NATIONAL UNIVERSITY

Syllabus
Subject: Physics

Three Year B.Sc. Pass Course
Effective from the Session: 2013–2014

National University

Syllabus for Three Year B.Sc. Pass Course

Subject: Physics

Session: 2013-2014

Course content and marks distribution

Paper Code	Paper	Paper Title	Marks	Credits
First Year				
112701	Paper-I	Mathematical Methods, Waves and Optics	100	4
112703	Paper-II	Mechanics, Properties of Matter and Relativity	100	4
Second Year				
122701	Paper-III	Thermodynamics and Statistical Mechanics	100	4
122703	Paper-IV	Electromagnetism and Basic Electonics	100	4
Third Year				
132701	Paper-V	Atomic Physics and Quantum Mechanics	100	4
132703	Paper-VI	Nuclear Physics and Solid State Physics	100	4
132704	Paper-VII	Physics Practical	100	4
		Total =	700	28

Detail Syllabus

First Year

Paper Code	Paper	Paper Title	Marks	Credits
112701	Paper-I	Mathematical Methods, Waves and Optics	100	4

A. MATHEMATICAL METHODS

1. Vector Analysis

Transformation properties of vectors; Differentiation and integration of vectors; Line integral, volume integral and surface integral involving vector fields; Gradient, divergence and curl of a vector field; Gauss' divergence theorem, Stokes' theorem, Green's theorem - application to simple problems; Orthogonal curvilinear co-ordinate systems, unit vectors in such systems, illustration by plane, spherical and cylindrical co-ordinate systems only.

2. Matrices

Hermitian adjoint and inverse of a matrix; Hermitian, orthogonal, and unitary matrices; Eigenvalue and eigenvector (for both degenerate and non-degenerate cases); Similarity transformation; digitalization of real symmetric matrices.

3. Ordinary Differential Equations

Solution of second order linear differential equations with constant coefficients and variable coefficients by Frobenius' method (singularity analysis not required); Solution of Legendre and Hermite equations about x=0; Legendre and Hermite polynomials - orthonormality properties.

4. Partial Differential Equations

Solution by the method of separation of variables; Laplace's equation and its solution in Cartesian, spherical polar (axially symmetric problems), and cylindrical polar (`infinite cylinder' problems) coordinate systems.

5. Fourier Series

Fourier expansion – statement of Dirichlet's condition, analysis of simple waveforms with Fourier series. Introduction to Fourier transforms; the Dirac-delta function and its Fourier transform; other simple examples. Vibration of stretched strings- plucked and struck cases.

B. WAVES AND OPTICS

1. Linear Harmonic Oscillator (LHO)

LHO. Free and forced vibrations. Damping. Resonance. Sharpness of resonance. Acoustic, optical, and electrical resonances: LCR circuit as an example of the resonance condition. A pair of linearly coupled harmonic oscillators --- eigenfrequencies and normal modes.

2. Waves

Plane progressive wave in 1-d and 3-d. Plane wave and spherical wave solutions. Dispersion: phase velocity and group velocity.

3. Fermat's principle

Fermat's principle and its application on plane and curved surfaces.

4. Cardinal points of an optical system

Two thin lenses separated by a distance, equivalent lens, different types of magnification, Helmholtz and Lagrange's equations, paraxial approximation, introduction to matrix methods in paraxial optics – simple application.

5. Wave theory of light

Huygen's principle; deduction of law of reflection and refraction.

6. Interference of Light

Condition of sustained interference by analytical treatment, Division amplitude and division of wave front, methods for production of interference fringes by biprism and determination of wavelength, measurement of thickness of thin films, colour of a thin film in reflected and

transmitted light, Haidinger's fringe, Theory of Newton's rings. Determination of wavelength and refractive index using Newton Ring apparatus .

7. Interferrometer

Michelson's interferometer and its theory relating to the formation of circular fringe's, Determination of wavelength of a source and small difference of wave lengths in D lines by Michelson's interferometer, standardization of a meter by Michelson's interferometer.

8. Diffraction of light

Fresnel and Fraunhofer class of diffraction, Fresnel's half period zones, zone plate its similarity with convex lens. Diffraction at straight edge, circular aperture.

9. Elements of fiber optics

Construction of optical fibers, image formation, numerical aperture, structure--step index, graded index, uses.

Books &References:

Mathematical Physics

1. Introduction to Mathematical Physics - C. Harper (Prentice-Hall of India).
2. Mathematical Methods - M. C. Potter and J. Goldberg (Prentice-Hall of India).
3. Vector Analysis - M. R. Spiegel, (Schaum's Outline Series) (Tata McGraw-Hill).
4. Tatwiya Padartha Bidyar Bhumika – S. Sengupta, Asok Ghosh and D. P. Roychaudhuri (W.B. State Book Board (WBSBB)).
5. Mathematical Physics – P.K. Chattopadhyay (Wiley Eastern)

Waves and Optics

1. Waves and Oscillations - Rathin N. Chaudhury (New Age Publ.).
2. Waves- J R Crawford (Tata McGraw Hill)
3. Fundamentals of Optics - F. A. Jenkins and H. E. White (Mc Graw Hill, Kogakusha).
4. Geometrical and Physical Optics - B. S. Longhurst (Orient Longmans).
5. Optics – A. K. Ghatak (Tata Mc Graw Hill).
6. Optics – Hecht and Zajac (Addison-Wesley)

Paper Code	Paper	Paper Title	Marks	Credits
112703	Paper-II	Mechanics, Properties of Matter and Relativity	100	4

A. MECHANICS

1. Mechanics of a Single Particle

Velocity and acceleration of a particle in (i) plane polar coordinates - radial and cross-radial components (ii) spherical polar and (iii) cylindrical polar co-ordinate system; Time and path

integral of force; work and energy; Conservative force and concept of potential; Dissipative forces; Conservation of linear and angular momentum.

2. ***Mechanics of a System of Particles***

Centre of mass, centre of mass frame, centre of moving systems, Collision: elastic and inelastic collision, coefficient of restitution. Expression of velocities of two bodies after elastic and inelastic collision in laboratory frame. Elastic collision in centre of mass frame. Relationship between angle of scatterings in laboratory frame and centre of mass frame. Motion of a rigid body about a fixed axis. Angular momentum and expression of angular momentum of a system of rotating bodies. Relationship of angular momentum of a system of bodies with angular momentum in centre of mass frame. Principle of conservation of angular momentum.

3. Rotational Motion

Moment of inertia, radius of gyration; Energy and angular momentum of rotating systems of particles; Parallel and perpendicular axes theorems of moment of inertia; Calculation of moment of inertia for simple symmetric systems; Ellipsoid of inertia and inertia tensor; Setting up of principal axes in simple symmetric cases. Rotating frames of reference - Coriolis and centrifugal forces, simple examples. Force free motion of rigid bodies - free spherical top and free symmetric top.

B. PROPERTIES OF MATTER

1. Gravitation

Gravitational potential and intensity, calculation of gravitational potential and intensity due to thin spherical shell, thick spherical shell, sphere, circular disc etc. Compound pendulum, measurement of ‘g’ by bar and Kater’s pendulum.

2. Elasticity

Hooke's law, work done in strain, elongation strain, volume strain, shearing strain, Young's modulus, Bulk modulus and rigidity modulus and their inter-relationship, Poisson’s ratio, torsion in a cylinder, twisting couple, variation of strain along its length. Bending of beams and cantilevers in different cases: loaded at free end, loaded uniformly, bending moments.

3. Viscosity

Equation of continuity, Energy of a liquid in flow, Bernoulli's theorem, critical velocity, Reynold's number, Poiseuille's equation, motion in a viscous medium: Stoke's law, streamline and turbulent flow.

4. Surface tension

Surface tension as a molecular phenomenon, surface tension and surface energy. Excess pressure on curved liquid surface (spherical bubble and drop). Theory and experimental determination of surface tension of liquid by ripple method.

C. RELATIVITY

1. Introduction

Galilean transformation and invariance of Newton's laws of motion, non-invariance of Maxwell's equations. Michelson-Morley experiment and explanation of the null result.

2. Special Theory of Relativity

Concept of inertial frame. Postulates of special theory; simultaneity; Lorentz transformation along one of the axes – length contraction, time dilatation and velocity addition theorem, Fizeau's experiment. Four vectors. Relativistic dynamics : variation of mass with velocity; energy momentum relationship.

3. Vectors and Tensors

Covariant and contravariant vectors. Contraction. Covariant, contravariant, and mixed tensors of rank-2, transformation properties. The metric tensor (flat space-time only). Raising and lowering of indices with metric tensors. (Consistent use of any one convention --- diag(-1,1,1,1) or diag(1,-1,-1,-1).) Example of common four-vectors: position, momentum, derivative, current density, four-velocity.

Books &References:

<u>Mechanics & Properties of Matter</u>

1. Theoretical Mechanics - M. R. Spiegel, (Schaum's Outline Series) (McGraw-Hill).
2. Mechanics - K. R. Symon (Addison-Wesley).
3. Introduction to Classical Mechanics - R. G. Takwale and P. S. Puranik (Tata McGraw-Hill).
4. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw-Hill).
5. Physics-I - D. Halliday and R.Risnick (Wiley India Pvt Ltd).
6. Padarther Dharma - D. P. Ray Chaudhuri (West Bengal State Book Board).
7. The Feynman Lectures on Physics – Vol I (Addison-Wesley).
8.An Introduction to Mechanics – D. Keppner and R.J. Kolenkow (Tata McGraw-Hill).
9.Mechanics – H. S. Hans and S. P. Puri (Tata McGraw-Hill).
10. Classical Mechanics – J. Goldstein (Narosa Publ. House).
11. Classical Mechanics – A. K. Roychaudhuri (O. U. P., Calcutta).

<u>Relativity</u>

1. Concepts of Modern Physics, Arthur Beiser, (Tata McGraw-Hill)
2. Modern Physics, K. S. Krane, (Wiley India Pvt Ltd)
3. Modern Physics, Murugeshan & Sivaprasath, (S. Chand & Company Ltd)
4. Introduction to Mechanics, Mahendra K. Verma, (Universities Press)

References:

1. Introduction to Special Relativity, R. Resnick, (Wiley India Pvt Ltd)
2. Elements of Properties of Matter, D. S. Mathur, (S. Chand & Company)
3. General Theory of Relativity, P. A. M. Dirac, (Prentice-Hall of India)

Second Year

Paper Code	Paper	Paper Title	Marks	Credits
122701	Paper-III	Thermodynamics and Statistical Mechanics	100	4

A. THERMODYNAMICS

1.Kinetic Theory of Gasses

Basic assumptions of kinetic theory, Ideal gas approximation, deduction of perfect gas laws. Maxwell's distribution law (both in terms of velocity and energy), root mean square and most probable speeds. Finite size of molecules : Collision probability, Distribution of free paths and mean free path from Maxwell's distribution. Degrees of freedom, equipartition of energy (detailed derivation not required).

2 .Real Gases

Nature of intermolecular interaction : isotherms of real gases. Van der-Waals equation of state, Other equations of state (mention only), critical constants of a gas, law of corresponding states; Virial Coefficients, Boyle temperature.

3. Heat transfer

Thermal conductivity, diffusivity, Fourier equation for heat conduction –its solution (steady state) for rectilinear and radial (spherical and cylindrical) flow of heat, Determination of thermal conductivity of solids by Searle's method, Forbe's method and Lee's disc method(for bad conductors).

4. Radiation

Nature of radiant heat, emissive and absorptive power, prevost's theory of heat exchange, Kirchhoff's law (simple deduction), Black body radiation, Stefan-Boltzmann law, Planck's formula for black body radiation (elementary idea).

5. Basic Concepts of Thermodynamics

Microscopic and macroscopic points of view : thermodynamic variables of a system, State function, exact and inexact differentials.

6 . First Law of Thermodynamics

Thermal equilibrium, Zeroth law and the concept of temperature. Thermodynamic equilibrium, internal energy, external work, quasi-static process, first law of thermodynamics and

applications including magnetic systems, specific heats and their ratio, isothermal and adiabatic changes in perfect and real gases.

7. Second Law of Thermodynamics

Reversible and irreversible processes, indicator diagram. Carnot's cycles-efficiency, Carnot's theorem. Kelvin's scale of temperature, relation to perfect gas scale, second law of thermodynamics – different formulations and their equivalence, Clausius inequality, entropy, change of entropy in simple reversible and irreversible processes, entropy and disorder; equilibrium and entropy principle, principle of degradation of energy.

8. Thermodynamic Functions

Enthalpy, Helmholtz and Gibbs' free energies; Legendre transformations, Maxwell's relations and simple deductions using these relations; thermodynamic equilibrium and free energies.

9. Change of State

Equilibrium between phases, triple point : Gibbs' phase rule (statement only) and simple applications. First and higher order phase transitions, Ehrenfest criterion. Clausius-Clapeyron's equation. Joule-Thomson effect.

B. STATISTICAL MECHANICS

1. Phase space

Concept of Microstates and macro states, Basic postulates - equal priori probability and ergodic hypothesis, Liouville theorem and conservation of density in phase space, Statistical ensemble - Micro-canonical, Canonical and Grand canonical ensemble and their partition functions, Relation of statistical mechanics with thermodynamics - Expressions of different thermodynamical quantities (e.g. Free energy, pressure, average energy, entropy, Specific heat) in terms of partition function;

2. Classical statistics

Maxwell-Boltzamann distribution function, Calculation of thermodynamical quantities for ideal gas, Maxwell-Bolzamann velocity distribution law, (Average, most probable velocity and root mean square speed and their relation; Principle of equipartition of energy.)

3. Quantum statistics

Concept of indistinguishability, Entropy of mixing and Gibb's paradox, Resolution of Gibb's paradox introducing indistinguishability; Bose-Einstein distribution function and its behaviour with temperature, Basic idea of phenomenon Bose-Einstein condensation (Qualitative description), Calculation of various thermodynamical quantities of photon gas (black body radiation); Fermi-Dirac distribution function and its behaviour with temperature, Basic idea of Fermi surface and fermi energy, Calculation of various thermodynamical quantities of free electron gas; Classical limits and distinguishing features of classical and quantum statistics.

Books &References:

<u>Heat &Thermodynamics</u>

1. Heat and thermodynamics - Zemansky and Ditman (Mc Graw Hill, Kugakusha).
2. Kinetic theory of gases - Loeb (Radha Publ. House).
3. Thermodynamics – F. Fermi (Dover)
4. Tapgatividya – Asoke Ghosh (W.B.S.B.B).
5. A Treatise on Heat - Saha and Sribastava (The Indian Press Ltd).
6. Gaser Anabik Tattwa- Pratip Kumar Chaudhuri (W. B. S. B. B).
7.Thermal Physics – S. Garg, R. M. Bansal, C. K. Ghosh (Tata Mc Graw Hill).
8.Heat and Thermodynamics – H. P. Roy and A. B. Gupta (New Central Book Agency).

<u>Statistical Mechanics</u>

1. Statistical Physics, F. Mandle (ELBS).
2. Fundamentals of Statistical and Thermal Physics, F. Reif, (Mc Graw Hill).

Paper Code	Paper	Paper Title	Marks	Credits
122703	Paper-IV	Electromagnetism and Basic Electonics	100	4

A. ELECTROMAGNETISM

1. Electrostatics

Quantisation of charge and Millikan's oil-drop experiment, Coulomb's law, intensity and potential --- example of point charge, Gauss' theorem --- simple applications, potential and field due to an electric dipole, mechanical force on the surface of a charged conductor. Dielectric medium, polarization, electric displacement.

2. Capacitor

Parallel-plates and cylindrical, energy stored in parallel plate capacitor.

3. Steady Current

Network analysis --- Kirchoff's laws, Thevnin and Norton's theorem, Wheatstone bridge, potentiometer.

4. Thermoelectricity

Seebeck, Peltier, and Thomson effects, laws of thermoelectricity, thermoelectric curve --- neutral and inversion temperature, thermoelectric power.

5. Magnetic effect of current

Biot and Savart's law, Ampere's circuital law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop --- concept of magnetic dipole, Ampere's equivalence theorem.

6. Lorentz force

Force on a moving charge in simultaneous electric and magnetic fields, force on a current carrying conductor in a magnetic field.

7. Magnetic materials

Intensity of magnetization, relation between **B**, **H**, and **M** --- illustration in the case of bar magnet, magnetic susceptibility --- dia, para and ferromagnetic materials, statement of Curie's law. Hysteresis in a ferromagnetic material, hysteresis loss.

8. Electromagnetic induction

Self and mutual inductances in simple cases, energy stored in inductance.

9. Varying currents

Growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit.

10. Alternating current

Mean and r.m.s. values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit --- power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer.

B. BASIC ELECTRONICS

1. Thermo-ionic emission

classical deduction of Richardson’s equation, characteristic curve of a vacuum diode, space charge, temperature and space charge limited current, Child Langmuir law, Triode and its characteristics curves, parameters from these curves. Triode as an amplifier, graphical analysis with load line. Semiconductors : junction diode, zener diode & their applications.

2. Basic concepts of Transistor

PNP & NPN transistors operation, characteristics curves of a transistor in common emitter and common base mode - current amplification factor, input & output resistance. Transistor as an amplifier (simple Mathematical treatment) in CE mode, d.c and a.c load line, graphical analysis of the amplifier.

3. Feed back in amplifiers

conditions of oscillation, Barkhausen criteria ; Working principle & description of Tuned collector and Hartley oscillators mentioning frequency of oscillation.

4. Logic gates

Logic gates: OR, AND, NOT, NAND, NOR, XOR, their circuit realization & truth tables. Boolean algebra, de Morgan's theorem, flip-flop circuit.

Books &References:

Electricity & Magnetism

1. Introduction to Electrodynamics – D. J. Griffith, (Prentice Hall, India Pvt. Ltd).
2. Berkeley Series Vol II (Electricity and Magnetism) E.M. Purcell (Tata McGraw-Hill).
3. The Feynman Lectures on Physics – Vol. II (Addison – Wesley).
4. Electricity and Magnetism - J. H. Fewkes and J. Yarwood (Oxford Univ. Press, Calcutta).
5. Physics-II - D. Halliday and R.Risnick (Wiley India Pvt Ltd).
6. Classical Electrodynamics – J.D> Jackson (Wiley India)

Electronics

1. Integrated Electronics – J. Millman and C. C. Halkias (Mc Graw Hill).
2. Electronic Fundamentals and Applications – D. Chattopadhyay and P. C. Rakshit (New Age International)
3. Electronics Fundamentals and Applications – J. D. Ryder (PHI Pvt. Ltd).
4. Electronic Device and Circuit Theory – R. Boylestad and L. Nashelsky (Prentice – Hall).
5. Integrated Electronics – J. Millman and C. C. Halkias (Mc Graw Hill).
6. Digital Logic and Computer Design – M. Moris Mano, (PHI (Pvt.) Ltd.).
7. Electronics – R.K. Kar (**Books and Allied (P) Ltd.**).
8. Digital Electronics – D. Ray Chaudhuri (Platinum Publishers)

Third Year

Paper Code	Paper	Paper Title	Marks	Credits
132701	Paper-V	Atomic Physics and Quantum Mechanics	100	4

1. Atomic Spectrum:

Good quantum numbers, and selection rules. Stern-Gerlach experiment and spin as an intrinsic quantum number. Incompatibility of spin with classical ideas. Bohr-Sommerfeld model. Fine structure. Study of fine structure by Michelson interferometer.

2. Vector model of atom:

Magnetic moment of the electron, Lande g factor. Vector model – space quantization. Zeeman effect. Explanation from vector atom model.

3. Bohr's hydrogen atom

Theory of hydrogen atom, expression of radii of electrons, expression of energies and hydrogen atom spectrum. Effect of nuclear motion on atomic spectra, reduced mass, modified Rydberg constant and wave number, Evidences in favour of Bohr' s theory, correspondence principle, fine structure of special lines and Sommerfield's relativistic atom model.

4. Uncertainity principle

Uncertainity principle - Its deduction and application to simple problems, viz, Non-existence of electron within nucleus, Ground state energy of Hydrogen atom, Radius of Bohr orbit.

5. Molecular spectroscopy

Diatomic molecules – rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and its application to molecular spectroscopy (qualitative discussion only).

B. QUANTUM MECHANICS

1. Old quantum theory

Planck's formula of black-body radiation. Photoelectric effect. Quantization of energy levels.

2. Basic quantum mechanics

de Broglie hypothesis. Electron double-slit experiment. Compton effect, Davisson-Germer experiment, Heisenberg's uncertainty principle (statement) with illustrations. Concept of wave function as describing the dynamical state of a single particle. Group and phase velocities, classical velocity of a particle and the group velocity of the wave representing the particle. Principle of superposition. Schr**ö**dinger equation. Probabilistic interpretation; equation of continuity, probability current density. Boundary conditions on the wave function.

3. Basic postulates of quantum mechanics

Dynamical variables as linear hermitian operators and eigenvalue equations, Momentum, energy and angular momentum operators. Measurement of observables, expectation values. Commutation relations between operators. Compatible observables and simultaneous measurements, Ehrenfest theorem.

Books &References:

Atomic Physics

1. Mani H.S. and Mehta G.K. : Introduction to Modern Physics
2. Beiser A. : Perspectives of Modern Physics
3. White A.E. : Introduction to Atomic Physics
4. Barrow H., : Introduction to Molecular Physics
5. Feynmann R.P. Et al : The Feymann Lectures in Physics, B.I. Publication
6. Hertzberg G. : Atomic Spectra and Atomic Structure
7. Hertzberg G. : Molecular spectra and Molecular Structure
8. Herchiaf : Fluorescence and phosphorescene Olon,

Quantum Mechanics

1. Quantum Mechanics – J. L. Powell and B. Crasemonn, (Oxford, Delhi).
2. Quantum Mechanics – F. Schwabl (Narosa).

3. Quantum Mechanics – A. K. Ghatak and S. Lokenathan (Macmillan, Delhi).
4. Introductory Quantum Mechanics - S. N. Ghoshal (Calcutta Book House).
5. A Textbook of Quantum Mechanics – P. M. Mathews and K. Venkatesan (Tata Mc Graw Hill).
6. Modern Quantum Mechanics – Sakurai (Persian Education)

Paper Code	Paper	Paper Title	Marks	Credits
132703	Paper-VI	Nuclear Physics and Solid State Physics	100	4

A. NUCLEAR PHYSICS

1. Bulk properties of nuclei

Nuclear mass, charge, size, binding energy, spin and magnetic moment. Isobars, isotopes and isotones; mass spectrometer (Bainbridge).

2. Nuclear structure

Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model (descriptive) and the Bethe-Weizsacker mass formula, application to stability considerations, extremesingle particle shell model (qualitative discussion with emphasis on phenomenology with examples).

3. Unstable nuclei

(a) Alpha decay : alpha particle spectra – velocity and energy of alpha particles. Geiger-Nuttal law.

(b) Beta decay : nature of beta ray spectra, the neutrino, energy levels and decay schemes, positron emission and electron capture, selection rules, beta absorption and range of beta particles, Kurie plot.

(c) Gamma decay : gamma ray spectra and nuclear energy levels, isomeric states. Gamma absorption in matter, photoelectric process, Compton scattering, pair production (qualitative).

4. Nuclear fission and fusion

Discovery and characteristics, fission products and energy release, spontaneous and induced fission, transuranic elements. Chain reaction and basic principle of nuclear reactors. Nuclear fusion: energetics in terms of liquid drop model.

B. SOLID STATE PHYSICS

1. ***Crystal Geometry***

Amorphous and crystalline materials, glassy forms periodic lattice, basis, translation vectors, primitive and non-primitive Crystal Axis, Unit Cell, Primitive and Conventional Bravais lattice,

Miller indices, symmetry, point groups and space groups. Body centered and face centered lattices, interplanner spacing. Indices of lattice planes.

2. Crystallography

Bragg's law, diffraction of X –ray, measurement of lattice parameter for cubic lattices. Theory of Laue Spots.

3. Bonding in Solids

Types of bonding in solids, covalent, Ionic bindings, energy of bonding, transition between covalent and ionic bonding, metallic bonding, Vander waal's bonding, hydrogen bond.

4. Lattice Vibrations

Linear monatomic chains, Acoustical and optical phonons, Qualitative description of the phonon spectrum, Brillouin Zones, Einstein and Debye theories of specific heat of solid T^3 Law. Qualitative description of free electron theory and its inadequacies with reference to Hall effect and specific heat of electrons in metals.

Books &References:

Nuclear Physics

1. Littlefield T.A. and Thorley N. : Atomic and Nuclear Physics E.L.B.S.
2. Enge H.A. : Introduction to Nuclear Physics, Addison-Wesley
3. Meyroff : Element of Nuclear Physics
4. Kaplan : Nuclear Physics
5. Cohen : Concepts of Nuclear Physics
6. Segre : Nuclei and particles. B1n'Cham : Nuclear Physics 31

Solid State Physics

1. Introduction to Solid State Physics, C. Kittel (Wiley Eastern).
2. Elementary Solid State Physics – M. Ali Omar (Pearson Education)
4. Solid State Physics – A. J. Dekker (Mc. Millan)
4. Solid State Physics – S. O. Pillai (New Age International)
5. Elements of Solid State Physics – J. P. Srivastava (Prentice Hall)
6. An Introduction to Solid State Physics and Application – R.J. Elliot and A.F. Gibson (McMillan)
7. Solid State Physics – D.W. Snoke (Person Education)

Paper Code	Paper	Paper Title	Marks	Credits
132704	Paper-VII	Physics Practical	100	4

LABORATORY CLASSES: At least 30 Experiments are to be performed during 3 years.

(Two Experiments, one from each group are to be performed in six (6) hours during final examination)

Distribution of Marks

Distribution of Marks			Distribution of Marks on each Experiment		
i)	**Two Experiments (One from each group)**	**2×35=70**	i)	Theory	**5**
ii)	**Laboratory Note Book**	**15**	ii)	Procedure & Data Collection	**15**
iii)	**Viva-voce on Experiment**	**15**	iii)	Caculations & Results	**10**
			iv)	Discussions	**5**
	Total	**100**		Total	**35**

Laboratory Teaching Classes

One laboratory class (of 3 periods duration) per week should be devoted to teach the following topics during the three years course. These lectures should be taken in laboratory and should be of interactive type so that students also participate in the learning process. As the course on physics practical will be taught in early months of first year, students will get sufficient time to use apparatus in practical classes.

Laboratory Teaching

1. Demonstration lectures on use of Vernier, Micrometer, Spherometer, Barometer, common balance ,etc.; graph plotting -2 Lab-class.
2. (i) Basic ideas of Probability & Statistics
   (ii) Error analysis, significant figures, limits of accuracy of an Experiment-associated choice of equipments. -3 Lab-class
3. Measuring instruments (e.g. Galvanometer, Multimeter & CRO) to be used in the laboratory – 2 Lab-class.

GROUP –A

1. Determination of the value of acceleration due to gravity by using bar Pendulum.
2. Determination of moment of inertia of a metallic cylinder/rectangular bar about an axis passing through its centre of gravity.
3. To determine the modulus of rigidity of the form of a cylindrical rod by statical method.
4. Determination of young's modulus of the material of the given wire by Searle's method.
5. To determine the focal length of two given convex lenses and their combination in contact by displacement method.

6. Determination of refractive index of the given liquid with the help of plane mirror, convex lens & spherometer.
7. To determine the focal length of two given convex lenses and their combination in contact by displacement method.
8. Determination of the refractive index of the material of a prism by drawing the i-δ curve using spectrometer.
9. To calibrate a polarimeter and hence to determine the concentration of sugar solution.
10. Determination of the surface tension of water by capillary rise method.
11. Determination of the co-efficient of viscosity of water by flow through a capillary tube
12. Determination of the frequency of a tuning fork with the help of a sonometer (Either by using the relevant formula or by using the n-l curve).
13. To determine refractive index of water using travelling microscope.
14. To determine the boiling point of a given liquid by platinum resistance thermometer.
15. Determination of thermal conductivity of the given rod by Searle's apparatus.
16. Determination of thermal conductivity of a bad conductor of heat by Lee's and Chorlton's method.
17. Determination of specific heat of the given liquid by the method of cooling.
18. To determine the boiling point of a given liquid by platinum resistance thermometer.
19. To determine the melting point of a solid with the help of a thermocouple.
20. To determine the wavelength of monochromatic source by Fresnel's biprism.
21. Determination of the width of a single slit by the Spectrometer with diffraction method.
22. To determine the wave length of monochromatic light by Newton's ring experiment.

GROUP –B

1. To determine the ballistic constant of a ballistic galvanometer.
2. Determination of specific resistance of the material of a given wire by meterbridge.
3. Verification of the laws of series and parallel resistance by a Post Office box.
4. Determination of E.C.E. of copper by using an ammeter and a copper voltameter.
5. Determination of EMF of a cell by potentiometer.
6. Comparison of the magnetic moments of two given bar magnets by deflection magnetometer.
7. Determination of the value of the given low resistance by drop of potential method with the help of metre-bridge.

8. Determination of internal resistance of a cell with the help of potentiometer.

9. Conversion of the given galvanometer into an ammeter & its calibration using copper voltameter.

10. Determination of resistance of a galvanometer by half -deflection method.

11. Determination of the reduction factor of a tangent galvanometer with copper voltameter and hence to determine the value of H, the horizontal component of earth's magnetic field.

12. Convert a given galvanometer into voltmeter and calibrate it.

13. To draw the forward characteristic curves of a semiconductor diode and hence calculate the dc resistance (r_{dc}).

14. To draw the dynamic characteristic curve of a triode for three different loads and to calculate the voltage gain for the load and to compare it with the theoretically calculated value.

15. To draw input, out put and mutual characteristics curve of a transistor in CE mode and hence to calculate its h-parameters.

16. To measure the resistance, reactance and self inductance of a chocked coil in an L-R circuit using an A.C. Voltmeter.

17. To determine the ripple factor of a full wave rectifier with a shunt capacitor filter using a D.C. voltmeter and to study the variation of ripple factor with load.

18. To studu a full wave rectifier with a shunt capacitor as filter circuit

and hence to determine the values of ripple factor using CRO at the differentncy loads.

19.To study the frequency response curve of a series LCR circuit and determine the

resonance frequency.

20. Determination of J (mechanical equivalent of heat) by Joule's electrical calorimeter.

21. To study the variation of mutual inductance of a given pair of co-axial coils by using a ballistic galvanometer.

22. To measure the self inductance of two coils by Anderson bridge .To find the total inductance of the above two coils connected in series and hence estimate the coefficient of coupling between the coils.

Books &References:

1. *BSc Practical Physics*, C. L. Arora, (S. Chand)
2. *An Advanced Course in Practical Physics*, D. Chattopadhyay and P. C. Rakshit, (New Central Book Agency)
3. *A Text Book of Advanced Practical Physics*, S. Ghosh, (New Central Book Agency)
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