T.D.C. B.Sc. SYLLABUS IN PHYSICS (PASS & HONOURS)

COURSE STRUCTURE (PHYSICS HONOURS)

TDC Sem Exam	Paper Code	Name of the Paper	Final Examination marks	Contact Hours
I	H101	**Mechanics and General Properties of Matter**	**35**	**60**
		Group A Dynamics and Kinematics	15	25
		Group B Gravitation and Properties of matter	20	35
	H102	**Mathematical Physics I** Group A	**35**	**60**
		Co-ordinate System and Vectors	18	30
		Group B Matrices , special functions and Fourier series	17	30
	H103	**Geometrical Optics, Waves and Oscillations** Group A	**35**	**60**
		Geometrical optics	20	35
		Group B Waves and oscillations	15	25
II	H201	**Physical Optics** Group A	**35**	**60**
		Interference and Diffraction	20	35
		Group B Polarization, Laser and Fibre Optics	15	25
	H202	**Heat and Thermodynamics**	**35**	**60**
		Group A Heat	20	35
		Group B Thermodynamics	15	25
	H203	**Electricity and Magnetism I**	**35**	**60**
		Group A Electricity	15	25
		Group B Magnetism	20	35
	H204	**Honours Laboratory I**	**90**	**160**
III	H301	**Classical Mechanics, Theory of Relativity**	**35**	**60**
		Group A Classical Mechanics	25	40
		Group B Special Theory of relativity	10	20
	H302	**Computational Physics**	**35**	**60**
		Group A Statistical distributions and Errors	15	30
		Group B Numerical Techniques	10	15
		Group C Operating systems and Programming	10	15
	H303	**Mathematical physics II**	**35**	**60**
		Group A Differential Equations	20	30
		Group B Tensors and Complex Numbers	15	30
IV	H401	**Electricity and magnetism II**	**35**	**60**
		Group A Classical Electricity and Magnetism	10	15
		Group B Electromagnetic Theory	15	30
		Group C AC circuits	10	15
	H402	**Electronics**	**35**	**60**
		Group A Network Ananlyis and Transistors	20	30
		Group B Oscillators, Modulators and Integrated circuits	15	30
	H403	**Statistical Mechanics, Plasma Physics**	**35**	**60**
		Group A Statistical Mechanics	25	40
		Group B Plasma Physics	10	20
	H404	**Honours Laboratory II**	**90**	**160**
V	H501	**Atomic and Molecular Physics**	**35**	**60**
		Group A Atomic Spectra	15	30
		Group B Modern Physics	10	15
		Group C Molecular Spectra	10	15
	H502	**Condensed matter Physics**	**35**	**60**
		Group A Crystallography	15	25
		Group B Lattice Vibration, Superconductivity and Liquid Crystals	20	35
	H503	**Quantum Mechanics**	**35**	**60**
		Group A Concepts of Matter Waves	15	25
		Group B Schroedinger Picture	20	35
VI	H601	**Astrophysics and Cosmology**	**35**	**60**

		Group A Astrophysics Group B Cosmology	25 10	40 20
	H602	**Nuclear and Particle Physics** Group A Nuclear Properties and Radioactivity Group B. Nuclear Reactions and Detectors Group C Particle Physics	**35** 10 10 15	**60** 20 20 20
	H603	**Digital Electronics, Solidstate devices, Introduction to Nanophysics** Group A Digital electronics Group B Solid State Devices Group C Introduction to Nanophysics	**35** 15 10 10	**60** 30 15 15
	H604	**Honours Laboratory III**	**90**	**160**
		Total Marks	900	

Course Structure (PHYSICS PASS)

TDC Sem Exam	Paper Code	Name of the Paper	Final Examination marks	Contact Hours
I	P101	**Mathematical Physics, Mechanics & General Properties of matter, Relativity** Group A Mathematical Physics Group B Mechanics and General Properties of Matter and Relativity	**35** 10 25	**80** 20 60
II	P201	**Electricity & Magnetism** Group A Electrostatics Group B Magnetism Group C Electromagnetism	**35** 10 10 15	**80** 25 25 30
	P202	**General Laboratory I**	**30**	**80**
III	P301	**Heat & Thermodynamics** Group A Heat Group B Thermodynamics	**35** 15 20	**80** 40 40
IV	P401	**Waves , Oscillations and Optics** Group A Waves and Oscillations Group B Ray and Physical Optics	**35** 10 25	**80** 20 60
	P402	**General Laboratory II**	**30**	**80**
V	P501	**Quantum Mechanics, Atomic and Nuclear Physics** Group A Quantum Mechanics Group B Atomic Physics Group C Nuclear Physics	**35** 10 15 10	**80** 25 30 25
VI	P601	**Crystallography & Electronics** Group A Elements of Crystallography Group B Electronics	**35** 10 25	**80** 25 55
	P602	**General Laboratory III**	**30**	**80**
		Total Marks	300	

DETAILED COURSES FOR PHYSICS HONOURS

Semester I

PAPER H101

MECHANICS & GENERAL PROPERTIES OF MATTER

Total Marks- 35
Pass marks -- 12

Group A Dynamics and Kinematics **Marks: 15**
Contact hours: 25

Dynamics: Inertial and non inertial frame of reference. Transformation equation of coordinate, velocity, acceleration in rotating frame of reference. Radial and transverse velocities of a rotating body. Radial and transverse accelerations. Transformation equation of force in non-inertial frames (both rotational and linear). Fictitious forces -- centrifugal force and Coriolis force. Effect of fictitious force on the earth, Focault's pendulum . Conservative force and its properties. Concept of potential function. Relationship of conservative force, Motion of a body in fractional medium under gravity.

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. Moment of inertia. Theorems of moment of inertia, calculation of moment of inertia in simple cases : Spherical shell, solid sphere, cylinder, uniform rectangular lamina.

Group B Gravitation and Properties of matter **Marks:20**
Contact hours : 35

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.

Elasticity : Relation between elastic constants, energy of elastically deformed bodies, torsion of a rod, Torsional pendulum, bending of beam, Cantilever (loaded at one end).

Surface tension : Excess pressure on curved liquid surface (spherical bubble and drop). Theory and experimental determination of surface tension of liquid by ripple method.

Viscosity of fluids: Poiseulle's equation, determination of viscosity of a liquid by Poiseulle's method.

SUGGESTED READING

Mechanics & General Properties of Matter

Mathur D.S.	: Elements of Properties of Matter
Purcell E.M. (Ed)	: Vol. I Mechanics, Mc Graw Hill. Berkely Physics Course,
Feynmam R.P. et. al.	: The Feynmam Lectures in Physics, Vol.I,B.I. Publication.
Sengupta A & Chatterjee H.K	: Treatise on General properties of matter
Saraf B. et.al.	: Physics Through Experiments, Vol I, Mechanical System. Vikas Publishing House,
Newman & Searle	: General Properties of Matter.

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PAPER H102

MATHEMATICAL PHYSICS I.

Total Marks-35

Pass marks : 12

Group A Co-ordinate System and Vectors **Marks : 18**

Contact Hours : 30

The Co-ordinate system : Orthogonal and non-orthogonal, Right handed and Left Handed Cartesian system, Necessity for curvilinear co-ordinate system. Polar, cylindrical and general curvilinear coordinate system. Length, area and volume elements in all these systems.

Vectors : Vector triple product, polar and axial vectors and their examples from Physics. Vectorial equation of straight line, plane and circle. Base vector, vector transformations. Scalar and vector fields with illustrations from Physics, directional derivative of a scalar field, gradient of a scalar field, divergence and curl of vector fields and their physical meaning, Expression for gradient, divergence and curl in curvilinear co-ordinates. Integration, important identities. Gauss, Green and Stoke's theorems and their applications.

Group B Matrices , special functions and Fourier series **Marks: 17**

Contact hours : 30

Matrices : Addition law of matrices, matrix multiplication, properties of matrices, special square matrices, inverse of matrices, Elementary transformation of matrices – similarity, orthogonal and unitary transformation. Eigen value, Eigen vector. Solution of simultaneous linear equations. Diagonalisation of matrix.

Special functions: Beta and Gamma functions, relation between them, recurrence relation for gamma function.

Fourier Series: Fourier's Theorem and Fourier series, application of Fourier's theorem to square wave and saw tooth wave

SUGGESTED READING

Mathematical Physics

Haper : Introduction to Mathematical Physics

Schaum Series : Vectors

Hinchey F.A. : Vectors and Tensors, Wiley Eastern

Joshi A.W. : Matrices and Tensors in Physics 2nd Ed, Wiley Eastern

Margendu and Murphy, : Mathematics for Engineers and Physicists.

Rai Singhania M D : Vector Analysis, S.Chand

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PAPER H 103

GEOMETRICAL OPTICS, WAVES & OSCILLATIONS

Total marks : 35

Pass Marks :12

Group A: Geometrical Optics **Marks-20**

Contact Hours : 35

Fermat's principles. Deduction of laws of reflection and refraction using Fermat's principle for plane and curved surfaces. Deduction of lens maker's formula. Thick lens : cardinal points (deduction not necessary). Focal length of two thin lenses separated by a distance.

Defects of image: monochromatic aberration and chromatic aberration, Different types of monochromatic aberration and their explanation. Chromatic aberration and its correction, Achromatic combination of lens & prism.

Spherical aberration and its removal by different methods. Condition of least spherical aberration when two lenses are employed. Aplanatic surface and aplanatic points. Explanation of transparent sphere as aplanatic surface, Extension of the above idea in construction of Abbe's high power oil immersion objective of microscope.

Different types of magnifications : Transverse, longitudinal, angular and their relationship. Deduction of Helmholtz-Lagrange's equation and Abbe's sine condition.

Eyepiece : Ramsden and Huygen eyepiece-construction, principles and relative advantage and disadvantage.

Group B : Waves and Oscillations **Marks-15**

Contact hours : 25

Simple harmonic motion: Simple harmonic oscillation - differential equation and its solution Instantaneous and average total energy. Superposition of two simple harmonic motions, Lissajous figures. Damped and forced vibrations. Energy of damped and forced vibrations, Instantaneous and average power of forced vibration, Sharpness of resonance,

Wave: Linear equation of plane progressive wave motion in one and three dimension, Instantaneous and average energy of one dimensional wave, Propagation in dispersive medium – Group and phase velocity

Vibration of strings: Wave equation in linear approximation, Eigen values and eigen functions of pluck and stuck string, Energy of transverse vibration.

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SUGGESTED READING

Optics

Jenkins and White, : Fundamentals of Optics McGraw Hill

Ghatak A.K. : Physical Optics

Born and Wolf : Optics

Khandelwal D.P., : Optics and Atomic Physics, Himalaya Publishing House

Laud B.B. : Lasers and Non-linear optics, Wiley Eastern

Longhurs R.S. : Geometrical and Physical optics. Longmans, 1975

K G Majumder and B Ghosh : A Text Book of Light, Shreedhar Publications

Waves and Acoustics

Ghosh R.K. : The Mathematics of waves and Vibrations, Mc Millan , 1975
Khandelwal D.P. : Oscillation and waves, Himalaya Publishing
Puri S.K. : Vibration and Waves, Tata Mc Graw Hill
Wood A.B. : A Text Book of Sound
Bhattacharjee K. : A Text Book of Sound
Berkely Main I.G. : Vibrations and Waves, Cambridge
Pain H.J. : The Physics of Vibration and waves, Mc Millan, 1975/Willcy Elbs

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Semester II

PAPER H 201

PHYSICAL OPTICS

Marks-35

Contact Hours : 60

Group A Interference and Diffraction **Marks:20**

Contact hours : 35

Interference of Light : Condition of sustained interference by analytical treatment, Division amplitude and division of wave front, methods for production of interference fringes by bi-prism,Lloyd's mirror- 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 .

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.

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. Fraunhofer diffraction at single slit, plane diffraction grating.

Dispersive and resolving power of optical system: Rayleigh's criterion of resolution of two spectral lines. Expression of resolving power of plane diffraction grating, telescope & microscope, Dispersive power of plane diffraction grating. Advantage of grating spectrum over prismatic spectrum.

Group B Polarization, Laser and Fibre Optics **Marks : 15**

Contact hours : 25

Polarisation of light : Different methods of production of polarized light, Brewster's law, double refraction, Nicol prism, construction and uses, polaroids, refraction through uniaxial crystal, quarter and half-wave plate, their uses in production and detection of elliptically and circularly polarized light. Babinets compensator, Analysis of polarized light. Optical activity, Fresnel explanation of optical rotation and its verification, half shade plate, rotary dispersion and polarimeters.

Interference of polarized light, Fresnel Arago's law. Interference of parallel polarized light. Different colors in white light.

Laser: Spontaneous and induced emission of radiation, population inversion and optical resonators. Einstein's A & B coefficient, Rate equation and operational principle of laser, Ruby laser and Helium- Neon laser. Applications of Laser, Principle of Holography.

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

SUGGESTED READING

Optics

Jenkins and White, : Fundamentals of Optics McGraw Hill

Ghatak A.K. : Physical Optics

Born and Wolf : Optics

Khandelwal D.P., : Optics and Atomic Physics, Himalaya Publishing House

Laud B.B. : Lasers and Non-linear optics, Wiley Eastern

Longhurs R.S. : Geometrical and Physical optics. Longmans, 1975

K G Majumder and B Ghosh : A Text Book of Light, Shreedhar Publications

PAPER H 202

HEAT AND THERMODYNAMICS

Total Marks : 35
Pass mamrks : 12

Group A : Heat **Marks:20**

Contact Hours : 35

Measurement of temperature: Platinum resistance thermometer, thermoelectric thermometer.

Kinetic theory of gases: Basic assumption of kinetic theory, Maxwell's distribution law (both in terms of velocity and energy), root mean square, mean and most probable velocities and their relations; collision cross-section and mean free path, Maxwell's derivation of mean free path; Degrees of freedom and equipartition of energy.

Real Gases: Andrew's experiment and importance of its results, Vanderwaal's equation of states, critical constants and their determination, law of corresponding states.

Transport phenomenon: Viscosity, conduction and diffusion of gases; Brownian motion – Einstein's theory, Perrin's experiment to determine Avogadro's number.

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).

Radiation : Kirchhoff's law, Black body radiation, Energy density, Radiation pressure, Stefans-Boltzmann law and its derivation, Planck's law and its derivation. Wien's law, Rayleigh-Jean's law as limiting cases of Planck's law.

Group B : Thermodynamics **Marks -15**

Contact Hours : 25

First law of thermodynamics: Internal energy, External work, First law of thermodynamics and its applications to isothermal and adiabatic changes in ideal and real gases, Specific heats of gases and their relations for ideal and real gases.

Second law of thermodynamics: Reversible and irreversible processes, Efficiency of Carnot's engine and Carnot's theorem; Second law of thermodynamics, Its different formulations and their equivalence; Concept of entropy function, its physical significance and relation with probability, Change of entropy in simple reversible and irreversible processes, Calculation of

entropy change for an ideal gas, real gas and a gas mixture.

Thermodynamic potentials: Enthalpy, Helmholtz and Gibb's free energy, Maxwell's thermodynamic relations and its applications – Three TDS equations and important thermodynamic relations.

Phase transitions: Equilibrium between phases, Gibb's phase rule, Triple point, First and higher order phase transitions, Clausius- Clapeyron's equation, Joule-Thomson effect, Temperature of inversion, Regenerative cooling.

SUGGESTED READING

Heat

Saha amd Srivastava : A Treatise on Heat
Rajam J.B. : A Text Book of Heat
Kittel C and Kroemer H : Thermal Physics
Zemansky MW. : Heat and Thermodynamics, McGraw Hill

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PAPER H 203

ELECTRICITY & MAGNETISM I

Total Marks – 35

Pass marks: 12

Group A Electricity **Marks : 15**
Contact hours : 25

Electrostatics: Concept of Electric Field Vector and its relationship with Coulomb force, Gauss's law and its application to simple systems, viz. Uniformly charged sphere, Infinitely long charged cylinder, Infinitely charged plane; Derivation of Div **E**= ρ/ε_0 (Differential form of Gauss Law) and Curl **E**=0 and their physical meaning. Energy density due to electrostatic field.

Concept of Electric Scalar Potential and its relation with Electric Field, Calculation of Potential for an arbitrary distribution of charge - Monopole, Dipole, Quadruple moments; Poisson's and Laplace Equation, Boundary condition and uniqueness theorem, Calculation of the potential and capacitance of Parallel Plate, Spherical and Co-axial Cylindrical Condenser.

Electrostatics in matter: Phenomenon of polarization in linear dielectric, Concept of free and bound charge, Electric field in medium (Electric Displacement vector **D**), Gauss law (Integral

and Differential form) in dielectric medium; Electric susceptibility, Dielectric constant, Electric permittivity and their relationship; Field inside a dielectric sphere in uniform electric field, Clausius-Mossoti Relation.

Thermo-electricity: Thermo-emf, Peltier and Thomson effect, experimental demonstration of Peltier and Thomson effect ; Experimental laws of thermoelectric circuits, Thermoelectric power diagram.

Group B Magnetism **Marks : 20**
Contact hours : 35

Magnetic effect of electric current: Concept of magnetic field vector and its relationship with steady current, Ampere's circuital law (both in integral and differential form) and its application to simple systems, viz., current carrying loop, solenoid, toroid ; Biot-Savart's law and its application to simple systems, viz., long straight wire carrying steady current, circular loop carrying steady current, solenoid, Helmholtz coil; Derivation of Curl $\mathbf{B} = \mu_0 \mathbf{J}$ (Differential form of Ampere's law) and Div$\mathbf{B}$=0 and their physical meaning; Conductance and Ohm's law; Concept of magnetic vector potential **A**; Energy due to magnetostatic field.

Magnetism in matter: Magnetization of linear magnetic medium; Magnetic dipole moment due to a current carrying loop, Concept of free and bound current, Magnetic field in medium (Auxiliary magnetic field vector **H**), Ampere's law (Integral and Differential form) in medium, Magnetic susceptibility and permittivity and their relationship.

Steady current: Kirchhoff laws, Application of these laws in Wheatstone bridge. Sensitivity of Wheatstone's bridge. Moving Coil and ballistic Galvanometer --- working principle, characteristics and comparison.

SUGGESTED READING

Electricity & Magnetism

Berkeley : Physics Course : Electricity & Magnetism, Mc Grow Hill.

Griffen D.J. : Introduction to Electrodynamics, Prentice Hall of India.

Laud B.B. : Electromagnetism.

Mahajan A.S.& Rangwala A.A. : Electricity & Magnetism, Tata Mc Graw Hill

Saraf B. etal : Physics Through Experiment, Vol 2 EMF constant & varying, Vikas Publications.

Kif A.F. : Fundementals of Electricity & Magnetism, Mcgraw Hill, International Student Edition.

Khandelwal D.P. : A laboratory Manual for Physics for undergraduate students, Vani Publication.

PAPER H 204

HONOURS LABORATORY I

(At least 15 experiments are to be performed during the year .Two Experiments, one from each group are to be performed in six (6) hours during final examination)

Marks: 90

GROUP A

1. Determination of the value of acceleration due to gravity by using bar Pendulum.
2. Determination of M.I. of the given body about an axis passing through its center of gravity by Torsional oscillation method.
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. Determination of focal length of the given concave lens with the help of convex lens.
6. Determination of refractive index of the given liquid with the help of plane mirror, convex lens & spherometer.
7. Determination of the co-efficient of viscosity of water by flow through a capillary tube
8. To determine the frequency of a tuning fork by Melde's method.
9. To determine refractive index of water using travelling microscope.
10. To determine the focal length of two given convex lenses and their combination in contact by displacement method.

GROUP B

11. Comparison of the magnetic moments of two given bar magnets by deflection magnetometer.
12. Determination of the value of the given low resistance by drop of potential method with the help of metre-bridge.
13. Determination of the resistance per unit length of a metre-bridge wire by Carey-Foster method.
14. Determination of the specific resistance of the materials of a given wire by metre-bridge.
15. Determination of internal resistance of a cell with the help of potentiometer.
16. Conversion of the given galvanometer into an ammeter & its calibration using copper voltameter.
17. To determine the value of J by Joule's electrical calorimeter.
18. To verify laws of series and parallel resistances by PO Box.
19. To compare the values of two low resistances with the help of potentiometer.
20. Determination of reduction factor of tangent galvanometer and hence to determine H, the horizontal component of earth's magnetic intensity at a place.

Semester III

PAPER H 301

CLASSICAL MECHANICS, THEORY OF RELATIVITY

Total Marks : 60

Pass marks : 12

Group A : Classical Mechanics **Marks: 25**

Contact Hours : 40

Constraints, Classification of constraints with examples. Generalised coordinates, Generalised velocities and generalized momenta.

Principles of virtual work, D' Alembert's principle and its derivation.

Lagrange's equation for conservative and nonconservative system of forces from D' Alembert principle. Conception of Lagrangian. Application of Lagrange's equation for calculation of Lagrangian and derivation of equation of motion for a simple physical system (Compound pendulum, linear harmonic oscillator).

Motion under central force : Central force and its examples. Reduction of motion of two bodies to the motion of single body by introducing the concept of reduced mass. Lagrangian of aparticle under central force. Differential equation of orbit of a particle under central force, Kepler's laws planetary motion and its deduction.

Hamiltonian formulation : Concepts of phase space, Principle of variation, Deduction of Hamiltion's canonical equations from variational principle.Concept of Hamiltonian and its physical interpretation. Deduction of Hamiltion's principle from D' Alemberts principle, Basic idea of Hamiltionian in quantum mechanics, Hamiltonian of simple pendulum, compound pendulum. Deduction of Hamiltion's canonical equations in above cases.

Group B : Special Theory of Relativity **Mark:10**

Contact Hours : 20

The principle of Gallilian transformation, Transformation of Newton's Laws, departure from Newtonian relativity, Absolute rest, absolute motion, Concept of ether, Michelson-Morley experiment, negation of ether concept. Einstein's postulates and Lorentz-Einstein transformation, Derivation of Lorentz transformation equations, Consequence of Lorentz

Transformation--- length contraction, time dilation, life time of cosmic ray muons, twin paradox, simultaneity, velocity addition rule, finite velocity of light, relativistic formula for momentum and energy.

Minkowski diagram, space-time, time-like, space-like and light like intervals, Energy momentum four vector,

SUGGESTED READING

Classical mechanics

Goldstein, : Classical Mechanics
Takwale R, G & Puranik P.S. : Introduction Classical Mechanics, Tata McGraw Hill, 1996
Rana N.C. : Classical Mechanics, Tara McGraw Hill.

Relativity

Sokolovshy Y.I. : Special Theory of Relativity.

Roy M. : Theory of Relativity.

Resnick R. : Introduction to special Theory of Relativity.

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PAPER H 302

COMPUTATIONAL PHYSICS

Total Marks : 60
Pass Marks : 12

Marks: 15

GroupA: Statistical distributions and Errors **Contact Hours : 30**

Probability: Mutually exclusive events, theorem of total probability, compound events and theorem of compound probability.

Probability distributions: Gaussian (continuous) distribution, its mean & standard deviation. Binomial distribution, its mean & standard deviation. Poisson distribution, its mean & standard deviation.

Theory of Errors: Definitions, classification of errors. Random error of a measured quantity. Propagation of error.

Group B : Numerical Techniques **Marks:10**
Contact Hours : 15

Solution of Algebraic equations by Bisection Method, Newton-Raphson's method,
Numerical Integration—Simpsons rule.
Numerical solution of non-liner equations –Picard's Method, Runge Kutta Method (up to 2^{nd} order)

Group C: Operating systems and programming **Marks:10**
Contact hours: 15

Introduction to operating systems: DOS, WINDOWS, UNIX
Algorithms and flow charts.
Programming Languages : FORTRN and C

SUGGESTED READING:

Ralston and Robinowitz P.A. : First Course in Numerical Analysis, Mc Grow Hill, 1983

PAPER H 303

MATHEMATICAL PHYSICS – II

Total Marks:35
Pass Marks : 12

Group A Differential Equations **Marks : 20**

Contact hours :30

Differential equations and special functions : Ordinary differential equations, Homogeneous equations, solutions in power series, series solution of second order, differential equation by the Froebenius method.

Legendre's differential equation, Legendre polynomial, Rodrigue's formula, Generating function of Legendre polynomial, orthogonal properties of Legendre polynomial, Recurrence relation for $P_n(X)$.

Bessel's Differential Equation and its solution, Bessel's function of first kind. Recurrence relation, spherical Bessel's function, Generating function in connection with Bessell's function.ter of physic

Group B Tensors and Complex Numbers

Marks : 15
Contact hours : 30

Tensors: Transformation of coordinates, tensorial character of physical quantities ,symmetric and antisymmetric tensors, rules for combination of tensors, additions ,subtractions, outer multiplications, contractions and inner multiplications, differentiation of tensors and kronekar Delta

Complex Variables:- Complex number and their graphical representation, roots of complex numbers, functions of complex variables, concepts of neighbor-hood, limit and continuity, analytical function, Cauchy-Rieman conditions and their applications.

SUGGESTED READING

Mathematical Physics II

B Rai, D P Choudhury and H I freedman : A course in Ordinary Differential Equations. Narosa

C Harper : Introduction to Mathematical Physics, Prientice Hall of India

Murray R Speigel : Vector Analysis, Mc Graw Hill (Schaum Series)

Murray R Speigel : Complex Variables, Mc Graw Hill (Schaum's Series)

Joshi A.W. : Matrices and tensors in Physics, 2nd edition, willey eastern

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PAPER H 401

ELETRICITY & MAGNETISM II

Mark – 35

Pass Marks : 12

Group A Classical Electricity and Magnetism **Marks :10**
Contact hours: 15

Electromagnetic induction: Electric and Magnetic flux, Electro-motive force, Faraday's law of induction (differential and integral form), Lenz's law, Self and Mutual induction and their relation for two coils, Toroids.

Magnetic properties of materials: Magnetic moment due to spin and orbital motion of the electron in atom, Effect of magnetic field on the angular momentum of electron; Distinguishing features of dia, para and ferro-magnetic material, Langevin theory of dia and para-magnetism, Currie-Weiss law & Domain theory of Ferro-magnetism, Ferrites; Phenomenon of Hysteresis. and Hysteresis loss.

Group B Electromagnetic Theory **Marks :15**
Contact hours: 30

Electromagnetic Theory: Equation of continuity and conservation principle in electromagnetism, Concept of Maxwell's displacement current and derivation of Maxwell equations (in vacuum and in medium), Wave equation of electromagnetic (EM) wave in vacuum and in medium and its identification of light; Wave equation in terms of scalar and vector potential, Lorentz and Coulomb gauge conditions; Transverse EM (TEM) wave and orthogonality of **E, B** and direction of propagation vector; EM wave in conducting medium - Skin effect;

Poynting Theorem and Poynting vector and their physical meaning.

Dispersion: Equation of motion of electron in a radiation field, Lorenz theory of dispersion for both normal and anomalous, Cauchy's formula; Rayleigh scattering, Blueness of sky.Raman effect and its theory-Expression of intensity of antistoke's line.

Group C AC circuits **Marks :10**
Contact hours: 15

Transient current :Growth and decay of current in LR, CR, LC, LCR circuits, Induction coil.
A.C. Circuits : Complex number approach in solving A.C. circuit problems, Phasor diagram– resistance, reactance & impedance; Series and Parallel Resonance - sharpness of resonance, power & Q- factors, bandwidth; magnetically coupled circuit– transformer and the loading effect of its coils, Rotating magnetic field.

SUGGESTED READING

Electromagnetic Theory

Griffith D.G. : Introduction to Electrodynamics, Prentice Hill of India

Portis A.M. : Electromagnetic fields.

Panofsky and Phillips : Classical Electricity and Magnetism India Book House.

Reitz and Milford : introduction to Electrodynamics Addison-Wesley

Feynmann R.P.etal : They Feymann Lectures In Physics Vol. 2 B.I. Pub.

Corson D.R. and : Introduction to Electromagnetic Field and Waves, Freeman Lorain P. Taraporevala.

Jordon E.C. and Balmain K.G. : Electromagnetic waves and Radiating Systems2nd Ed. Prentice Hall of India.

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PAPER H 402

ELECTRONICS

Total Marks – 35

Pass marks : 12

Group A Network Analysis and Transistors **Marks :20**
Contact hours: 30

Network theorems: Thevenin's, Norton's & Maximum power transfer theorem. Introduction to thermionic emission, Richardson's equation, Child-Langmuir law, Junction diode-pn diode equation, characteristic curve, Depletion region & junction Capacitance. Rectifiers- ripple factor, percentage regulation & efficiency. Filter circuits:- shunt capacitor, series inductor & L-section filters (qualitative descriptions). Zener diode –Avalanche & zener effect,voltage regulation with Zener diode. Rectifiers- ripple factor, percentage regulation & efficiency.

Junction transistor- Types of biasing & their stability ; Transistor as four terminal network-h,

Y & Z parameters, transistor configurations. h parameter equivalence of a transistor in C-E mode, d.c. & a.c. load lines, Operating point of class A, B, AB & C amplifiers. Idea of multistage amplifier, frequency response of two stage R-C coupled C-E amplifier- gain & band width. Power amplifier characteristics, push-pull class B amplifier. Feedback in amplifiers, Barkhausen criteria;

Group B Oscillators, Modulators and Integrated circuits **Marks :15**
Contact hours: 30

Oscillators: Tuned collector, series fed Hartley Oscillator, Phase-shift R-C oscillator; Tuned amplifiers—advantages, frequency response, single tuned amplifier and its a.c. equivalence.

Multivibrator:- Astable, Mono-Stable and Bistable

Modulation:- types, theory of Amplitude Modulation, collector modulated class C amplifier; Demodulation- diode detector circuit for the demodulation of AM wave, Block diagram & description of super heterodyne radio receiver.

Integrated Circuit : Differential amplifier—common and differential mode voltage gain, CMRR. Characteristics of ideal and real OPAMPs, concept of virtual ground, Approx. analysis of inverting and non-inverting mode of operation. Application of OPAMPs — sum and difference amplifier, integrator, differentiator.

SUGGESTED READING

Electronics

Chattopadhyay et al. : Foundation of Electronics

Schilling L & Velove : Electronic Circuits, 3rd Ed, McGraw Hill

Stanley W.D., Electronic Devices : Circuits & Applications Prentice Hall

Malvino A.P : Digital Principle and applications, 4th Ed, McGraw Hill, International Student edition

Millman J & Helkias : Integrated Circuits.

Millman J & Grabel A. : Microelectronics, 2nd Ed, McGraw Hill, International Student Edition.

Altmann S.L. :Band Theory of Metals, The Elements, Pergamon.

PAPER H 403

STATISTICAL MECHANICS, PLASMA PHYSICS

Total Marks : 35

Pass Marks:12

Group A : Statistical Mechanics **Mark-25**

Contact hours : 40

Phase space: Concept of Microstates and macrostates, 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;

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.)

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.

Group B : Plasma Physics **Mark :10**

Contact Hours : 20

Plasma – its definition, composition and characteristics, microscopic and macroscopic description of plasma.

Motion of charged particle in uniform magnetic field, motion of charged particle in uniform electric and magnetic field B-drift, curvature drift, magnetic confinement of plasma.

Collision processes in Plasma- Non-Coulomb collisions, electron plasma oscillation and ion-plasma oscillation, Pinch effect - Quasi equilibrium pinch effect and dynamic or time varying pinch effect, Solar corona and Solar wind, Van Allen radiation belt.

Transport phenomena in plasma-diffusion and mobility, Ambipolar diffusion and its coefficient.

SUGGESTED READING

Statistical Mechanics

Laud B.B . : Introduction to statistical Mechanics, McMillan
Reif F. : Statistical Physics, McGraw Hill
Huang K : Statistical Mechanics, Wiley Eastern
Lakanathan S. and Gambhir R.S. : Statistical and Thermal Physics, Prentice Hall of India' 91
Raja Gopal E S. :Statistical Mechanics and Properties of Matter.

Plasma Physics:

Sen A. : Introduction to Plasma Physics
Uberoi C. : Magnetized Plasma

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PAPER H 404

HONOURS LABORATORY II

(At least 14 experiments are to be performed during the year. Two experiments, one from each group are to be performeded in eight hours during examination)

Marks: 90

Group : A (Marks –60)

1. To determine the boiling point of a given liquid by platinum resistance thermometer.

2. Determination of thermal conductivity of the given rod by Searle's apparatus.

3. To determine the melting point of a solid with the help of a thermocouple.

4. The determine the ballistic constant of a ballistic galvanometer.

5. Determination of the angle of minimum deviation of the angle of the given prism with the help of spectrometer & hence to find the refractive index of the material of the prism.

6. To draw the calibration curve connecting refractive index & wave length of some known lines using prism & spectrometer & hence to calculate the wave length of an unknown line.

7. To draw the calibration curve connecting the deviation of a ray by a prism & wave length of some known lines using spectrometer & hence to calculate the wave length of unknown line

8. Determination of the width of a single slit by the Spectrometer with diffraction method.

9. To determine the grating constant of plane diffraction grating & hence to find the wave length of the an unknown line.

10. To draw the calibration curve & hence determine the concentration of an unknown solution with the help of a polarimeter.

11. To determine the wavelength of monochromatic source by Fresnel's biprism.

12. To determine the wave length of monochromatic light by Newton's ring experiment.

13. To verify Jurin's law and determination of surface tension of water.

14. Determination of coefficient of linear expansion of the given rod by travelling microscope / optical liver method.

Group : B (Marks –30)

(Use FORTRAN / C/C++ ,for writing the following programmes)

15. a)To find maximum, minimum & range of a given set of numbers.

    b) To add, multiply and find inverse of a given (3x3) matrix.

16. a) To arrange the given set of 10 numbers in increasing or decreasing order, calculate the mean.

    b) To solve the given three simultaneous equations by elimination method .

15. To find the roots of a given quadratic equation.

16. To fit a straight line or a parabolic curve to a given set a data.

17. To find values of (a) sin x, (b) cos x, (c) e^x considering their series expansion.

18. To solve first order, homogeneous, linear differential equation.

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Semester V

PAPER H 501

ATOMIC & MOLECULAR PHYSICS

Total Marks-35

Pass Marks : 12

Group A Atomic Spectra **Marks :15**
Contact hours: 30

Positive rays and their analysis, Rutherford's experiment on scattering of particles by gold foil. Derivation of Rutherford's differential scattering cross section formula, Rutherford's model of atom and its limitations.

Excitation & Ionisation potentials, Frank and Hertz experiment. Characteristics X-ray spectra, Moseley's law, Doublet fine structure, H-like character of X-ray energy states.

Difference between continuous & characteristics X-ray spectra, Aston's mass spectrograph, Effect of nuclear motion on atomic spectra. Reduced mass, modified Rydberg constant and wave number, Evidences in favour of Bohr's theory, correspondence principle.

Sommerfield's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom. Limitation of sommerfield atom model. Vector atom model and different quantum numbers associated with different quantisations in vector atom model. Magnetic moment of atom (one and two electrons system) Quantisation of magnetic moment. Different Coupling schemes L-S and J-J couplings. Stern-Gerlech experiment and its conclusion.

Pauli's exclusion principle and its explanation. Use of pauli's exclusion principle. Justification of Periodic arrangement of atoms by Pauli's exclusion conclusion.

Group B Modern Physics **Marks :10**
Contact hours: 15

Zeeman Effect, Normal and anomalous Zeeman effect. Experimental arrangement to demonstrate Normal Zeeman effect, Classical and quantum mechanical explanation of both normal and anomalous Zeeman Effect explanation, Paschen Back effect, Scattering of X-rays, Thomson scattering and derivation of scattering cross section.

Compton scattering, Its theory and expression of Compton shift. Experimental arrangement and results of Compton scattering, explanation of fine structure in X-ray line spectrum. Auger effect.

Group C Molecular Spectra **Marks :10**
Contact hours: 15

Molecular spectra, Born-oppenheimer approximation, Rotational Energy levels and Vibrational energy levels in diatomic molecules. Vibration Rotational levels in a vibrating and rotating diatomic molecule.

SUGGESTED READING

Atomic and Molecular Physics

Mani H.S. and Mehta G.K.	: Introduction to Modern Physics
Beiser A.	: Perspectives of Modern Physics
White A.E.	: Introduction to Atomic Physics
Barrow H.,	: Introduction to Molecular Physics
Feynmann R.P. Et al	: The Feymann Lectures in Physics, B.I. Publication
Khandelwal D.P.	: Optics and Atomic Physics, Himalaya Publishing
Hertzberg G.	: Atomic Spectra and Atomic Structure
Hertzberg G.	: Molecular spectra and Molecular Structure
Herchiaf	: Fluorescence and phosphorescene Olon, Experiments in Modern Physics.

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PAPER H 502

CONDENSED MATTER PHYSICS

Total Marks – 35

Pass Marks : 12

Group A Crystallography **Marks :15**
Contact hours: 25

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.

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

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.

Group B Lattice Vibration, Superconductivity and Liquid Crystals **Marks :20**
Contact hours: 35

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.

Elementary band theory, Bloch theorem, Kronig-Penney model, effectively mass of election, concept of hole, band gaps, conductors, semi conductors and insulators, intrinsic and extrinsic semiconductors p-and n –type semiconductors.

Superconductivity: Experimental observations, Meissner effect, Type I and Type II superconductors, London's equation and penetration depth. Qualitative idea of BCS theory.

Liquid Crystals : Definition, Classification, Uses

SUGGESTED READING

Condesnsed Matter Physics

Kittel C, : Introduction to Solid State Physics, 5th Ed, John Wiley

Ashcroft N.W. and Mermin N.D. : Solid State Physics, Holt Reinhert and Winston

Blackmore J.S. : Solid State Physics

Dekker A.J. : Solid State Physics, Prentice Hall

Bube R. H. :Electronics properties of Crystalline solids Academic

Bube R.H. :Electronics in solids: An introductory survey, Academic

Goldmid H.J. :Problems in solid state physics, Pion

Harrison W.A. :Electronic Structure and Properties of Solids, Freeman

Mickelvey J.P. :Solid state and semiconductor physics, Krieger,1982

Bossenberg H.M. :The Solid State, Oxford Univ. Press

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PAPER H 503

QUANTUM MECHANICS

Total Marks- 35

Pass Marks :12

Group A Concepts of Matter Waves **Marks :15**
Contact hours: 25

Matter wave: Failure of classical mechanics and origin of quantum mechanics with reference to black body radiation, Photoelectric effect as evidence of corpuscular theory of light, Devisson-Garmer's experiment and G P Thompson's experiment as evidence of the wave property of particles; De Broglie concept of matter wave and its properties, Concept of wave packet and its group and phase velocity, Feynman double slit thought experiment to illustrate wave-particle duality, Complementary principle.

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.

GroupB Schroedinger Picture **Marks :20**
Contact hours: 35

Schrodinger equation: Schrodinger equation in time-dependent and time-independent form, Physical interpretation of wave function, Equation of continuity; Basic postulates of quantum mechanics, Scrodinger equation as eigen value equation, eigen value, eigen function, Dynamical variable as hermitian operator, States and operators, Commutation relation, Average and expectation value of dynamical variables, Ehrenfest theorem; Angular momentum operators L^2 and L_z and their eigen values and eigen functions, Spatial quantization.

Applications: a) Simple applications of Schrodinger equation, viz. Free particle in one dimensional infinite potential well and calculation of its eigen values and normalized eigen functions, Particle in three-dimensional box - concept of degeneracy, Calculation for transmission and reflection coefficient for particle encountering step potential, particle inside finite rectangular potential barrier - Phenomenon of quantum tunneling;

b) **Linear harmonic oscillato**r: Energy eigen value and eigen function of linear harmonic oscillator, ground state wave function;

c) **Hydrogen atom**: Hamiltonian describing Hydrogen atom, Separation of radial and angular momentum part of Hamiltonian operator, Solution of the angular momentum part introducing spherical harmonics, Solution of the radial part of the equation (Laguerre polynomial solutions to be assumed) to find energy eigen value and eigen function.

SUGGESTED READING

Quantum Mechanics

Ghatak A.P. and Lokanathan S	: Quantum Mechanics
Mathew P.M. and Venkateswan S	: Quantum Mechanics
Eisenberg and Resnick	: Quantum Physics of Atom, Molecules,Soild, Nuclei and particules, John Wieley
Dicke R and Wittke J.	: Introduction to Quantum theory
Park D.	: Quantum Theory
Marhew P.T.	: Quantum Mechanics
Gasirowitz,	: Quantum Physics
L Liboff	: Introductory Quantum Mechanics
Cohen Tanoudji et al	: Quantum Mechanics , Vol I & II

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PAPER H 601

ASTROPHYSICS AND COSMOLOGY

Total Marks : 35

Pass marks:12

Group A : Astrophysics **Marks:25**
Contact hours: 40

Introduction to celestial objects, Co-ordinates and the concept of time.

Brightness of stars and its measurement by magnitude scale. Apparent magnitude, Relationship between brightness and apparent magnitude of stars. Absolute magnitude and the distance modulus. Visual magnitude, Bolometric magnitude and bolometric correction.

Different magnitude standard: UBV system and six colour photometry. Colour index of a star and its relationship with absolute magnitude. Luminosities of stars and its relationship with absolute bolometric magnitudes.

Spectral classification : The Hemy Draper (HD) catalogue and Herzsprung- Russel diagram (HRD).

Different types of stars : Binary stars and their classification and origin, Jean's theory of star formation. Nebulae and their classification and distribution. Crab nebula stealer structure, Internal structure, stelar structure, Internal structure.

Energy production in stars: P.P and CNO chain. Evolutionary track of stars. Formation of white dwarf pulsars and black holes, Chandrashekhar's limit.

Group B. Cosmology **Marks 10**
Contact hours: 15

Introduction to Cosmology : Friedman Models, Hubble's law. A brief overview of thermal history of the universe. Big Bang theory and steady state theory of Universe formation (basic features, success, shortcomings).

SUGGESTED READING

Astrophysics and cosmology

Narlikar J. V : From Black cloud to Black Holes

Narlikar J. V. : The structure of the universe

Smithand Jacob Saunders : An introduction to Astronomy and Astrophysics

Basu, Baidyanath : Introduction Astronomy

Gravitation : Hartley

Raine and Thomas : An Introduction to Cosmology, IoP Series in Astronomy and Astrophysics

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PAPER H 602

NUCLEAR AND PARTICLE PHYSICS

Total Marks-35

Pass Marks :12

Group A Nuclear Properties and Radioactivity **Marks :10**
Contact hours: 15

General properties of nucleus: Constituents, mass, charge, size, spin, magnetic moment, parity, electrical quadrupole moment.

Radioactivity: Alpha decay, range of alpha particles and the stopping power of the absorber in connection with alpha particles.Alpha rays spectrum and it's characteristics, fine structure. Gammow-Condon & Gurey's Theory of alpha decay, quantum mechanical treatment of alpha decay. Experimental justification of above theory. Geiger Nuttal law and determination of range of alpha particles.

Beta Decay: experimental arrangement for study of beta decay and beta ray spectrum. Theoretical inadequacy to explain the beta ray spectrum. Pauli's Neutrino hypothesis, Fermi theory of beta decay (qualitative), Inverse beta decay.

Neutrino & antineutrino: problems relating to the detection of neutrino, Rein and Cowans experiment for detection of antineutrino.

Gamma Rays: Origin of gamma rays, Gamma ray spectrum, Interaction of gamma radiation with matter with special reference to Compton scattering. Photoelectric absorption & pair production. Internal conversion. Mossbauer effect -- it's explanation & application.

Group B Nuclear Reactions and Detectors **Marks :10**

Contact hours: 15

Nuclear Radiation detectors and Accelerators: Proportional counters, Ionization Chamber, G.M. Counter, Scintillation counter, Photomultiplier tube, Cherenkov radiation and it's detection., Betatron, Synchrotron. Alternating gradient Synchroton.

Nuclear force: Qualitative Introduction of the nature of the nuclear force. Yukawa's meson theory of nuclear force.

Models of nucleus and Fission : Liquid drop model, Shell model, Concept of Mirror Nuclei. Semi-empirical mass formula , it's explanation and applications. Characteristics of nuclear fission, explanation of nuclear fission by Liquid drop model, calculation of energy released in nuclear fission reaction.

Nuclear Reaction: Conservation rules, Q values, Nuclear reaction, Kinematics and cross-sections, different types of nuclear reactions. Chain Reaction and it's types, Four factor formula in connection with controlled chain reaction. Nuclear Reactor -- It's construction and principle of generation of energy, different types of nuclear reactors. Nuclear Fusion--Its explanation, Explanation of energy formation in stars and sun. Principles of hydrogen bomb.

Group C : Particle Physics **Marks :15**

Contact hours: 20

Classification of fundamental forces and elementary particles. Symmetrics in particle Physics : Charge conjugation, parity, time reversal, isospin, strangeness. Conservation laws. Motivation for quark model and quarkmodel. Elementary idea of colour, asymptotic freedom. Standard Model (qualitative).

SUGGESTED READING

Nuclear Physics

Littlefield T.A. and Thorley N. : Atomic and Nuclear Physics E.L.B.S.

Enge H.A. : Introduction to Nuclear Physics, Addison-Wesley

Meyroff : Element of Nuclear Physics

Kaplan : Nuclear Physics

Cohen : Concepts of Nuclear Physics

Segre : Nuclei and particles.

B1n'Cham : Nuclear Physics

Perkins : High Energy Physics
Singru R.M. : Introduction to Experimental Nuclear Physics Wiley Eastern
Siegbahn. : Alpha, Beta and Gama Spectroscopy, North Holland

Particle Physics

Segre : Nuclei and particles.
Griffith : Introduction to Particle Physics
Halzen &Martin : Quarks and Leptons
G t'Hooft : Ultimate building blocks of matter
B1n'Cham : Nuclear Physics
Perkins : High Energy Physics

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PAPER H 603

DIGITAL ELECTRONICS, SOLID STATE DEVICES, INTRODUCTION TO NANOPHYSICS

Total Marks : 35

Pass Marks : 12

Group A :Digital Electronics : **Marks : 15**

Contact hours: 30

Number System : Binary Number System, Hexadecimal Number System, Octal Number System-conversions, positive & negative number representations, Integer & floating point representations and their storage in computer memory; Binary Coded Decimal Number (BCD), Gray & ASCII Codes; Half Adder, Full Adder (block diagrams only).

Logic gates- OR, AND, NOT, XOR, NAND & NOR- their circuit realization and truth tables. Boolean Algebra- basic laws and theorems, De-Morgan's theorems – proof, application in combinational logic circuit design. Half adder and full adder ; Sequential circuits: Flip-flops-RS, JK, JK master slave & D, edge triggering and clocked operation. Ripple counter, Analog to digital & digital to analog converters.

Memory Elements : Random Access Memory (RAM), Read Only Memory (ROM), CDROM, EPROM, Magnetic disc & Magnetic tape, Input & Output devices - their functions.

Electronic Digital Computers – their development and types, basic architecture, introduction to micro-processors, techniques of micro-processor programming.

Group B : Solid State Devices **Marks :10**

Contact hours: 15

Junction diode tunnel diode, photo diode LED, solar cell.FET,biasing and amplification, JFET – Biasing, FET parameters, Shorted-gate drain current, pinch-off voltage and Gate-source cut off voltage, common-drain JFET amplifier ; MOSFET – construction & working principle , enhancement MOSFET, Transfer characteristics ; Silicon Controlled Rectifier (SCR) – working, equivalent circuit of SCR, SCR switching ; UJT – operation, emitter characteristics and its use as relaxation oscillator.Multi-meter as ammeter, voltmeter and ohm meter, Cathode Ray Oscilloscope – cathode ray tube, waveform display and uses.

Group C : Introduction to Nanophysics **Marks :10**

Contact hours: 15

Introduction, Definition, Length scales , Importance of Nanoscale and Technology, History of Nanotechnology, Benefits and challenges in Molecular manufacturing: The Molecular assembler concept, Understanding advanced capabilities, Visions and Objective of Nanotechnology, Nanotechnology in different fields: Automobile,Electronics, Nanobiotechnology, Materials, Medicine,

Nanoparticles : Introduction, types of nanoparticles,Techniques of Synthesizing nanoparticles, Characterization of nanoparticles, Toxic effect of nanomaterials. Observing nanoparticles --- Transmission Electron Microscope (TEM)

SUGGESTED READING

Solid state devices

Streetman B.G. : Solid state Electronic Devices, 2nd Ed, Prentice Hall

Stanly W.D. : Electronics Circuits and Applications 2n Ed, Prentice Hall of India

Ryder J.D. :Electronics fundamentals and applications 2nd Ed, prentice Hall of India

Millman J. and Grabel A :Microelectronics 2nd Ed, McGraw Hill International Ed.

Nanophysics

Mark Ratner and Daniel Ratner : Nanotechnology:A Gentle Introduction to the Next Big Idea ,2002

Richard Feyman :There's Plenty of Room at the Bottom: An Invitation to Enter a New Field of Physics .
(Free on line book http://www.zyvex.com/nanotech/feynman.html)

E.L. Wolf : Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience , Wiley 2006

Charles P Poole,Jr Frank,J Owens : Introduction to Nanotechnology, John Wiley and Sons, 2003

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PAPER H 604

HONOURS LABORATORY III

(At least 12 experiments from Group A and one project from Group B are to be performed through the year. During examination, one experiment from group A is to be performed and the poject work should be demonstrated in front of external examiner in six (6) hours)

Marks: 90

Group A (Marks – 60)

1. 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.
2. To draw input, out put and mutual characteristics curve of a transistor in CE mode and hence to calculate its h-parameters.
3. To draw input, out put and mutual characteristic curves of a transistor in CB mode and hence to calculate its h-parameters.
4. To study the combination of logic gates and hence to identify a digital circuit (say $\mathbf{Y = A\cdot B + C}$, $\mathbf{Y = \bar{A}\cdot B + C}$ etc.) by measuring intermediate and final outputs at various input combinations.
5. To measure the resistance, reactance and self inductance of a chocked coil in an L-R circuit using an A.C. Voltmeter.
7. 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.
8. To study an OPAM by measuring its (i) input offset voltage & offset current, (ii) input bias current at inverting & non-inverting input and (iii) closed loop gain.
9. To studu a full waveve rectifier with a shunt capacitor as filter circuit and hence to determine the values of ripple factor using CRO at the differentncy loads.

10. To determine the e/m of an electron by a suitable method.
11. To verify De Morgan's theorems in a bread board / logic board.
12. To verify Norton's theorem for a Wheastone bridge using a stabilized zero impedance power supply.
13. To verify Thevenin's theorem for a Wheatstone bridge using a stabilized zero impedance power supply.
14. To study the given Zener Diode as a voltage regulator and hence to determine the Percentage regulation and Line regulation.
15. To obtain hystresis curve (B-H curve) for a given ferromagnetic material on a CRO using a solenoid and then to determine hysteresis loss per cycle per unit volume of the material.
16. To study the frequency, rise time, fall time, Pulse height, Pulse width of a rectangular or triangular or sine wave by CRO
17. To study the frequency response curve of a series LCR circuit and determine the resonance frequency.

Group B (Project , Marks – 30)

1. Experimental Electronics Projects :

   (For examples: Regulated/Stabilized poer supply, Intercom circuit, Emergency light, Transistor amplifier audio, Transistor oscillator, Battery eliminater, Half adder Circuit)
2. Theoretical/Experimental projects of advance level in any branch of physics.
3. Computational Projects

SUGGESTED READING (Practical)

Worshnop and Flint. : Practical Physics

Mazumder : A Text Book of Practical Physics

Dasgupta C.R. : A Text Book of Practical Physics

Indraaprakash & Ramkrishna, : A Text Book of Practical Physics

Sarafb. Etal, : Mechanical System Vikash Publishing

Khandelwal D.P. : A Laboratory Manual of Physics for Undergraduate classes, Vani Publication

DETAILS COURSES OF READING FOR PHYSICS PASS

Semester I

PAPER P 101

MATHEMATICAL PHYSICS, MECHANICS & GENERAL PROPERTIES OF MATTER

Total Marks:35
Pass marks:12

Group A : Mathematical Physics **Marks-10**
Contact hours: 20

Vectors :The dot and cross product of vectors, the triple vector products, the triple scalar products, elementary idea of Gradient, Divergence and curls.

Matrices: Addition law of matrices, matrices multiplication, properties of matrices, special square matrices, inverse of matrices

Group B : Mechanics , General Properties of Matter & Relativity **Marks-25**
Contact hours: 60

Moment of Inertia: Theorems of moment of inertia, calculation of moment of inertia in simple cases: thin uniform rod, spherical shell, solid sphere, cylinder, uniform rectangular lamina.

Simple harmonic motion, Equation of S.H.M, Composition of simple harmonic motion, Lissajous figures, resolution of S.H.M. into two equal and opposite circular motion.

Compound pendulum, measurement of 'g' by bar and Kater's pendulum.

Elasticity: Relation between elastic constants, energy of elastically deformed bodies, torsion of a rod, torsional pendulum, bending of beam, cantilever.

Surface tension: Excess pressure on curved liquid surface (spherical bubble and drop). Viscosity of fluids: Poiseu1le's equation, determination of viscosity of a liquid by Poiseu1le's method.

Relativity : Galilean transformation, invariance of the laws of motion under Galilean transformation, Michelson- Morley experiment, postulates of special theory of relativity, Finite speed of a signal, Lorentz transformation equations, Relativity of Simultaneity, Length contraction, time dilation, with cosmic ray μ meson, twin- paradox. Variation of mass with velocity, Mass Energy relation

Semester II
PAPER P 201

ELECTRICITY AND MAGNETISM

Total Marks-35
Pass Marks : 12

Group A Electrostatic **Marks :10**
Contact hours : 25

Electric field and potential: Electric flux, potential as line integral of electric field, intensity potential relation, Gauss's theorem in integral and differential form, application of Gauss's theorem to simple problems.

Mechanical force on charged conductor: Energy in an electrostatic medium, Field and potential due to electric dipole, forces and Torques between dipoles, mutual potential energy.

Electric capacity: Capacity of spherical and cylindrical condensers.

Group B Magnetism **Marks :10**
Contact hours : 25

Magnetism: Magnetic dipole its field and potential, potential energy of magnetic dipole in uniform magnetic field, mutual potential energy between dipoles, dipoles in homogeneous magnetic field.

Magnetic field in matter: Intensity of magnetisation, Permeability & susceptibility, Hysteresis & Hyteresis loss, Distinguishing features of para, dia-& ferro magnetic materials.

Steady current: Kirchoff's law, sensitivity of wheat stone bridge, principle of potentiometer, measurement of electric current using potentiometer.

Group C Electromagnetism **Marks :15**
Contact hours : 30

Magnetic effects of currents: Application of Biot-savart's law to circular coil carrying current, a solenoid carrying current Helmholtz coil. Magnetic shell, potential at a point due to magnetic shell. Equivalent magnetic shell & ampere's theorem. Ballistic galvanometer, its sensitivity & figure of merit.

Electromagnetic induction: Integrated & differential form of Faraday's law. Energy in magnetic fields due to establishment of current in a circuit, mutual inductance between two coils, Growth and decay of current in L-R, C-R, L-C, L-C-R circuits, induction coil.

Reactance and impedance of A.C. Circuits, power consumed in AC circuit & Power factor, Transformer.

PAPER P 202
GENERAL LABORATORY I

Marks-30

(At least 8 experiments are to be performed during the year and one experiment in four (4) hours during the examination))

1. Determination of specific resistance of the material of a given wire by meterbridge.
2. Verification of the laws of series and parallel resistance by a Post Office box.
3. Determination of E.C.E. of copper by using an ammeter and a copper voltameter.
4. Determination of Young's modulus of the material of a given wire Searle's apparatus.
5. Determination of the refractive index of the given liquid with the help of a plane mirror, convex lens and a spherometer.
6. Determination of focal length of the given concave lens with the help of a convex lens.
7. Determination of the value of acceleration due to gravity by using the given bar pendulum.
8. Determination of the moment of inertia of the given body about an axis passing through its centre of gravity by torsional oscillation method.
9. Determination of specific heat of the given liquid by the method of cooling.
10. Determination of the frequency of a given tuning fork by Sonometer
11. Determination of RI of water by travelling microscope.
12. Measurement of Dip at a place by Dip circle.

Semester III

PAPER P 301

HEAT & THERMODYNAMICS

Total Marks-35
Pass Marks : 12

Group A Heat **Marks :15**
Contact hours : 40

Platinum resistance thermometer, thermocouple thermometer, specific heats of gases, determination of Cp by Electrical continuous Flow method, Cv by Joly's Differential Steam calorimeter.

Work done by a gas during isothermal and adiabatic expansion. Andrew experiment and importance of its results, Vander Waal's equation of state, critical constants and their determination, Law of corresponding states. Kinetic theory of gases, pressure exerted by a gas, Maxwell's law of distribution of velocities and its experimental verification, Most probable velocity, mean free path -simple deduction conucition and diffusion, Brownian movement. Expression for Avogadro's number.

Thermal conductivity and diffusivity, rectilinear flow of heat, Ingen Hanusz's experiment. Determination of conductivity- Searle's method.

Group B Thermodynamics **Marks :20**
Contact hours : 40

Thermodynamics : basic concepts, first law of thermodynamics and its application, indicator diagram, reversible and irreversible process. Second law of thermodynamics, Carnot's cycle. entropy- its properties and physical interpretation, Entropy changes during reversible and irreversible process.

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).

Semester IV

PAPER P 401

WAVES, OSCILLATIONS ands OPTICS

Group A : Waves and Oscillations **Marks:10**

Contact hours: 20

Free vibration, damped vibration, forced vibration, resonance and sharpness of resonance, composition of simple Harmonic vibration. Lissajous figure, Equation of wave motion, energy and intensity of plane progressive wave, principle of superposition of sound waves, beats combination of tone, determination of frequency by method of beats, stationary waves, Doppler effect

Expression for velocity of sound in homogenous medium, Laplace's correction to Newton's experiment

Vibration of strings, velocity of transverse wave in string, stationary wave in strings and air column, Melde's experiment, Kundt's tube experiment.

Electrically maintained tuning fork, determination of frequency of tuning fork.

Group B : Ray & Physical Optics **Marks:25**

Contact hours: 60

Fermat's principles, deduction of laws of reflection and refraction for plane surface using Fermat's principle, Deduction of lens maker's formula, thick lens, Cardinal points (deduction not necessary). Focal length of two thin lenses separated by a distance, chromatic aberration and correction, achromatic combination of lens & prism.

Defects of image- monochromatic aberration and chromatic aberration, Different types of monochromatic aberration and their explanation.

Eyepiece: Ramsden and Huygen eyepiece-their ray diagrams, principles and relative advantage and disadvantage.

Interference of Light : Condition of sustained interference by analytical treatment. Division of amplitude and division of wave front, methods for production of interference fringes by biprism, Lloyd's mirror, measurement of wavelength, measurement of thickness of thin film-reflected and transmitted light. Haidinger's fringe, theory of Newton's rings, determination of wavelength and refractive index.

Diffraction of light : Fresnel and Fraunhofer class of diffraction, Fresnel half period zone, zone plate- its similarity with convex lens. Fresnel diffraction at straight edge, circular aperture and circular disc. Fraunhofer diffraction, single slit, double slit, plane diffraction grating.

Polarisation of light : Different methods of production of polarised light, Brewster's law, double refraction, Nicol prism-construction and uses, polaroids, refraction through uniaxial crystal, quarter and half-wave plate, Babinets compensator, Optical activity, Fresnel explanation of optical rotation and its verification, half shade plate, rotary dispersion and polarimeters.

PAPER P 402

GENERAL LABORATORY II

Marks-30

(At least 8 experiments are to be performed during the year and one experiment in four (4) hours during the examination)

1. Determination of the coefficient of linear expansion of the given rod by optical lever method.
2. Determination of the focal length of the two given convex lenses and their combination by displacement method.
3. Comparison of the moments of two given bar magnetic by deflection magnetometer.
4. Determination of the value of the given low resistance by the drop of potential method with meterbridge
5. Determination of the resistance per unit length of a meterbridge wire by Carey Foster's method.
6. 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.
7. Measurement of current by potentiometer when a cell of known e.m.f. is given for calibration.
8. Conversion of a given galvanometer into ammeter and to calibrate it with the help of copper voltameter.
9. Determination of the modulus of rigidity of the material in the form of cylinder by statistical method.
10. Convert a given galvanometer into voltmeter and calibrate it.
11. Determination of EMF of a cell by potentiometer.
12. Determination of coefficient of viscocity of water by Poisseulies method.

Semester V

PAPER P 501

QUANTUM MECHANICS, ATOMIC & NUCLEAR PHYSICS

Group A : Quantum Mechanics **Marks -10**

Contact hours: 25

Failure of classical Mechanics and origin of quantum mechanics, photoelectric effect, compton effect, wave-particle duality, De-Broglies concept of matter waves, De-Broglies relation, properties of matter waves. Wave velocity and group velocity.

Heisenberg's uncertainty principle its proof and its application in the non-existence of electrons in the nucleus, binding energy of an electron in Hydrogen atom, radius of Bohr orbit, complementary principle.

Group B : Atomic Physics **Marks-15**

Contact hours: 30

Positive rays and their analysis, Mass Spectrograph- A AStron and Bain bridge, Bohr's 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.

Excitation and Ionisation potentials, Frank and Hertz experiment, characteristic X-ray spectra, Moseleys law, Bragg's law, Bragg's spectrometer-determination of wavelength.

Group C : Nuclear Physics **Marks-10**

Contact hours: 25

Radioactivity: law of successive disintegration, secular and transient equilibrium, Alpha ray spectrum, Geiger- Nuttal law. Beta ray spectrum and pauli's neutrino hypothesis. Nuclei and their properties-charge, mass, size, density, angular momentum, nuclear magnetic moment, binding energy curve, packing fraction and nuclear stability, Nuclear transmutation,

Sustained chain reaction and reactors. Breeder reaction Linear accelerator and cyclotron, Ionisation and cloud chamber, Cosmic rays and composition, geo-magnetic effect, altitude effect, cosmic rays showers.

Semester VI

PAPER P 601

CRYSTALLOGRAPHY & ELECTRONICS

Group A : Elements of Crystallography **Marks-10**
Contact hours: 25

Amorphous and crystalline materials, Lattice translation vectors, unit cell, primitive cell, basis, Miller indices and representation of crystal planes, interplaner spacing, symmetry consideration, symmetry group, space group, different types of crysta1 structures, classification of crystals based on nature of structures, Bravias lattice, reciprocal lattice, Theory of Laue Spots.

Bragg's law, diffraction of X-ray, measurement of Lattice parameter for cubic lattices.

Group B : Electronics **Marks-25**
Contact hours: 55

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. 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. Feed back in amplifiers: conditions of oscillation, Barkhausen criteria ; Working principle & description of Tuned collector and Hartley oscillators mentioning frequency of oscillation. Logic gates: OR, AND, NOT, NAND, NOR, XOR, their circuit realization & truth tables . de Morgan's theorem.

PAPER P 602

GENERAL LABORATORY III
Marks-30

(At least 10 experiments are to be performed during the year and one experiment in four (4) hours during the examination))

1. Determination of thermal conductivity of a given rod by Searle's apparatus.
2. Determination of the focal length of the given convex mirror with the help of a convex lens.
3. Determination of the angle of minimum deviation and the angle of a given prism with the help of a spectrometer and hence to find the refractive index of the material of the prism.
4. Determination of the wavelength of sodium light by Newton's ring.
5. Comparison of the value of two given low resistance with the help of potentiometer
6. Determination of resistance of a galvanometer by half -deflection method.
7. Plotting of Vp-Ip characteristics of a diode valve and hence to determine the plate resistance.
8. Drawing of static plate characteristics of a triode valve and hence to find out the valve constants.
9. Determination of the refractive index of the material of a convex lens by measuring its focal length and radii of curvatures.
10. Determination of internal resistance of a cell by Potentiometer.
11. Determination of J (mechanical equivalent of heat) by Joule's electrical calorimeter.
12. To draw the forward characteristic curves of a semiconductor diode and hence calculate the dc resistance (r_{dc}).
13. Verify Truth tables for the logic gates AND, OR, NOT.
14. Verify de Morgan's theorem using breit board / logic board.
15. To draw out put characteristics of C.B Transistor and hence find current gain.
16. To draw out put characteristic C.E Transistor and hence find current gain.

Suggested Readings for Pass Course :

1. Mathematical Physics, Rajput
2. Mechanics, Mathur
3. Relativity, S Mukherjee
4. Heat & Thermodynamics, Brij lal and Subrahmaniam
5. Optics, K G Mazumder and B Ghosh
6. Electricity ad Magnetism, D C Tayal
7. Nuclear Physics, Brij Lal and Subrahmaniam
8. Quantum Mechanics, Satyaprakash
9. Crystallography, Puri & Babar
10. Electronics, V K Mehta
11. Atomic Physics, Rajam