, The Feynmann Lectures in Physics, Vol. 1. B.I. publications, Bombay, Delhi, Calcutta, Madras.

3. Mechanics of particles, Rigid Bodies and Continous Media (In Hindi) by Kalra, Bhandari and Kakani

Paper-II: Oscillations, waves and Acoustics

UNIT - I

Free oscillations of simple systems: Equilibrium; concept of potential well, small oscillations approximation, solutions, linear and transverse oscillations of a mass between two springs, diatomic molecule, reduced mass concept.

Damped and forced oscillations: Damped oscillations; critical damping, Q of an oscillator. Forced oscillator with one degree of freedom; Transient and steady state oscillations, resonance energy absorption, low and high frequency responses.

UNIT - II

Free oscillations of system with two degrees of freedom: Two dimensional oscillator; normal modes, longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum.

Fourier analysis: Fourier series and Fourier coefficients; simple examples (square wave, saw-tooth wave, half and full wave rectifier), use of exponential representation for harmonic oscillations, expression for Fourier coefficients. Non-periodic disturbance; representation by Fourier integral, Fourier transform. Case of a wave train of finite length, constancy of $\Delta x\ \Delta k$ (the uncertainty product) qualitative description only

UNIT - III

Wave equation: Waves in a one-dimensional chain of particles; classical wave equation; wave velocity, boundary conditions and normal modes, dispersion relations, dispersion waves, acoustic and optical modes.

Waves in continuous media: Speed of transverse waves on a uniform string, speed of longitudinal waves in a fluid, energy density and energy transmission in waves, typical measurements, dispersion in waves, group velocity and phase velocity, their measurements.

Superposition of waves: Linear homogenous equations and the superposition principle, interference in space and energy distribution; beats and combination tones.

UNIT -IV

Ultrasonics: Production, detection, and applications of ultrasonic waves
Vibrations in bounded systems: Normal modes of a bounded system; harmonics, the quality of sound, Chladni's figures, Vibration of a drum. Noise and Music; Limits of human audibility; intensity and loudness, bel and decibel. Music scale and musical instruments.

UNIT - V

Reflection, refraction, and diffraction of sound: Acoustic impedance of a medium, percentage reflection, and refraction at a boundary, impedance matching for transducers. Diffraction of sound; principle of a sonar system, sound ranging.
Applied acoustics: Transducers and their characteristics, recording and reproduction of sound, measurement of frequency, velocity, waveform, and intensity. The acoustics of halls, reverberation period, Sabine's formula.

Text and Reference Books:

1. Waves and Oscillations, Berkley Physics Course Vol. III
2. Vibrations and waves, I.G. Main (Cambridge University Press)
3. The Physics of Vibrations and Waves, H.J. Pain, McMillan (1975).
4. Oscillations,Waves and Acoustics (In Hindi) by Kakani,Bhandari & Kalra

PAPER-III: ELECTRICITY AND MAGNETISM

UNIT – I

Electric Field: Coulomb's law, unit of charge (SI and other systems of units). Conservation and quantization of charge. Field due to different charge distributions, monopole, dipole, quadrupoles, line charge, sheet charge. Torque on a dipole in uniform field and non-uniform fields, flux of an electric field. Gauss's law - applications to deduce E fields, force per unit area on the surface of a charged conductor.

Potential: Line integral of electric field and electrical potential. Field as the gradient of potential. Potential energy of a system of charges and its calculation in various configurations. Field equations for E in vacuum. Energy associated with E field. Differential form of Gauss's law: Poisson's equation, Laplace's equation, boundary conditions and uniqueness theorems.

Electric field around conductors: induced charges, field and potential inside a conductor, field near the surface of a conductor, method of images.

UNIT – II

Electric fields in matter: atomic and molecular dipoles, induced dipoles, electronic and molecular contributions. Electrical field caused by polarized matter, E and D fields, permittivity, dielectric constant. Capacitor filled with dielectric, field equations in presence of dielectric. The field of a polarized sphere, dielectric sphere in a uniform field. Energy in dielectric systems. Polarizability and susceptibility, frequency dependence of polarizability, Claussius-Mossotti equation.

Magnetic filed: Magnetic field B seen through Lorentz force on a moving charge, unit for B field, magnetic dipoles in atoms and molecules, gyromagnetic ratio. Magnetic field due to currents: Biot and Savart's law. Field equations in magnetostatics, Ampere's law. Fields due to a straight wire, magnetic dipole, circular current and solenoid. Magnetic fields in matter. Magnetizing current, magnetization vector, H and B fields, magnetic permeability, susceptibility. Comparison of magnetostatics and electrostatics.

UNIT – III

Electrical current: current density and current; non-steady currents and continuity equations. Electrical conductivity, resistivity, conductance and their temperature dependence. Thermo electric current and dark current, non-ohmic circuitry, thermistor. Varying current. Rise and decay of currents in LR and CR circuits, time constant, integrating and differentiating circuits, electrical shielding. Study of a discrete LC transmission line.

UNIT – IV

Alternating currents: Skin effect for resistance at high frequencies, complex impedance, reactance, impedances of LCR series and parallel circuits, resonance, Q factor, power dissipation and power factor. AC bridges: Anderson's ,deSauty's and Owens bridges, Self and mutual inductance. Measurement of mutual inductance by Carry Foster Method, Coupled circuits and Transformers.

UNIT – V

Ballistic Galvanometer (moving coil type), its distinction from beat type. B.G. differential equation and its solution under different conditions of damping. Critical

damping, over damping. Logarithmic decrements, charge sensitivity, current sensitivity, determination of B using search coil and B.G. Determination of high resistance using B.G. Factors for sensitivity. B.G. constant. Measurement of mutual inductance by Carey Foster's bridge by B.G. Measurement of small resistance by Kelvin's double bridge.

Text and Reference Books:

1. E.M. Purcell, Ed. Berkely Physics Course, Vol. 1, Electricity and Magnetism McGraw Hill.
2. D. Halliday and R. Resnick, Physics, vol. 2, Wiley Eastern, New Delhi.
3. D.J. Griffiths, Introduction to Electrodynamics, Prentice Hall of India.
4. Reitz and Milford, Electricity and Magnetism, Addison Wesley.
5. A.S. Mahajan and A.A. Rangawala , Electricity and Magnetism, Tata McGraw Hill.
6. A.M. Portis Electromagnetic Fields
7. S.S. Atwood, Electricity and Magnetism, Dover publication.
8. A.F. Kip, Fundamentals of Electricity and Magnetism, International Student Edition, McGraw Hill and Kogakusha, 1969
9. Electricity and Magnetism (In Hindi) by Bhandari, Kalra and Kakani

Paper-IV: PHYSICS PRACTICALS

Note: Students are expected to perform sixteen experiments in all taking the eight experiments from each section. One experiment from section A and one from section B will be set in the examination paper.

The distribution of marks in the practical examination will be as follows:

(i) Two experiments 48 Marks

For each experiment, distribution of marks will be as follows:

Figure : 3

Formula/Theory : 3

Observation : 10

Calculation(including error) and Result : 6

Precautions : 2

(ii) Viva voce 12

(iii) Records 15

Total 75 Marks

LIST OF EXPERIMENTS

Section-A

1. Determination of elastic constants Y,η, σ and K by Searle's method.

2. Determination of thermal conductivity 'K' of a bad conductor by Lee's method.

3. Determination of J by Callender and Barne's method.

4. Study of temperature variation of surface tension by Jaegers method.

5. Study of free fall of a body: use of a digital timer to get time and velocity at different depth and analysis.

6. Study of collision in two dimensions

7. Kater's pendlum , precise setting ,analysis and determination of value of acceleration due to gravity 'g' at a place.

8. Study of damping of a bar pendulum under various kinds of damping mechanisms.

9. To determine coefficient of damping k, relaxation time T and quality factor of a damped SHM using a simple pendulum.

10. Study of dependence of period of oscillations of a spring or rubber band on mass and spring constant.

11. To determine the velocity of sound in air at room temperature with Kundt's tube.

12. Using scattering to deduce the nature of potential hump or well (two dimensional)

13 Study of laws of parallel and perpendicular axes for estimation of moment of inertia.

14. Computer simulation of equations of motion for a system of particles.

15. Computer simulation of molecular rotations, as rigid bodies.

16. Study of motion of a top and a gyroscope.

17. Study of torsion of a wire; dependence on radius, length, torque and material (static method)

18. To determine the modulus of rigidity of the material of a wire by statistical method using Bortan's apparatus

19. To determine the value of modulus of rigidity of the material of a given wire by dynamical method using Maxwell's needle

20 .Study of flow of liquids through capillaries: laminar and turbulent flow stages, capillaries

21. To determine the coefficient of viscosity of water by Poisevill's method

22. Studying the fall of solids through a liquid.

23 To determine the coefficient of viscosity of a liquid (glycerene or castor oil) by Stoke's method

23. Study of air flow through a capillary: U- tube with a long capillary fitted on one arm, mercury level difference pushing air.

24. To determine Poisson's ratio of rubber

SECTION -B

1. Calibration of Carey Foster's bridge wire and determination of the specific resistance of the material of the given wire.

2. Measurement of thermo e.m.f.

3. To study growth and decay of current in R.C. circuit and determine the time constant.

4. To determine impedance of L-R circuit and find phase relation ship in current and voltage.

5. To determine the constants of a ballistic galvanometer. Current and charge sensitivity, time period, log decrement and galvanometer resistance.

6. To determine intensity of magnetic field using search coil and ballistic galvanometer.

7. To determine high resistance by method of leakage .Measure leakage resistance of a condenser.

8. To determine low resistance by Kelvin's double bridge.

9. Determination of dielectric constant of a given liquid.

10. To determine inductance of a coil using Anderson's method.

11. Desauty's bridge method for comparison of two capacitors.

12. To determine mutual inductance by Carry Foster's Method

13. Study of the impedance of a capacitor of varying frequencies to measure C.

14. Response curve for LCR circuits series resonance.

15. Study of a discrete LC transmission line.

16. Response curve for LCR circuit parallel resonance

17. Measurements of electric charge and related quantities using an electrometer.

18. Study of potential distribution in a given geometrical configuration.

19. Mapping of electric fields for specified configurations.

20. Study of magnetic field using a vibration magnetometer.

21 Study of the rise and decay of current in a RL circuits.

22. Characteristics of a choke.

23 Study of the impedance of an inductor at varying frequencies to measure R and L

PHYSICS

Paper Code	Paper & Title	Hrs/week	Max. Marks
2161	I: Kinetic Theory, Thermodynamics and Statistical Physics	2	50
2162	II: Optics	2	50
2163	III: Electronics	2	50
2164	IV: Practical	4	75

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Paper-I: Kinetic Theory, Thermodynamics and Statistical Physics

UNIT – I

Ideal Gas: Kinetic Model, Deduction of Boyle's law, Review of the kinetic model of an ideal gas, Interpretation of temperature, Brownian motion, Estimate of the Avogadro number, Equipartition of energy, specific heat of monatomic gas, extension to di and triatomic gases, Behaviour at low temperatures, Adiabatic expansion of an ideal gas. Application to atmospheric physics (derivation of barometric equation)
Real Gas: Van der Waals model; equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants gas and vapour. Joule-Thomson expansion of an Ideal gas and Van der Waals gas; Constancy of U+pV, Joule coefficients, Estimates of J-T cooling, adiabatic expansion of an ideal gas.
Liquification of gases: Joule Expansion, Joule-Thomson and adiabatic cooling, Boyle temperature and inversion temperature, principles of regenerative cooling and cascade cooling, Liquification of hydrogen and helium, meaning of efficiency.

UNIT - II

Transport phenomena in gases: Molecular collisions mean free path and collision cross-sections, Estimates of molecular diameter and mean free path, Experimental determination of mean free path. Transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

Maxwellian distribution of speeds in gas: Derivation of distribution of speeds and velocities, experimental verification, distinction between mean, rms and the most probable speed values. Doppler broadening of spectral lines.

UNIT -III

The laws of thermodynamics: The Zeroth law, various indicator diagrams, work done by and on the system, First law of thermodynamics, internal energy as a state function. Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics, Different versions of the second law, Reversible and irreversible changes. Practical cycles used in internal combustion engines. Entropy, principle of increase of entropy. Thermodynamic scale of temperature; its identity with the perfect gas scale. Impossibility of attaining absolute zero; third law of thermodynamics.

Thermodynamic relationships: Thermodynamic variables; extensive and intensive, Maxwell's general relationships; applications to J-T cooling and adiabatic cooling in a general system, Van der Waals gas, and the Clausius-Clapeyron heat equation.

Thermodynamic Potentials: Relation to the thermodynamic variables, Equilibrium of thermodynamic systems, Cooling due to adiabatic demagnetization.

UNIT - IV

Statistical basis of the thermodynamics: Probability and thermodynamic probability, principle of equal a priori probabilities, probability distribution and its narrowing with the increasing n, average properties, Accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states.

Phase space representation: The mu space; its division into sheets of energy, phase cells of arbitrary size, one-dimensional oscillator, free particles, the functions $\Phi(E)$ and $\Omega(E)$, definition of probability.

Black Body Radiation: Spectral distribution of BB radiation; pure temperature dependence, Stefan-Boltzmann law, Wien's displacement law, Rayleigh-Jeans law and the ultraviolet catastrophy, Pressure of radiation, Planck's hypothesis, mean energy of an oscillator and the Planck's law, complete fit with the experiment. Interpretation of specific heats of gases at low temperature.

UNIT-V

The bridge of Statistical physics with thermodynamics: Thermal equilibrium between two subsystems, beta parameter and its identity with $(kT)^{-1}$, probability and entropy, Boltzmann entropy relation, statistical interpretation of the second law

of thermodynamics. Boltzmann canonical distribution law; rigorous form of equipartition of energy.

Transition to quantum statistics: 'h' as a natural constant and its implications, Setting phase-cell size as nature's constant (Planck's constant h); quantization of energy. Indistinguishability of particles and its consequences. Bose-Einstein and Fermi-Dirac conditions, applications to liquid helium, free electrons in a metal, and photons in blackbody chamber, Fermi level and Fermi energy.

Text and Reference books:

1. B.B. Laud, "Introduction to Statistical Mechanics" (Macmillan 1981)
2. F. Reif, "Statistical Physics" (McGraw-Hill, 1988)
3. K. Huang, "Statistical Physics" (Wiley Eastern, 1988)
4. Kinetic Theory, Thermodynamics and Statistical physics (in Hindi) ,Kalra,Kakani and Bhandari

Paper-II OPTICS

Unit-I

Format's Principle: Principle of experiments path, the aplantic points of a sphere and other applications.

General theory of image formation: Cardinal points of an system; general relationship; thick lenses and lens combinations, telephoto lenses.

Aberration in images: Chromatic aberration; achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reduction; spherical mirrors and schmidt corrector plates; oil immersion objective, meniscus lenses.

Optical instruments: Entrance and exit pupils, need for a multiple lens eye pieces. Common type eye pieces.

Unit – II

Interference of Light

The principle of superposition ; two slit interference, coherence requirement for the sources, localized fringes in this films, transition from fringes of equal thickness to those of equal inclination, Newton's rings,Michelson interferrometer its uses for determination of wavelength, wavelength difference and standarization of

meter. Intensity distribution in multiple beam interference, Febry-Perot interferrometer and etalon.Lummer Gehrke plate, Lloyds mirror

Unit – III

Diffraction of light

Fresnel diffraction: Half period zones, circular aperture and obstacles ; straight edge, explanation of rectilinear propagation,Zone plate with multi focii

Fraunhofer diffraction: Diffraction at a slit, a circular aperture and a circular disc, resolution of images ; Rayleigh criterion. Resolving power of a telescope and microscope, out line of phase contrast microscopy.

Diffraction grating: Diffraction at N parallel slits, plane diffraction grating, concave grating resolving power of grating and prisms.

Unit – IV

Polarization of light

Double refraction and optical rotations : Double refraction in uniaxial crystals, explanation interms of electromagneties theory, Malus Lawphase retardation plates, rotation of plane of polarization, origin of optical rotation in liquids and in crystals.Babinet Compensator, Polarimters and their applications in measurement of specific rotation

Dispersion and Scattering: Theory of dispersion of light, absorption band and anomalous dispersion theory of Rayleigh Scattering.

Unit - V

LASER

Laser System : Purity of spectral line ; Coherence length and coherence time, spatial coherence of a source ; Einstein's A and B coefficients ; Coherence of induced emissions, conditions for laser action, existence of a metastable state , population inversion by pumping and cavity. He-Ne and Ruby Laser

Application of lasers: Spatial coherence and directionality, estimates of Laser and non linear optics : Polarization P including higher order terms in E and generation of harmonics. Momentum mismatch and choice of right crystal and direction for compensation.

Recommended Books

1. Principle of Optics : B. K. Mathur (IIIrd edition)
2. Text book of Optics : Subrahmanyam and Brijlal (S.Chand and Co.)
3. Optics : Jankins and White (McGraw Hill)
4. Text book of Optics : D. P. Khandelwal
5. Universities Optics Vol. I & II : Whittkar and Yarwood
6. Optics : Ajay Ghatak (Tata McGraw Hill)
7. Optics (in Hindi) Bhandari, Kalra and Kakani

Paper-III: ELECTRONICS

Unit I

Basic circuit analysis:

Voltage and current sources, Open and Short Circuits, Kirchoff's laws, Voltage and current divider rules, Mesh and node analysis, Principle of superposition, Thevenin's and Norton's theorem, Maximum Power transfer theorem.

Semiconductor diodes:

p-n junction diodes, I-V characteristics, diode as a rectifier, half wave, full wave and bridge rectifiers, clippers and clampers, Zener, varactor diode and their applications, Optoelctronic diodes: LED and Photodiodes.

Bipolar Junction Transistors (BJT):

Basic construction of pnp and npn transistors and their operation, Input and output characteristics of CB, CE and CC configurations, Biasing methods, active, saturation and cutoff regions, load line concepts, Graphical analysis of CE configuration and phase relationship.

Field effect transistors:

Basic constructions of JFET and MOSFET, Drain characteristics of JFET, biasing of JFET, operating regions, pinch-off voltage.

Unit II

Small signal amplifiers:

General amplifier characteristics, Two port analysis of a transistor, definition of h-parameters, current gain, voltage gain and power gain of an amplifier, Input and output resistances, Analysis of CB, CE and CC amplifiers for current gain, voltage gain, input and output impedences using h – parameters, Decibel power, Classifications of amplifiers, class A, B, AB and C amplifiers (graphical treatment only), RC coupled transistor amplifier, Gain frequency response, and high frequency limitations. Transformer coupled amplifer.

Unit III

Feed back amplifiers:

Basics of Negative feedback, Merits and demerits of negative feedback and its applications, Voltage series amplifier (Emitter follower) and Current series amplifier (CE amplifier with and without bypass capacitor).

Oscillators:

Positive feedback, Barkhausen criterion, Phase shift oscillator, Colpitt's and Hartley oscillators, and Crystal oscillator.

Operational Amplifiers:

Characteristics of Operational amplifiers, circuit symbols, ideal and practical op-amp, Inverting and noninverting configurations, Applications of OP-AMP as an adder, subtractor, inverter, scale changer, phase shifter, differentiator and integrator.

Unit IV

Digital Electronics:

Binary, Octal, decimal and hexadecimal numbers and their inter conversions, 1's and 2's compliments of binary numbers, addition and subtraction of binary numbers, OR, AND, NOT, NAND, NOR and XOR gates and their symbols and truth tables, Boolean algebra, DeMorgan's theorem, minterms and maxterms, sum of minterms and product of maxterms forms of Boolean functions, simplifications of Boolean function using Karnaugh's map (up to 4-variables).

Unit V

Modulation:

Basics of modulation, amplitude and frequency modulation, sidebands, Comparison between AM and FM, power of amplitude modulation and spectrum, AM and FM transmitters (Block diagram and principle of operation only).

Demodulation:

Demodulation of AM and FM waves, linear envelope detector, Hetrodyne and superhetrodyne receiver (Block diagram and principle of operation only).

Cathode Ray Oscilloscope:

Cathode ray tube- theory and construction, Cathode Ray Oscilloscope (Block diagram and operation), Application of CRO, wave form display, frequency, phase and amplitude determination, Lissajous figures.

Recommended Books:

1. Electronic Devices and Circuit theory by R. Boylestead and L. Nashelsky

(Prentice Hall of India).
2. Foundations of Electronics by D. Chattopadhyaya, P.C. Rakshit, B. Saha and N.N. Purkait (New Age International (P) Limited Publishers).
3. Electronic Devices by Allan Mottershed (Prentice Hall of India).
4. Digital fundamentals by Thomas L Floyd (Unuited Book Stall, New Delhi).
5. Electronic fundamentals and applications by John D. Ryder (Prentice Hall of India).
6. Electricity and Magnetism by K.K. Tewari (S. Chand &Company Limited).
7. Electronics (in Hindi) Bhandari and Kakani

PAPER-IV: PHYSICS PRACTICAL

The distribution of marks in the practical examination will be as follows:

(i) Two experiments 48 Marks

For each experiment, distribution of marks will be as follows:

Figure : 3

Formula/Theory : 3

Observation : 10

Calculation(including error) and Result : 6

Precautions : 2

(ii) Viva voce 12

(iii) Records 15

Total 75 Marks

MAX. MARKS :75

Students are expected to perform sixteen experiments in all taking eight from each section.. One experiment from Section A and one from Section B shall be set in the examination paper.

List of Experiments

Section-A

1 Determination of the size of the Lycopodium grains using Cornu's method.

2. Determination of wavelength of Mercury light using grating

3. Determination of resolving power of grating

4. Determination of dispersive power of the glass prism

5. Determination of wavelength of sodium light using Fresenel's biprism

6. Determination of wavelength of sodium light using Newton's rings

7. Determination of specific rotation of cane sugar solution using polarimeter.

8. Determination of wavelength of ultra sonic wave.

9. Determination of focal length of a high power microscope objective.

10. Measurement of absorption by a solution.

11. Study of aberrations of a thick lens.

12. Study of interference fringes in thin films of the following (not all)

(a) Thermal expansion of a crystal using interference fringes.

(b) Bending of a glass plate under load.

(c) Bending of a rod under load.

(d) Use of Newton's ring to determine the radii of curvature of surfaces.

(e) Use of fringes in wedge film .

13.Resolving limit of the eye and of a telescope with a variable aperture.

14.Fresnel diffraction at a straight edge and a slit.

15. Fraunhoffer diffraction at a single slit.

16. Resolving limits of grating and prism.

17. Study of polarization of the light by simple reflection.

18. Verification of Cauchy's relation using Prism and Gratting.

Section-B

1. To draw characteristic curves of Common emitter transistor and calculate its hybrid parameters.

2. To study gain and frequency response of a single stage Common emitter amplifier.

3. To determine varactor diode characteristics.

4. To draw characteristics of Zener diode and calculate voltage regulation factor.

5. To study ripple factor and internal resistance of a solid state power supply using LR,CR and Pi filter using a CRO

6. To find barrier height of a given solid state diode.

7. Use of p-n junction for the measurement of temperature.

8. Design and construction of phase shift oscillator.

9. Design, build and test of a lograithimic amplifier.

10. Study of a function generator using Operational Amplifier.

11. Study of NAND and NOR circuits (discrete and IC) XOR and De Morgans Theorem.

12 Study of multiplixures and demultiplexures.

13 Study of half adder and full adder circuit.

14. Study RS, D and JK flip - flops.

15. Study of Modulo- 3 , Modulo-5 and Modulo-7 binary counter circuits.

16. Study of characteristics of a thermistor.

17. Determination of solar constant or temperature of an oven through radiation measurement.

18. Resistance thermometry: temperature of a torch bulb filaments from R value, platinum resistance thermometry.

THIRD YEAR T.D.C., SCIENCE 2008-2009

PHYSICS

Paper Code	Paper & Title	Hrs/week	Max. Marks
1161	I: Quantum Mechanics, Atomic and Molecular Physics	2	50
1162	II: Electrodynamics, Electromagnetic Waves and Relativity	2	50
1163	III: Solid State, Nuclear and Particle Physics	2	50
1164	IV: Practical	4	75

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Paper-I: Quantum mechanics and Atomic & Molecular Physics

Unit-I

Introductory Schrodinger theory :

Rise and fall of Plank-Bohr quantum theory Duality of radiation and matter, de Broglie's hypothesis, justification for the relation , experimental confirmation

Phase and group velocities of a wave ; formation of a wave packet, illustrations. Uncertainty principle relating to position and momentum, relating to energy and time, application complimentarity principle, photon interpretation of two slit interference, Einstein-de-Brroglie relations as a link between particle and wave properties, general equation of wave propogation, propogation of matter waves, time dependent and time independent schrodinger equations, physical meaning of ψ, conditions to be satisfied by schrodinger equation as an operator equation. Postulatery approach to wave mechanics, operators, observable and measurements.

Simple one dimensional problem ; particle in a box with rigid walls. Concept of a potential well. Wave functions and energies for the ground and excited states ;

quantization of energy qualitative discussion of the solutions for a shallow potential well.

Unit – II

Operator formulation in quantum mechanics

Operators, eigen values and eigen functions; linear operators, product of two operators, commuting and non commuting operators, simulataneous eigen functions, orthogonal functions.Hermition operators, their eigen values, Hermition adjoint operators, expectation values of an operator.

Application of Operator methids ; Simple harmonic oscillator, step-up and step-down operators, eigen functions and eigen values of the ground state and excited state, zero point energy probability density and its variations with degree of excitation ; orthogonality of wave functions.

Other one dimensional problems ; step potential, penetration through rectangular barrier. Transmission coefficients, barriers of special shapes, quantum mechanical tunneling, particle in of three dimensional cubical box, degeneracy.

UNIT-III

Angular momentum and spin

Central force ; orbital angular momentum, operators for its cartesian components, commutation relations, mutual as well as with L^2 , operators L^+ and L^-, their interpretation as step operators eigen values of L_2 , half integral values for quantum numbers. Angular momentum operators in spherical polar coordinates ; evaluation of their eigen functions explicitly in terms of the coordinates, their degeneracy.
Schrodinger equation for hydrogen atom in spherical polar coordinates ; separations into radial and angular variation, qualitative discussion of spherical harmonics.
Angular momentum and magnetic moment of electron due to orbital motion Bhor mageton.

Unit – IV

Mono valent and divalent atoms

Back ground from quantum theory : The four quantum numbers ; spectral terms arising from L-S coupling, s,p,d,f, notation, selection rules. Half life of excited states, width of a spectral line.
Spectra of mono and divalent atoms : Doublet fine structures of hydrogen lines ; screening constant for monovalent atoms, series limits, doublet structure for alkali spectrum. Spectra of helium and alkaline earth atoms, singlet and triplet series.

Effect of magnetic field on energy levels : Gyromagnetic ratios for orbital and spin motions ; vector model, Lande g factor, strong and week field effects, illustrative cases of H, Na, Ca and Hg.
X-ray spectra : The continuous x-ray spectrum, Duane and Hunt limit. Characteristic x-rays : Mosley's law, doublet fine structure, H-like character of x-ray states, x-ray absorption spectra, absorption edges.

Unit – V

Diatomic and triatomic molecules

Sharing of electrons : formation of molecular orbitals, H_2^+ ions H_2^- molecule, electronic levels, singlet and triplet characters. Rotational energy levels, internuclear distance.
Vibrational energy levels, force constants, anharmonicity dissociation energy, isotope effects on rotational and vibrational energies. Raman effect.
Spectra of diatomic molecules : Pure rotation spectra ; selection rules, vibration-rotation spetra, selection rules, vibration-rotation spectra ; selection rules, P, Q and R branches.
Electronic band systems, sequences and progressions
Frnak-Candon principle.

Recommended Books

1. Quantum mechanics : S.P. Singh, M.K. Bagde and Kamal Singh (S.Chand and Co
2. Quantum mechanics A listair I M Rac. ELBS (Low Drice edition)
3. Quantum mechanics , S. N. Biswas, Books and Allied, Calcutta (P) Ltd.
4. Atomic and Nuclear Physics ; A.B. Gupta, mew central book agency pvt. Ltd.
5. Introduction to Modern Physics, H S Mans and G K Mehta

PAPER-II: ELECTRODYNAMICS, ELECTROMAGNETIC WAVES AND RELATIVITY

UNIT – I

Motion of charged particles in E and B fields: Case of cathode ray oscillograph, positive ray parabola, velocity selector, magnetic focusing, mass spectrography.

Faraday's law for electromagnetic induction: Faraday's law integral and differential forms; self-inductance of a solenoid and of a straight conductor, energy stored in an inductor and in the magnetic field. Displacement current; modified Ampere's law, Maxwell's equation for time-dependent electromagnetic field in vacuum and in material media, boundary conditions.

UNIT – II

Electromagnetic potentials: Magnetic vector potential A and scalar potential Φ. Poisson's equation for A in terms of current density, solutions for line surface currents. Coulomb and Lorentz gauge transformations, Lorentz law in terms of potentials.

Maxwell's equations and electromagnetic waves: Plane-wave solution for Maxwell's equation; orthogonality of E, B and propagation vector. Poynting vector; energy and momentum propagation, reflection and transmission at dielectric boundaries (normal incidence), polarization by reflection, Brewster's angle.

UNIT – III

Electromagnetic waves in conductors: Modified field equation; attenuation of the wave, reflection at and transmission through a conducting surface.Total internal reflection

Radiation from accelerated charges: Modification(Conceptual only) of Coulomb's law to include velocity and acceleration dependent terms in E field. Radiation from an oscillating dipole and its polarization. Radial and spherical power of electromagnetic radiation, Radiation pressure equation in free space and medium

UNIT – IV

The Lorentz transformations: Galilean transformations; Newtonian relativity, instances of their failure; electromagnetism, aberration of light, Michelson-Morley experiment; Einstein's basic postulates and geometric derivation of Lorentz transformations; invariance of Maxwell's equations, length contraction, simultaneity, synchronization and time dilation, Einstein's velocity addition rule, Doppler effect in light. Relativistic gravitational Red Shift

UNIT – V

Relativistic dynamics: Variation of mass with velocity, mass energy equivalence, relativistic formulae for momentum and energy.

The structure of space-time: Four vectors; invariance of an interval, time-like, space-like and light-like intervals, Minkowski space.

Relativistic electrodynamics: Electric field of a point charge in uniform motion; transverse components, magnetism as a relativistic phenomenon, transformation of E and B fields.

Text and Reference books:

1. D.J. Griffiths: Introduction to Electrodynamics, Prentice Hall of India, 1989.
2. Reitz and Milford: Introduction to Electrodynamics, Addison-Wesley.
3. A.M. Portis: Electromagnetic Fields
4. J.B. Marion: Classical Electromagnetic radiation (Academic Press)
5. R.P. Feynmann, R.B. Leighton and M. Sands: The Feynmann lectures in physics, Vol. II (B.I. Publications).
6. B. Saraf et al. : Physics through experiments Vol. I – EMF, constant and varying, Vikas Publishing House.
7. D.R. Corson and P. Lorrain: Introduction to Electromagnetic fields and waves, Freeman-Taraporevala, Bombay, 1970.
8. E.C. Jordan and K.G. Balmain: Electromagnetic waves and radiating systems, 2nd Ed., Prentice Hall of India, New Delhi, 1971.
9. Eletrodynamics ,Electromagetic Waves and Relativity (In Hindi) Kalra,Kakani and Bhandari

Paper-III: SOLID STATE, NUCLEAR AND PARTICLE PHYSICS

UNIT – I

Crystal geometry: crystal lattice, crystal planes and Miller indices, unit cells. Typical crystal structures, coordination number, packing fraction, symmetry elements, rotation, inversion and reflection, point groups and crystal classes, space groups.

Crystallography: Bloch functions, Bloch's theorem, diffraction of X-rays by a crystal lattice. Laue's formulation of X-ray diffraction, reciprocal lattice, Brillouin zones, Laue spots, rotating crystal and Debye-Scherrer methods.

UNIT – II

Types of binding in solids: covalent binding and its origin, ionic binding, energy of binding, transition between covalent and ionic binding, metallic binding, Van der Waal's binding, hydrogen bond.

Conduction in metals : Drude's theory, DC conductivity, AC conductivity, plasma frequency, thermal conductivity of metals, Fermi-Dirac distribution, thermal properties of free-electron gas, Sommerfeld's theory of conduction in metals.

UNIT – III

Conduction in semiconductor: Bands in solids, metals, insulators and semiconductors. Motion of free electrons on a chain of atoms, effective mass, electrons and holes, donor and acceptor impurities, donor impurity levels. Thermal excitation of carriers, electrical conductivity. Elementary ideas of Hall effect in metals and semiconductors and magnetoresistance.

Charge transport in semi-conductors: Ionization energy of impurity atoms, carrier concentration in doped semiconductors at high and low temperatures, control of conductivity of semiconductors by impurities and current flow in semi-conductors.

UNIT – IV

Structure of nucleus: discovery of the nucleus, composition. Basic properties: charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus. Coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve. Liquid drop model of the nucleus.

Nuclear forces: two-nucleon system, deuteron problem, binding energy, nuclear potential well, results of p-p and n-p scattering experiments, meson theory of nuclear forces e.g. Bartlett, Heisenberg, Majorana forces and potentials.

Radioactivity: decay constant and half-life, spectra of emitters, Geiger-Nuttal law, Gamow's explanation. Beta decay: elementary Fermi's theory. Antineutrino. Nuclear radiation, energy levels.

UNIT – V

Detectors for charged particles: Ion chamber, Geiger counter, resolving time, cloud chamber.

Accelerators: Need for accelerators; cyclic accelerators, cyclotron, betatron ,synchrocyclotron, variable energy cyclotron, phase stability.

Rutherford scattering formula, different types of nuclear reactions.

Artificial radioactivity: Nuclear fission, neutron reactions, Fermi and transuranic elements, chain reaction, criticality, moderators.

Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary cosmic rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories.

Resonant particles: discovery and important properties. Strangeness, conservation of strangeness in particle interactions, quark hypothesis, high energy electron scattering from protons, basic interactions of quarks and leptons, interrelation between particle physics and cosmology.

Text and Reference books:

1 D.J. Griffiths: Introduction to Electrodynamics, Prentice Hall of India, 1989.
2 Reitz and Milford: Introduction to Electrodynamics, Addison-Wesley.
3 A.M. Portis: Electromagnetic Fields
4 J.B. Marion: Classical Electromagnetic radiation (Academic Press)
5 R.P. Feynmann, R.B. Leighton and M. Sands: The Feynmann lectures in physics, Vol. II (B.I. Publications).
6 B. Saraf et al. : Physics through experiments Vol. I – EMF, constant and varying, Vikas Publishing House.
7 D.R. Corson and P. Lorrain: Introduction to Electromagnetic fields and waves, Freeman-Taraporevala, Bombay, 1970.
8 E.C. Jordan and K.G. Balmain: Electromagnetic waves and radiating systems, 2nd Ed., Prentice Hall of India, New Delhi, 1971.
9. Solid State Physics, Nuclear Physics and Particle Physics (In Hindi) Kalra,Kakani and Mandot

Paper-IV: PHYSICS PRACTICALS

Note: Students are required to do any sixteen experiments from two sections in all taking eight experiment from each section. One experiment from section A and ten from section B shall be set in the examination paper.

The distribution of marks in the practical examination will be as follows:

(i) Two experiments 48 Marks

For each experiment, distribution of marks will be as follows:

Figure : 3

Formula/Theory : 3

Observation : 10

Calculation (including error) and Result : 6

Precautions : 2

(ii) Viva voce 12

(iii) Records 15

Total 75 Marks

LIST OF EXPERIMENTS

Section-A

1. Determination of e/m, specific charge of an electron by helical method.

2. Determination of Planck's constant by photo conductivity method.

3. Determination of refractive index of air using Jamin's interferrometer.

4. Determination of wave length of a monochromatic light using Michelsons Interferometer.

5. Verification of Fresnels law of reflection by a plane surface.

6. To analyze elliptically polarized light by photoelectric cell/Babinets compensator.

7. Determination of viscosity of a fluid by rotation viscometer.

8. Study of ferromagnetic material by plotting hysteresis curve of the specimen by Ballistic galvanometer/ CRO.

9.Study of Photoelectric effect and to determine electronic charge and work function

10. Determination of ultrasonic wave velocity in a liquid

12.Determination of Surface tension by Forgusion-Kennedy method.

13.Wave length of spectral lines of Hg lamp by Constant Deviation Spectrometer (Visual)

Section-B

1. Study frequency response of a common emitter current series negative feed back amplifier.

2. Study the characteristics of a Field effect Transistor and to determine mutual conductance, output resistance and voltage gain.

3. Study voltage wave forms of a transistorized monostable and bistable multivibrator.

5. Study clipping and clamping using diode.

6. Study detection efficiency of a diode by direct method.

7. Study amplitude modulation with the help of CRO

8. Study frequency response of an inverting and non-inverting operational amplifier

9. .Study variation of output power with load impedance in Push-Pull amplifier.

10.Study of Hartley oscillator and determination of Q of a standard coil

11.Study frequency response of a transformer coupled amplifier.

12. Study of field emission as a tunneling phenomenon.

13. Numerical simulation of wave functions of simple harmonic oscillator.

14.Computation of wave function and their interpretation for various potentials.

15. Computation of transmission coefficients for barriers of different shapes.

16. Simulation of wave functions for a particle in a critical box.

17. Study of fine structure in a doublet spectrum and its quantum mechanical interpretation.

18. Interpretation of angular wavefunctions of hydrogen atom and its application to the study of pure rotation spectra of molecules.

19. Study of Paschen - Back effect and its quantum mechanical interpretation.

20 Flame spectra of some salt.

21. Spectrum of atomic hydrogen and Rydeberg consatnt.

22. Absorption spectrum of a coloured solution or flourescene spectrum of a salt.(e.g. uranyl nitrate)

23. Interoreting a given Zeeman spectrum with a polariod.

24. Absorption spectrum of Iodine vapour.

25. Studying the Raman spectrum of a sample(may use laser excitation).

26 Studying the linear dispersion in a given prism or a grating specrtometer.

27. Studying the life time of a phospher through decay study.

28 Study of induced emf for a magnet crossing a coil(CDPE Jaipur experimemt)