Vidyasagar University

Midnapore – 721 102

Revised

3 YR DEGREE SYLLABUS IN PHYSICS (H & G)

on

3 - TIRE EXAM PATTERN

W. E. F. 2006 - 2007

VIDYASAGAR UNIVERSITY, MIDNAPORE - 721 102
SYLLABUS IN PHYSICS (HONOURS AND GENERAL)
3 TIRE EXAMS PATTERN

Honours Course:

The entire course is divided into eight Papers with total 800 marks to be studied in three years. At the end of 1st year there will be Part - I examination of two theoretical papers (Paper I, II), at the end of 2nd year two theoretical papers and one practical paper in Part II examination. At the end of 3rd year there will be one theoretical paper and two practical papers in Part III examination. Final result will be determined on the basis of Part – I, Part – II and Part – III examination taken together. Each theory paper is of 90 marks for external and 10 marks allotted for internal assessment.

A number of tutorial classes have been allotted for each course for group discussion, problem session and demonstration experiments or general guide line on different aspects.

Three tire Examination pattern

Part I	Part II	Part III
100 x 2 Theory 90 x 2 external 10 x 2 internal	**100 x 2 Theory + 100 Practical** 90 x 2 external theory 10 x 2 internal theory 90 x 1 external practical 10 x 1 internal practical	**100 x 1 Theory + 100 x 2 practical** 90 x 1 external theory 10 x 1 internal theory 90 x 2 external Practical 10 x 2 internal Practical

Part - I Examination

Theory

Paper I - 100 marks (University written Exam 90 + College Internal Assessment 10)

Paper II - 100marks (University written Exam 90 + College Internal Assessment 10)

Paper I **Full marks - 100 (Theory), [150 + 20 Lectures], Time: 4 hrs.**

- Group A - Mathematical methods of Physics (60 lectures)
- Group B - Classical Mechanics I (48 lectures)
- Group C - General properties of matter and fluid mechanics (23 lectures)
- Group D - Vibration, Waves and Acoustics (39 lectures)

Paper II **Full Marks 100 (Theory), [150 + 20 Lectures], Time : 4 Hrs.**

- Group A - Geometrical Optics (21 lectures)
- Group B - Physical optics (47 lectures)
- Group C - Heat (42 lectures)
- Group D - Thermodynamics (40 lectures)
- Group E - Relativity (20 lectures)

Part –II Examination

Theory

Paper III - 100 marks (University written Exam 90 + College Internal Assessment 10)

Paper IV - 100 marks (University written Exam 90 + College Internal Assessment 10)

Practical

Paper V – 100 marks

Paper III **Full Marks 100 (Theory),** [University written Exam 90 + College Internal Assessment 10], **[150 + 20 Lectures], Time : 4 Hrs.**

Group A	-	Electrostatics (35 lectures)
Group B	-	Electricity and Magnetism and motion of charged particle in electromagnetic field. (70 lectures)
Group C	-	Electromagnetic Theory and Plasma (35 lectures)
Group D	-	Electronics I (30 lectures)

Paper IV - Full Marks 100 (Theory), [University written Exam 90 + College Internal Assessment 10], **[150 + 20 Lectures], Time : 4 Hrs.**

Group A	-	Classical Mechanics II (21 lectures)
Group B	-	Statistical Mechanics(23 lectures)
Group C	-	LASER and Instruments (43 lectures)
Group D	-	Atomic and Molecular Physics (27 lectures)
Group E	-	Nuclear Physics + Cosmic Ray + Particle Physics (56 lectures)

Paper V - Practical Full Marks 100 Time: 6 Hrs. x 2 days

Group A	-	40 Marks (LNB - 5, Viva - 5, Expt - 30)
Group B	-	50 Marks (LNB - 5, Viva - 5, Expt - 40)
Group C	-	10 Marks - Computer application

Examination of Gr A & C will be held in one day and Gr B in another day.

<u>Part – III Examination</u>

Paper VI - Full Marks 100 (Theory), [University written Exam 90 + College Internal Assessment 10], **[150 + 20 Lectures], Time : 4 Hrs.**

Group A	-	Electronics II (65 Lectures)
Group B	-	Solid state Physics (37 Lectures)
Group C	-	Quantum Mechanics (68 Lectures)

Paper VII – Practical Full Marks - 100 Time : 6 Hrs.

Group A	-	40 Marks
Group B	-	60 Marks

Paper VIII(a) - Practical Group A Full Marks - 70 Time: 6 Hrs.

Group A	-	Non Electronic Expt. - 55 Marks (Expt. 45, LNB-5, Viva-5)
Group B	-	Computer Practice - 15 Marks

Paper VIII(b) Project 30 marks (Experimental based)

Syllabus in Physics (Honours)

Paper – I (150 + 20 Lectures)

F. M - 100 marks (University written Exam 90 + College Internal Assessment 10)

Group A

Mathematical Methods of Physics [60 Lectures]

1. **Preliminary Topics [8 L]**

Analytic functions and Taylor's series expansion. Functions of several variables - Partial differentiation. Random variable and probabilities. Statistical expectation value, Variance, Gaussian and Poisson distribution.

2. **Vector Analysis [21 L]**

Fundamental concepts of vector algebra, scalar and vector products. Differentiation and integration of vectors. concept of tensor. Gradient, Divergence and Curl of a vector field. Gauss's divergence theorem, Stokes' theorem and Green's theorem - simple applications. Orthogonal curvilinear co-ordinates unit vector, gradient, curl, Divergence, Laplacian in spherical and cylindrical polar systems. Change of variables & the Jacobian, evaluation of surface & volume integrals.

3. **Differential equalions [10 L]**

Solution of second order differential equation with constant coefficient & variable coefficient by Forbenius method. Legendre and Hermite Polynomials differential equation, generatory recursion relation, Rodrigue formula, orthonormal properties.

4. **Partial differential equations [8 L]**

Solution by seperation of variables. Laplace's equation in Cartesian, spherical polar and cylindrical systems with application in wave equation.

5. **Matrices [8 L]**

Inverse of a matrix, Matrix algebra, Hermitian and Unitary matrices. Similarity transformation. Diagonalisation of matrices with non degenerate eigen values. Eigen values and eigenvectors.

6. **Tutorials [5 L]**

Group B

Classical Mechanics I (48 lectures)

1. **Particle Dynamics [11 L]**

Velocity and acceleration of a particle in plane polar, cylindrical and spherical polar co-ordinates. Time and path integral of force, conservative and dissipative force and concept of potential; Centre

of mass of a system of particles. Linear momentum, angular momentum and equations of motion. Rocket motion.

2. **Rotational motion [16 L]**

Moment of inertia & radius of gyration. Parallel and perpendicular axes theorems. Moment of inertia about any axis. Ellipsoid of inertia and inertia tensor, principal axes. Motion of a rigid body. Angular momentum. Precessional motion, top, inertial and non- inertial frame of reference, Rotating frame reference. Corriolis and Centrifugal forces - simple examples.

3. **Gravitation and central force problem [16 L]**

Gravitational potential and intensity, potential & Intensity due to a spherical body, Gravitational self energy, Gauss's theorem, Laplaces' equation - application in each case. Motion under central force. Nature of orbits under attractive inverse square field. Stability of orbit. Keplar's laws of planetary motion. Two body problem, reduced mass, binary stars.

4. **Tutorial [5 L]**

Group C (23 lectures)

1. **General properties of matter and Fluid Mechanics [18 L]**

Elastic constants of an isotropic solid, their interrelations. Tortion in a cylinder, Bending of beam, Bending moment and shearing force. Cantilever vibration of a canlever. Beam supported at both the ends. Kinematics of fluid motion, Poiseully equation, equation of continuity. Euler's equation, Bernoulli's theorem - applications. Viscous fluids, Stream line and terbulant flow, Critical velocity, flow through a capillary tube. Stokes law. Surface tension, Surface energy, molecular interpretation, Excess pressure on a curved liquid surface. Capillary rise.

2. **Tutorial [5 L]**

Group D

Vibrations, Waves & Acoustics (39 lectures)

1. **Vibrations [12 L]**

Potential energy vs. displacement relation. Concept of equilibrium. Development of SHO & other anharmonic, terms from force equations, Damped oscillation, critical damping, Q factor of an oscillator. Forced vibration, resonance, low and high frequency responses. Eigen frequency and normal modes, energy transfers between modes, coupled pendulum, Lissagous figures. Anharmonic oscillator. Fourier series & Fourier coefficients. Fourier analysis in some simple cases.

2. **Waves [12 L]**

Progressive wave in one dimension and in three dimension, wave equation, Plane wave & spherical wave, Intensity, dispersion, group velocity, phase velocity.

Speed of transverse waves in a uniform string, eigen frequencies & eigen modes for plucked & struck string.
Speed of longitudinal waves in a field, energy density & intensity of waves.
Superposition of waves - superposition principle, interference in space and energy distribution, beats, combinational tones.
Production, detection & application of ultrasonic waves.
Doppler effect, Shock waves.

3. **Acoustics [10 L]**

Vibrations in bounded system. Normal modes of a bounded system, harmonics, quality of sound, Noise & Music, Intensity & loudness, bel and phon.
Principle of sonar system, Transducer and their characteristics, recording & reproduction of sound, measurement of velocity, frequency and intensity. Acoustics of halls, reverberation & Sabines formula.

4. **Tutorial [5L]**

Paper I

Books

Mathematical Methods of Physics :

1. Introduction to Mathematical Physics - C. Harper
2. Advanced Mathematics - M. R. Spiegal
3. Vector & Tensor analysis - M. R. Spiegal
4. *Tattiya Padarthabidyar Bhumika*- S. Sengupta, Asok Ghosh, D. Raychowdhury
5. Mathematics for Physicists & Engineers - Piper
6. Mathematical Physics - Rajput & Gupta

Classical Mechanics & General Properties of Matter & Fluid Mechanics:

1. Theoretical Mechanics - M. R. Spiegal
2. Mechanics - K. R. Symon
3. Feynnman Lectures on Physic Vol. 1
4. Mechanics - N. C. Rana & V. J. Yoga
5. Mechanics - Takwale & Pusanik
6. Mechanics - Satya Prakash
7. Mechanics & General Properties of matter - D. P. Raychowdhury & S. N. Maity
8. General Properties of matter - F. H. Newmann & V H L Searle
9. Berkelay Physics Course Vol - 1

Vibration, Waves & Accoustics :

1. Advanced accoustics - D. P. Raychowdhury
2. Vibration, Waves & Accoustics - D. Chattopadhyay & P. C. Rakshit
3. The Physics of vibrations & waves - I. G. Main

4. Mathematics of waves & vibrations - R. K. Ghosh
5. Physics of vibrations & waves - H. I. Pain
6. Waves & oscillations - Rathindra Nath Chowdhury

Paper – II (150 + 20 Lectures)

F. M - 100 marks (University written Exam 90 + College Internal Assessment 10)

Group A ::Geometrical Optics (21 lectures)

1. **Geometrical optics (18 L)**

Fermat's principle and its applications - Matrix method of Paraxial optics. Magnification, Helmholtz - Lagrange Laws, Cardinal points of an optical system - thick lens and lens combinations, telephoto lenses, paraxial approximation.

Aberration in images, Seidal aberration, aplenetic points of a sphere. Achromatic combination of lenses, oil immersion objectives, eye pieces - Ramsdan & Huygen.

2. **Tutorials [3 L]**

Group B

Physical Optics (47 lectures)

1. **Physical optics I (28 L)**

Wave theory of light: Huygen's principle - applications

Interference of light: Young's experiment, spatial and temporal coherence - Biprism & Leoyd's mirror expt. Interference in thin film, fringes of equal inclination and equal thickness, Newton's ring. Michelson interferometer - application to measure wave length, difference of two wave lengths and standardizations of metre. Multiple beam interferometer. Febry-Perot interferometer and etalon - applications. Diffraction: Fresnel's half period zones. Circular apertures and circular disc. Straight edge, explanation of rectilinear propagation. Fraunhofer diffraction : Diffraction at single slit, circular apature and circular disc. Double slit and plane diffraction transmission grating, concave grating. Raylaigh criteria of resolution, resolving power of prism, telescope, microscope and transmission grating. Outline of phase contrast microscopy.

2. **Physical optics II (14 L)**

Polarisation by reflection, Brewster's law, Double refraction. Nicol prism, polaroids, half and quarter wave plates, Production and analysis of polarised light. Optical activity and its origin in liquid and crystals (Polarimeter). Kerr effect. Farrady effect. Zeeman effect. Preliminary idea.

3. **Tutorial (5 L)**

Group C

Heat (42 lectures)

1. **Kinetic theory of gases (18 L)**

Deduction of Perfect Gas law. Maxwell's distribution law (interms of velocity and energy). r.m.s. and most probable speeds. Mean free path. Equipartition of energy. Specific heat. Viscosity. Thermal conduction and diffusion in gases. Brownian motion. Einstein's theory. Perrin's work to determine Avogadro number.

2. **Real Gases (5 L)**

Isothermals of real gases. Van-der-waal's equation of state. Other equation of state (mention only). Critical constants. Virial co-efficient. Boyle temperature.

3. **Heat transfer (14 L)**

Thermal conductivity, Diffusivity, Fourier equation of heat conduction and its application to rectilinear, spherical and cylindrical flow of heat. Black body rediation, Kirchoff's law, Stefan Boltzmann law, Wien's and Rayleigh - Jeans law, Planck's law (no deduction), Solar temperature & rediation pyrometer. Importance of convection in atmospheric physics, adiabatic lapse rate.

4. **Tutorial [5 L]**

Group D

Thermodynamics (40 lectures)

1. **Thermodynamics I (20 L)**

Thermodynamic variables & static functions, Zero'th law of thermodynamics, Firat law of Thermodynamics, work done in isothermal and adiabatic changes in perfect & real gases. Cannot cycle and Carnot's theorem, application to thermodynamic. Second law of thermodynamics. Entropy, reversible and irreversible processes classics and integrality and . Entropy change in some simple reversible & irreversible process. Clausius inequality and Principle of increase of entropy. Thermodynamic scale of temperature. Impossibility of attaining absolute zero (third law of thermodynamics).

2. **Thermodynamics II (15 L)**

Enthalpy, Helmholtz and Gibb's force energies. Maxwell's relations - varios applications. Equilibrium between phases, trible point, Gibb's phase rule and applications. First and higher order phase transition, Ehrenfest criterion, Clausius Clapeyron's equation. Joule - Thomeon effect, adiabatic expansion of gases. regenerative cooling & cascade cooling liquifiction of gases. Production and measurement of low temperature - (Adiabatic Demagnetization)

Heat engines - Otto and Diesel Cycles.

Refrigerators - Compression & Absorption type (Preliminary idea)

3. **Tutorials (5 L)**

Group E

Relativity (20 lectures)

1. Special theory of Relativity (18L): Newtonian relativity, Gallition transformation, contradiction between Newtonian relativity and electro dynamics. Astronomical aberration, Fizeau's expt and Mischelson-Morley expt. Postulates of special theory of relativity - simultaneity - Lorentz transformation - length contraction - time dilation and velocity addition theorem. Invariance of Maxwell's equation. Doppler effect in light. Variation of mass with velocity, energy momentum relation. Mean energy equivalence. Four vectors, invariance of an interval time like, space like and light like intervals. Light cone causality.
2. Tutorials [2 L]

Paper II

Books

Optics

1. Physical optis - A. K. Ghatak
2. Geometrical and Physical optics - Longhurt
3. Fundamentals of optics - F. A. Jenkins & H. E. White
4. Optics - B. K. Mathur
5. Optics - M. Born & Wolf
6. Manchester Physics Series - Optics - F. G. Smith & J. H. Thomson
7. Bhouto Alokvigyan – Bijoy Sankar Basak
8. Optical Physics - Lipson & Lipson

Heat and Thermodynamics

1. Heat and Thermodynamics - Zemansky and Dittman
2. Kinetic theory of gases - Loeb
3. Thermal Physics - C. Kittel & H. Kroner
4. A Treatise on heat - Saha & Srivastava
5. Thermodynamics - E. Fermi
6. Gaser Anabik Tatta – Pradip Kumar Choudhury
7. Heat and Thermodynamics - H. P. Ray & A. B. Gupta
8. Tapgati Vidya – Ashok Ghosh

Relativity

1. Introduction to special theory of Relativity - R. Resnick
2. Special theory of Relativity - A P French
3. Apakhik Tatta – Sri Ranjan Banerjee.

Part - II

Paper III (150 + 20 Lectures)

F. M - 100 marks (University written Exam 90 + College Internal Assessment 10)

Group A

Electrostatics [35 L]

1. **Electrostatic field & potential (15L)**

Coulomb's law, intensity and potential, Gauss's theorem - its application, poisson's and laplace's equations, uniqueness theorem, super position theorem. Application of Laplace's equation in simple cases of symmetric charge distribution.

Potential and field due to different charge distributions. Line charge, Planer charge, Spherical shell, etc. energy associated with field. Multi pole expansion of scalar potential - monopole, dipole and quadrupoles. Potential and field due to a dipole, work done in deflecting a dipole. Dipole - Dipole interaction. Force on dipole in a non homogeneous field.

2. **Dielectrics : (10 L)**

Polarisation, Polarizability, tension, electronic & molecular contributions, electric displacement vector $(\vec{D})$, Gauss's theorem in dielectric media, boundary conditions, electrostatic field energy, capacitors - parallel plate, spherical and cyllindrical capacitors containing dielectrics (uniform and nonuniform). Field of a polarised sphere - dielectric sphere in an uniform field. Claussius - Mossotti relation, electrets.

3. **Electrical images (5 L)**

Solution of field problems by method of images. Point charge near a conducting plane. Boundary value problem in uniform external field for a conducting spherical shell and dielectric sphere.

4. **Tutorial(5 L)**

Group - B [70 L]

Electricity & Magnetism & Motion of Charged Particle in Electro Magnetic Field

1. **Magnetic field (14 L)**

Lorentz Force and magnetic field $\vec{B}$. Magnetic field due to currents - Biot - Savart's law. Magnetic vector potential. Calculation of vector potential and field in simple cases - straight wire, circular current & solenoid Galvanometer. Current loop - magnetic dipole. Torque on a current loop. Magnetic dipoles in atoms & molecules. Geomagnetic ratio. Ampere's theorem. Ampere's circuital law. Force between two parallel current carrying conductor.

2. **Magnetic materials (18 L)**

Free current and bound current, surface & volume density of current distribution. Magnetisation - non uniform magnetisation of matter. Ampere's law in forms of force current density. Introduction of $\vec{H}$. Boundary condition of $\vec{B}$ and $\vec{H}$. Magnetisation. Magnetic scalar potential, Application of Laplace's equation to the problems of magnetic sphere in uniform magnetic field. Hysteresis and energy loss in Ferro magnetic materials. Magnetic circuits. Energy stored in magnetic field.

3. **Electric current and circuits : (28 L)**

Non steady current & continuity equation. Krichhoff's laws and application. Non-ohmic circuitry - Thermister & LDR. Wheatsons bridge. Kelvin double bridge, callender grifith bridge.

Electromagnetic induction, calculation of self & mutual induction in simple cases. Inductancs in series & parallel. Reciprocity theorem. Earth inductor. Ballistic galvanometer and flux meter.

Growth and decay of current in charging and discharging a capacitor - LCR circuit Oscillatory discharge.

Alternating current. Complex impedance, reactance, LCR circuit in series & parallal, resonance, Q Factor, power dissipation, Elementary theory of transformer. A. C. bridges

Thevinin's theorem, Norton's theorem, Max. Power transfer theorem, T and π networks.

Theory of rotating magnetic field - induction motor. Three phase electrical power supply, delta and star connection and transformation.

4. **Motion of charged particles in $\vec{E}$ & $\vec{B}$ fields (5L)**

Millikan oil drop expt. (Charge quatisation), Positive ray parabola, velocity selectors, magnetic focussing, Mass spectrography.

5. **Tutorial (5 L)**

Group C
Electromagnetic Theory and Plasma (35L)

1. **Generalisation of Ampere's law (5 L):**

Displacement current, Maxwell's field equations, wave equation for electromagnetic field & its solution plane and spherical wave solutions, gauge invariance. Transverse nature of fields, relation between **E** & **B,** Energy density of field. Poynting vector and Poynting's theorem, boundary condition.

2. **E - M waves in an isotropic dielectric, wave equation (3 L):**

Wave Equation; Reflection and refraction at plane boundary; Reflection & Transmission coefficient; Fresnel's formula; Polarizations on reflection - Brewster's law - total internal reflection.

3. **E - M waves in conducting medium (5 L)**

Wave equation in conducting medium. Reflection & transmission at metallic surface - skin effect and skin depth. Propagation E - M waves between parallel & conducting (ionized) plates in wave guides.

4. **Dispersion (5 L)**

Equation of motion of electron in radiation field - Lorentz theory of dispersion - normal and anomalous. Sell Meier & Cauchy's formula, absorptive and dispersive mode. Half power frequency & band width.

5. **Scattering (2L)**

Scattering of a radiation by bound charge. Rayleigh scattering blue of sky, absorption.

6. **Radiation from accelerated charges (5L)**

Modification of Coulomb's law to include velocity and acceleration dependent terms in E field. Radiation from an oscillating dipole & its polarisation. Concept of retarded potentials. (Qualitative discussions only)

7. Basic concept on Plasma : (5L)

Discharge of electricity through gases, Potential distribution, condition for plasma existence.

8. Tutorials (5 L)

Group D
Electronics I (30 L)

1. **Thermiomic emission and vacuum Tubes (4L)**

Thermiomic emission and work function, Richardson's law (no derivation). Space charge and temperature limited current, Child-Langmuir law, Schottky effect, Elementary application of triode valve.

2. **Diodes (6L)**

Conductor, insulator and semiconductor; concept of hole, extrinsic semiconductor, p-n junction, space charge and electric field distribution at junctions. forward and reverse biased junctions, depletion region, avalanche and zenar breakdown. I - V characteristics and use of zenar as voltage regulator, light emitting diodes, photo diodes. Analysis of half and full wave rectifiers. Bridge rectifier with C and π filter. Power supply.

3. **Bipolar Junction Transitor (BJT) (8L)**

Current component in junction transistor, characteristics in CB & CE modes, cut off, saturation and active regions; α and β of transistors and their relations. Output characteristics - load line and Q point; biasing of a transistor - stability factors; hybrid parameters and small signal single stage low frequency CE amplifier (analysis with h parameter model) current and voltage gains, input and output impedances, effect of source resistance, power gain, comparison of CB, CC and CE amplifiers, emitter followers.

4. **Boolean algebra (2L)**

Binary, decimal and hexadecimal systems, conversion of one system to another. 1's complement and 2's complement of binary number, binary addition & subtraction.

5. **Logic gates (5L)**

AND, OR, NOT gates - truth tables, circuits of AND and OR gates using diodes and transistors, circuit of NOT gates using transistor. NAND and NOR as universal gate. Combination of gates to obtain different Boolean functions. de Morgan's theorem - simplification of Boolean expressions.

5. **Tutorials (5 L)**

Paper - III

Books

Electrostatics - Electricity and Magnetism and electromagnetic theory and Plasma.

1. Berklay Physics Course II - E M Purcell
2. Feynman Lectures on Physics Vol II
3. Introduction to Electrodynamics - D J Griffith
4. Electricity & Magnetism - J H Fewkes & J Yarwood
5. Electricity and Magnetism - D. Chatopadhyaya and P. C. Rakshit
6. Electromagnetic theory - Reitz, Milford and Christy
7. Fundamentals of Electricity and Magnetism - A F Kip
8. Electricity and Magnetism - A S Mahajan & A A Rangawala
9. Principles of Electricity and Magnetism - Pugh & Pugh
10. Electromagnetic fields - A M Portis
11. Electricity & Magnetism – Matveeb
12. Plasma Physics – S. N. Sen

Electronics

1. Electronic fundamentals and applications - J D Ryder
2. Electronics fundamentals and applications - D. Chattopadhyaya and P. C. Rakshit
3. Integrated Electronics - J. Millman & C. C. Halkias
4. Micro electronics - J Millman and A Gabriel
5. Electronic devices and circuit theory - R Boylestad and L Nashalsky
6. Electronic devices - W D stanley
7. Electronic circuits – L. Schelling and Velove
8. Digital principles and applications - A P Mallvino.

Paper IV (150 + 20 Lectures)

F. M - 100 marks (University written Exam 90 + College Internal Assessment 10)

Group A : Classical Mechanics II (21L)

1. Generalised co-ordinates, constraints and degrees of free com; D'Alembert principle, Lagrange's equation for conservative systems and its applications to simple cases, cyclic co-ordinates and conservation principles. Definition of Hamiltonian. Hamilton's equation - (statement - derivation by Lagendre transformation) its application to simple cases. Canonically conjugate variables. Canonical transformations, Poisson brackets. Small oscillations - normal modes and eigen frequencies (19 L).

2. Tutorials (2 L)

Group B

Statistical Mechanics (23 L)

1. **Statistical Mechanics [8L]**

Classical description in terms of phase space. Principle of a priori probabilities. Probability distribution, One dimensional oscillator, free particles functions $\phi(E)$ & $\Omega(E)$, average properties of a system in equilibrium stage. Interaction between two systems - thermal, mechanical and diffusive. Statistical definition of temperature, pressure, entropy and chemical potential. Third law of thermodynamics.

2. **Quantum Statistics [12L]**

Gibb's paradox, identical particle and symmetry requirement. Deribation of M-B, F-D and B-E statistics. Planck's law, Rayleigh Jeans and Wien laws. Phonons and specific heats of solids - Einsten - Debye theory. Bose Einstein condensation. Fermi distribution at zero & non zero temperature. Fermi energy, degenrate and non degenerate Fermi gas. Electron specific heat of methods at low temperature - therionic emission - Richandon Dushman equation. Introduction to micro cannomical, grand cannonical and cannomical ensembles.

3. Tutorials [3 L]

Group - C

Laser & Instruments (43 Lectures)

1. **Laser -** Population inversion; Einstein's A, B coefficients : feed back of energy in a resonator; 3 level and 4 level systems. Helium - neon and semiconductor laser. Laser applications, holography isotope separation, precision measurements of frequency and distance.[10 L]
2. **Fibre optics** - Optical Fibre core and cladding, total internal reflection; optical fibre as wave guide : step index and graded index fibre, communication through optical fibre - energy loss, band width and channel capacity - a typical system, attenuation and dispersion, splicing and coupler, fibre sensor.[10L]

3. **Vacuum Techniques** - Production of vacuum; conductance and pumping speed; rotary oil pump; diffusion pump, measurement of high vacuum - Mcleod, Penning and Pirani gauges, leak detector.[5 L]
4. **Particle accelerator** - Cyclotron & Betatron - basic theory, synchrotron, electron storage ring (ESR) and linear accelerator. [5 L]
5. **Detectors** – Ionization chamber, proportional counter GM counters, spark chambers, cloud chamber, semiconductor detectors for charged particles & γ-ray detectors, Scintillation counters, Photodiodes & charge coupled device (CCD) camera for detection of electromagnetic radiation.[8L]
6. Tutorials [5 L]

Group D

Atomic & Molecular Physics (27 L)

1. Atomic and Molecular Physics & X - Ray : [22L]

Spectrum of hydrogen atom. Four quantum numbers, L - S coupling. Selection rule. Half life of excited states - width of spectral line - Doppler broadening, Doublet line structure of hydrogen lines. Screening constant of monovalent atom, doublet structure of alkali spectra. Spectra of helium & alkaline earth atoms - singlet & triplet series. Lamb & Rutherford expt.

Effect of magnetic field on energy levels, gyromagnetic ratio of orbital & spin motions, vector atom model, Lande g factor, strong and weak field effects - Zeeman effect.

X-Ray spectra, continuous and characteristics. X-Rays - Duane & Hunt limit. Moseley's law, Doublet fine structure, H - like character of X-Ray states. X-Ray absorption spectra. Diatomic molecule, rotational & vibrational energy levels - vibration & rotation spectra. Raman effect and its application.

2. Tutorial (5 L)

Group E

Nuclear Physics, Cosmic ray & Particle physics (56 L)

1. **Properties of nuclei [9L]**

Nuclear charge, mass, size, binding energy, spin, isospin, magnetic moment, electric quadrapole moment, Isotope, Isobars & Isotones mass spectrometer (Brainbridge) and its uses.

Nuclear stability & nuclear binding, liquid drop model (descriptive) and Bethe-weizsacker mass formula - application of mass formula to stability consideration, Shell model (qualitative discussions), Theory of nuclear forces.

2. **Unstable nuclei [14L]**

(a) α decay, alpha particle spectra : velocity and energy of α particles. Geiger Nuttal law - Gamow's explanation.

(b) β decay – Nature of β ray spectra, neutrino, energy levels & decay schemes, positron emission & electron capture, selection rule, beta absorption & range of beta particles.

(c) γ decay - γ ray spectra & nuclear energy levels isomeric states, multipolarity of transition & selection rules (no derivations). Internal conversions and Bremstralung (descripative). γ absorption in matter-photoelectric process, compton seattering, pair production.(qualitative discussions)

3. Nuclear reaction [14L]

(a) Rutherford expt. & conservation principles in nuclear reactions ; Q value and thresholds, exoergic and endoergic reactions, reaction cross section, examples of different types of reaction & their characteristics. Compound nuclear reaction and direct interactions, Ghoshal's experiment.

(b) Fission - characteristics, liquid drop model, fission products & energy release - spontaneous & induced fission. Transuranic Elements, chain reactions, basic principle of nuclear, reactors.

(c) Nuclear fusion, energy released in stars.

4. **Cosmic ray & elementary Particles : [14L]**

(a) Cosmic ray – Nature and origin of primary and secondary rays, hard & soft, muon, pion, mesons & hyprons. Mean life of muon & pion. extensive air shower, solar modulation of primary ray, effect of Earth magnetic fields.

(b) Elementary particles-Classifications, mass, charge, spin, Isospin, Parity, hypron charge and charge conjugate - conservationtion law. Hadrons & lepton, baryon & meson, elementary ideas about quarks & leptons.

5. Tutorials [5 L]

Paper IV

Books

Classical Mechanics

1) Classical Mechanics - Green Wood
2) Classical Mechanics - Takwale & Puranik
3) Classical Mechanics - A K Roy chaudhuri
4) Classical Mechanics - Satya Prakash
5) Classical Mechanics - Goldstien

Statistics

1) Berkley Physics Course 5 - Statistical Physics - F. Reif

2) Statistical Mechanic - K. Huang
3) Introduction to statistical Physics - B. B. Laud
4) Statistical Physics - F. Mandle
5) Statistical & Thermal Physics - Gambhir & Lokenathan

Laser Fiber optics and Instrumental methods

1. Lasers and Non linear optics - Laud
2. Laser Principles and Application - A K Ghatak and K Tyagarajan
3. Optical electronics - Ghatak & Tyagarajan
4. Introduction to Fibre optics - R A Shotwell
5. Introduction to Physics Applications - Calcutta University
6. Nuclei & Particles - Segre
7. Atomic & Nuclear Physics - S N Ghoshal

Atomic and molecular physics.

1) Atomic spectra and atomic structure - G - Herzleerg
2) Atomic spectra - H. khun
3) Theory of atomic spectra - H.Barrow
4) Introduction to Molecular spectra - Re johnson
5) Atomic spectra - White

Nuclear Physics Cosmic ray & particles physics

1) Nuclear physics - Kaplan
2) Concepts of Nuclear physics - Cohen
3) Nuclear and particles - Segre
4) Nuclear physics - S B Patel
5) High enargis physics - Perkins
6) Cosmic rays - Rossi
7) Atomic and nuclear physics - S N Ghoshal
8) Paramanu O Kendraker Sathay Parichay – S. N. Ghosal
9) Atomics spectra – Condon + Shortly
10) Diaatomic molecules - Herzberg
11) Quantum Mechanics - Anderson

Paper – V (Practical)
Group A, Marks - 40
List of experiments

1. Study of flexture of a bar.
2. Study of tortion of a wire, dynamical method
3. Study of flow of liquid through capillary tube
4. Study of surface tension of liquid. Capillary rise
5. Study of fall of solid through a liquid
6. a) Calibration of spectrometer (b) Dispersive power of prism
7. Newton's ring expt.
8. Single slit experiment
9. Melde's expt.
10. Focal length of a concave lens lay combination method
11. Refractive index of a liquid using a convex lens and a plane mirror.
12. Deflection Magnetometer expt to determine earth horizontal Magnetic field
13. Study the forward and reverse characteristics of a zener diode
14. Regulation characteristics of a bridge rectifier (i) without using a filter and (ii) using a filter
15. To draw the out put characteristics of a transistor in CE and CB mode
16. Constant volume / constant pressure gas thermometer
17. Experimental study of Probability distribution for a two option system - A cubic dice with face caluing may be used with two options of weightage ratio 5 : 1 or 1 : 1. May use 12 inch dice as a group for one inch observation, take about 200 observations.
18. Study of Harmonic oscillations and its relaxation. Simple / Compound pendulum.
19. Study of transverse wave speed on a string - Sonometer expt.
20. Triode valve (a) Stastic characteristics (b) Dynamic characteristics.

Paper V (Practical)
Group B :: Marks 50

1. Determination of thermal conductivity of a bad conductor by Leas method
2. Calibration of a thermo couple and find some unknown temp.
3. Platinum resistance thermometer
4. Study of a thermistor characteristics
5. Study of characteristics of a step down transformer
6. Study of variation of mutual inductance of a coaxial coil
7. Study of Magnetic flux using a search coil
8. Measurement of high resistance by method of leakage
9. Study the effect of capacitance in d.c. circuits

10. Study the effect of an inductance in d.c. circuits
11. Low resistance measurement C. F. bridge
12. Study of impedance of inductor at varrying frequency to measure R & L
13. Study of impedance of a capacitor of varrying frequency to measure C
14. Response curve of L - C - R series resonance
15. Measurement of absorption by a solution
16. Double slit experiment
17. Calibration of polarimeter and study of optical rotation of solution
18. To study the intensity distribution of grating pattern by Laser & LDR
19. Study of the characteristics of a Ballistic galvanometer.

Paper V (Practical)

Group C – Computer application, Marks - 10

Computer fundamentals and programming in C or Fortran. Assigned jobs with computer.

1. Sorting -
    a. Arranging in ascending / descending order.
    b. Natural even / add number between given limit.
    c. Max/Min of a set.
2. Read N number - find their mean, median and mode
3. Solution of
    a. Sum of G P series / simple series
    b. Area under curve
4. Solution of simple algebraic equation.
5. Use of Origin software to draw graphs.

Part - III

Paper VI (150 + 20 Lectures)

F. M - 100 marks (University written Exam 90 + College Internal Assessment 10)

Group A

Electronics II (65 lectures)

1. **Field effect transistor (FET)** - JFET structure and operation -static drain & transfer characteristics. FET amplifiers - small signal low frequency equivalent ckt. MOSFET - different types, operation - drain & tranfer characteristics. CMOS.[4 L]
2. **Feed back amplifier** : Principle, negative & positive feed back voltage & current feed back.[2 L]
3. **Multistage amplifier** - Two stage R-C coupled amplifier - frequency response, gain & band width. Class A, B, AB & C amplifier, single tuned amplifier, power amplifier - class B push pull amplifier.[4 L]
4. **Oscillators** - Barkhausen criteria, Hartley, colpit, wienbridge and crystal oscillators. Relaxation oscillators - Astable, monostable and bistable multivibrators.[6 L]
5. **Operational amplifiers -** OPAMP characteristics, virtual guard ring; differential amplifiers, CMRR; inverting and non-inverting amplifiers Mathematical operation - addition, subtraction, integration and differentiation, solution of differential equations and linear algebraic equations, comparator, function generator, Schimitt trigger.[12 L]
6. **Combinational logic -** Half adder, full adder, digital comparator, decoder, encoder (ROM). digital to analog conversion, analog to digital conversion, multiplexer.[6 L]
7. **Sequential logic** - Flip - flops - RS, D, JK, JKMS, edge triggering and locked operation, shift registers, ripple counter (binary and decade).[6 L]
8. **Electronic measuring instruments** – electronic multi meter, digital voltmeter, CRO - cathode ray tube - electron emission mechanism, brightness & focussing control, fluorescent screen, deflection sensitivity vertical and horizontal amplifier; time base, triggering - measurement of voltage, frequency and phase with a CRO.[10 L]
9. **Microprocessor :** Preliminary ideas of microprocessor architecture, registers, addressing mode, instructions op codes, Assembly language programming of 8085 [8 L]
10. **Tutorials [7 L]**

Group B

Solid state Physics (37 lectures)

1. Crystal structure - Elementary ideas about Existing structure, lattice & basis, unit cell, reciprocal lattice, fundamental type of lattices, Miller indices, simple cubic, f.c.c. and b.c.c. lattices, Laue & Bragg equation.[7 L]

2. Structure of solids different type of binding - ionic, covalent, metallic and vander waals Bloch Theorem, Band Theory of Solids, Kronig Penny Model energy and band structure. Electrons & holes; conductor, semiconductors and insulators; free electron theory of metals, effective mass, drift current, mobility and conductivity : Wiedemann - Franz law. Hall effect in metals. [8 L]
3. Dielectric properties of materials - Electronic ionic and dipolar Polarisability, local fields, induced & oriented Polarisation - molecular field in dielectric; Claussius - Mosotti relation.[5 L]
4. Magnetic Properties of Materials – Dia, para, and ferro magnetic properties of solids. Langevin's theory of Paramagnetism & diamagnetism classical and quantum theory of paramagnetism. Curie's law, spontaneous magnetisation and domain structure. Spontaneous magnetisation and its temperature dependence. Curie-Weiss law explanation of hysteresis.[10L]
5. Super conductivity - zero resistivity, critical temp. - application.[2 L]
6. Tutorials [5 L]

Group C : Quantum Mechanics (68 L)

1. **Basic quantum Mechanics [18 L]**

Rise and fall of Planck - Bohr quantum theory. de Broglie hypothesis, Compton effect, Davisson - German experiment. Phase & group velocities, uncertainty principle, complementanity principle photon interpretation of two slit interference. Concept of wave function, Principle of superposition, Schrodinger equation, Probabilatic Interpretation, equation of continuity, Probability current density, Boundary condition of wave function, time dependent and time independent Schrodinger equations. Schrodinger equation as an operator equation - operators - observables & measurements.

2. **Operator formulation [20 L]**

Operator eigen values and eigen functions, linear operators, product of two operators, commuting & non commuting operators. Simultaneous eigen functions. Orthogonal functions. Hermitian operators, Hermitian adjoints, expectation values. Ehrenfest theorem.

Simple harmonic oscillator. Step up and step down operators - eigen functions & eigen values of ground & excited states. Zero point energy. Probability density, orthonormality.

One dimensional potential barrier, penetration through rectangular barrier - reflection & transmission co-efficients - explanation of α - decay, quantum mechanical tunneling.

3. **Angular momentum and spin [22 L]**

Central forces, orbital angular momentum. Angular momentum operators and their commutation relations, mutual with L^2, L^+ & L^- operator - as step operators. Eigen values of L^2 and L_z. Angular momentum operators in spherical polar co-ordinates, evaluation of eigen functions - degeneracy schrodinger or equation of hydrogen atom in spherical polar co-ordinates seperation of variables - spherical harmonics.

Angular momentum and magnetic moment of electron due to orbital motion - Bohr magneton, Stern - Gerlach experiment - electron spin. Pauli's method of spin variable in Schrodinger equation. Eigen values and eigen function of spin operator. Pauli spin operators & commutation relation.

4. Tutorials [8 L]

Paper VI

Books

Electronics II - Books already mentioned plus the following ones.

1. Digital logic and computer design - M Moris Mano
2. Introduction to Microprocessor - Laventhal
3. Microprocessor Architecture, Programming & Application - R A Gaonkar

Solid State Physics

1. Introduction to solid state physics - C. Kittel
2. Solid State Physics - D L Bhattacharya
3. Solid State Physics - Dekker
4. Solid State Physics - Blackemore
5. Solid State Physics - R P Singhal

Quantum Mechanics

1) Quantum Mechanics - J L Powell & B . Crasemann
2) Quantum Mechanics - A K Ghatak & S. Lokenathan
3) Quantum Mechanics - Mathews & Venkatesh
4) Quantum Mechanics - S.N Ghoshal

Paper VII (Practical)

Group A, Marks - 40

1. Construct a regulated power supply on a bread board
    a. using a power transistor as pass element
    b. a second transistor as feed back amplifier
    c. a zenar diode as a reference voltage source and to study its operational characteristic
2. Study the effects of negative feed back on frequency response of a RC coupled amplifier
3. a) To draw the output characteristics of a silicon transistor and to calculate h_{oe} & h_{fe}

   b)To determine the hybrid prarameters of a transistor using a.c. source.
4. To construct and study the frequency response of voltage amplifier using a transistor in CE mode & to find its band width.
5. To design and test the following circuits using OPAMP
    a. Offset values
    b. Inverting and non-inverting amplifier
    c. Integrator
    d. Differentiator & differential amplifier.
    e. Adder & Subtractor
6. Design and construction of a phase shift oscillator.
7. To construct Wien bridge oscillator on a bread board using OPAMP and to study the wave form of the oscillator and frequency determination using CRO.
8. Setting up of a F E T Voltmeter and its use for the callibration of a thermocouple.

Group B

Full Marks - 60

1. (a) Verify various Boolean expressions using IC gates
   (b) NAND & NOR Gate circuits using I.C.
   (c) Multiplexure & Demultiplexures using I.C.
   (d) Half adder & full adder circuits using I.C.
   (e) Design and verify the following flip flop operations
   (i) RS (ii) JK (iii) D
   (f) Study of Modulo - 3, Modulo - 5, Modulo - 7 binary counters.

2. Study of 8085 microprocessor : Machine language programming
   (a) Add, (b) copy, (c) largest number, (d) delay.

3. Measure an analog input connected to ADC at parallel ports.
   (a) Generate saw tooth, square & triangular wave using DAC connected at the output ports.

(b) Control of Read relay switches connected at the output part.

4. Design and fabrication of temperature controller and to study its performance characteristics.

5. Construction of AND, OR, NOT, Gates using diodes & transistors and verification of Truth table.

6. Multivibrators using transistors & IC555.

Paper VIII(a) (Practical)

Group A, Marks 55

1. Study of Resolving power of a grating. Difference of D1 & D2 lines by a grating
2. Biprism expt.
3. B - H loop
4. Anderson bridge
5. Study of Fourier spectrum of -
    a. Square
    b. trangular
    c. half sinusoidal wave form by CRO
6. To determine the Stefan's constant
7. Spectrum of hydrogen & Rydberg constant
8. Absorption spectra of I_2 vapour.
9. Magnetic susceptibility of $FeCl_3$ solution.
10. Hall probe in magnetic field measurement
11. Use of P-N junction for measurement of temperature
12. Planck's constants
13. To study interference & diffraction of a LASER at straight edge of a wire.

Group B, Marks - 15

Computer

1. Sum of infinite series with specified accuracy
2. Integration by Simpson rule
3. Least square fit for given set of date to a straight line
4. Motion of projectile using computer
5. Motion of particle in a central field.
6. Convert a given integer into binary and octal system & vice versa
7. Inverse of a matrix
8. Computer generation of phase space plots of harmonic oscillator.

Paper VIII(b)

Project, Full Marks 30

This work should be an experimental one with special reference to the techniques into practical classes. This may be application oriented or some simple law / experimental verification.

1. The project will be centrally evaluated by the corresponding co-ordinator and internally by Head of the department of the College in consultation with supervisors. The co-ordinator will average the mark and submit to the University. The Board of Study will recommend the centre for central evaluation of the project work.

2. Distribution of marks -

(a)	Nature of work	-	10
(b)	Presentation	-	10
(c)	Viva	-	10
	Total	-	30

B. Sc PHYSICS (GENERAL COURSE)

The entire course is divided into four papers with total 400 marks to be studied in three years. At the end of first year there will be Part I examination of one theoretical paper (Paper I), at the end of 2nd year one theory paper (Paper II) and one practical paper (Paper III) of 100 marks each in Part II examination. At the end of the 3rd Year there will be one theoretical paper (Paper IV) of 75 marks and one practical paper (Paper V) of 25 marks in Part III examination.

Final result will be determined on the basis of Part I, Part II and Part III examination taken together.

Each theory paper is of 90 marks for external and 10 marks allotted for internal assessment of 100 marks paper and less than 100 marks, the marks of internal assessment will be proportionately less.

Three tire Examination pattern:

Part I	Part II	Part III
Theory - 100	Theory – 100	Theory – 75
	Practical - 100	Practical - 25

Part I Examination : Paper I - Theoretical Full Marks – 100 (University written Exam 90 + College Internal Assessment 10), Time – 3 Hrs.

Part II Examination: Paper II - Theoretical Full Marks – 100 (University written Exam 90 + College Internal Assessment 10), Time – 3 Hrs.

Paper III - Practical Full Marks – 100 = 90+10, Time – 6 hrs.

A. - Experiment Gr. A (30 marks)

B. - Experiment Gr. B (40 marks)

C. - Computer Practical Gr. C (10 marks)

D. - LNB – 10, E – Viva – 10

Part II Examination: Paper IV (A) - Theoretical Full Marks – 75 (University written Exam 67 + College Internal Assessment 8), Time – 3 Hrs.

Paper IV (B) - Practical Full Marks – 25, Time 3 hrs.

Part – I

Paper – I [160 L] **Time – 3 Hrs.**

Full Marks – 100 (University written Exam 90 + College Internal Assessment 10), Time – 3 Hrs.

1. Mathematical Background [12 L] - Scalar and vector, dot, cross and triple products. Gradient of a scalar field, divergence and curl of a vector field. Line, surface and volume integrals, flux of a vector field. Gauss's divergence theorem, green's theorem and stoke's theorem. [6 L]

   Function of two and these variables, partial derivatives – geometrical interpretation. Total differential of a function of two and three variables, higher order derivatives, application. [6 L]
2. Mechanics [28 L] - Laws of motion, motion in uniform field, velocity components in different co-ordinate systems. Uniformly rotating frame, centripetal acceleration, coriolis force and application. [5 L]

   Motion under a central force, kepler's law. Gravitational law and field. Potential due to a spherical body, Gauss and Poisson's equation, gravitational self energy. [6 L]

   System or Particle, centre of mass equation of motion, conservation of linear and angular momenta, conservation of energy, single stage and multi stage rockets, (elementary idea) elastic and inelastic collisions. [7 L]

   Rigid body motion, rotational motion, moments of initial and their products, principal moments and axes. Euler's equation. [10 L]
3. SHM, Simple & Compound pendulums, torsional pendulum [8 L]- Superposition of two simple harmonic motions of some frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of same frequency, lissajous figures, cases of different frequencies, forced oscillator and damped oscillator, critical damping.
4. Properties of matter [20 L] - Elasticity, small deformation, Hooke's law, elastic constants of an isotropic solid – interrelation. Beams supported at both the ends cantilever, torsion of a cylinder, bending moments and shearing forces [7 L]

   Kinematics of moving fluids, equation of continuity, Eular's equation, Bernoulli's theorem, viscous fluids, stream line and turbulent flow. Poiseullie's law. Reynold's number, Stoke's law [8 L]

   Surface torsion and surface energy, molecular interpretation. Pressure on a curved liquid surface, wetting [5 L].

5. Kinetic theory [25 L] - Ideal gas, kinetic model, deduction of Boyle's law, interpretation of temperature, rms speed of molecules. Brownian motion, Avogadro number, equipartition of energy, specific heats of gases. Behaviour at law temperature application to astrophysics. [7 L]

   Real Gas: Venderwals gas equation, nature of vendar waal forces, comparison with experimental P – V curves critical constants. Joule's experiment of ideal and vender waals gas, Joule coefficient, estimate of J – T cooling [6 L]

   Liquefaction of gases: Boyle temperature and inversion temperature. Regenerative cooling and cascade cooling, liquefaction of hydrogen and helium. Refrigeration cycles, efficiency [5 L]

   Transport phenomena : Molecular collision, mean free path, collision cross section. Molecular diameter and man free path. Transport of mass, momentum and energy and inter relationship, dependence of temperature and pressure [7 L]

6. Thermodynamics [25 L] - Zeroth law, indicator diagram, work done by and on the system, first law, internal energy as state function and other applications. Reversible and irreversible changes, carnot cycle, it efficiency, carnots theorem. Second law – Different versions. Internal combusion engines and paractical cycles. Entropy, pricipal of increase of entropy. Thermodynamic scale of temperature – identity with perfect gas scale. Third law of thermodynamics [8 L]

   Thermodynamic relationships- Thermodynamic variables – extensive and intensive, Maxwell's general relationship, application to J – T cooling and adiabatic cooling in a general system, vanderwaals gas, Clausius – clapyron equation. Thermodynamic potential and equilibrium – relationship with thermodynamic variables. Cooling due to adiabatic demagnetization. Production and measurement of low temperatures [10 L]

   Black Body Radiation - Temperature dependence –Stefan Boltzman law, pressure of radiation, special distribution of Black Body radiation. Wien's displacement law, Rayligh – Jeans law, ultraviolet Catastrophy, Plank's quantum postulates – Plank's law – fit with experiment. Specific heat of gas at law temperature [7 L]

7. Waves [10 L] - Speed of transverse waves on a string, speed of longitudinal waves in fluid, energy density and energy transmission in waves – measurement, gravity waves and ripples, group velocity and wave velocity – measurements. Superposition of waves – principle of superposition – nonlinear super position and consequences.

   Standing waves – normal modes of bounded systems examples, Harmonics and quality of sound examples. Production and detection of ultrasonic & infrasonic waves.

8. Accoustics [10 L] - Noise and music, human ear its responses, audibility, intensity and loudness, Bel and decibel, musical scale, temperament and musical instruments.

   Reflection and refraction sound, acoustic impedance, percentage reflection and refraction at a boundary, impedance matching for transducers, diffraction of sound, solar system.

   Transducers and their characteristics, recording and reproduction of sounds. Various system, Measurements of frequency, wave form, intensity and velocity. Accountics of halls, reverberation, Sabine's formula.

9. Geometrical Optics [12 L] - Fermat's principle, aplanatic pts. of a sphere and other applications. Theory of image formation, cardinal points, general relationship, thick lens & lens combinations. Lagrange's equation of magnification, telescopic combinations, telephoto lenses & eyepieces.

   Chromatic aberrations, achromatic combination of lenses in contact & seperated by a distance. Mono chromatic aberrations & their reductions, a spherical mirror & Schmidt corrector plates, aplanatic points, oil immersion objectives, meniscus lens.

   Entrance & exit pupils, multiple lens eye piece, common type of eyepieces.

10. Tutorials [10 L]

Part – II

Paper – II [160 L] **Time – 3 Hrs.**

Full Marks – 100 (University written Exam 90 + College Internal Assessment 10)

1. Electrostatics [36 L] - Coulomb's law in vacuum, calculations of E for simple distribution of changes at rest dipole & quadruple fields [8 L].

   Work done on a charges in an electrostatic field conservative nature of the field electric potential ϕ, $E = -\nabla\phi$, torque on a dipole in an uniform field & its energy, flux of electric field, Gauss's law and its application for symmetric change distributions, Gaussian pillbox, field at the surface of a conductor, screening of field, capacitors, electrostatic field energy, force per unit area at the surface of a conductor in an electric field, conducting sphere in a uniform electric field, point change in front of a grounded infinite conductor. [18 L]

   Dielectrics - Parallel plate capacitor with a dielectric, dielectric constant, Polarization, Polarization and displacement vectors, molecular interpretation of Clausius – Mossetti equation, boundary conditions satisfied by E and D at the interface of two dielectrics [10 L]
2. Electric Current [15 L] - Steady current, current density, nonsteady current, equation of continuity, Kirchhoff's law and analysis of multiloop circuits, Rise and decay of current in LR & CR circuits, decay constant, transients in LCR circuits, AC circuits, complex number & their applications in AC ckt problem. Impedance & reactance, series & parallel resonance, Q – factor. Power consumed by AC ckt, power factor, Y and y networks and transmission of election power.
3. Magnetostatics [12 L] - Force on a moving change, Lorentz force and difinition of B, force an a straight conductor carrying current in a uniform magnetic field, torque on a current loop, magnetic dipole moment angular momentum and gyromagnetic ratio. Biotsavart's law, calculation of H in simple geometric situations, Ampere's law $\nabla.B = 0$, $\nabla \times B = \mu_0 J$, field due to a magnetic dipole, magnetization current, Magnetization vector, Half order field, magnetic permeability, interpretation of bar magnet as a surface distribution of solenoidal current.
4. Time varying fields [12 L] - Electromagnetic inductions, Farraday's law, integral and differential form of Farraday's law. Mutual & Self inductance transformers, energy in a static magnetic field, Maxwell's, displacement current, Maxwell equations, electro magnetic field energy density.
5. Electro Magnetic Waves [5 L] – Wave equation satisfied by **E** & **B** in conducting medium. Basic ideas on Plasma.
6. Physical optics [40 L] - Interference of light, principle of superposition, double slit, coherence, optical path retardation, lateral shift of fringes. Ragleigh refractometer and other

applications. Localised fringes, thin films applications for precession measurements of displacements. Haidinger fringes, fringes of equal inclination. Michelson interferometer, precision measurement of wavelength, wavelength difference and the width of spectral lines. Twymann Green intreferometer and is uses. Intensity distribution in multiple beam interference, Tolansky fringes, Febry Perot interferometer & etalon [14 L]

Freshnel's diffraction, half period zones, zone plates, straight edges, rectilinear propagation. Fraunhofer different, diffraction at a slit, half period zones, phasordiagram and integral calculus method, intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images. Rayleigh criterion resolving power of a telescope and microscoppic system phase contrast microscope. Diffraction grating, Diffraction at N parallel slits. Intensity distribution, plane diffraction grating, reflection grating and blazed grating, concave grating and different mountings. Resolution power of a grating and resolving power of a prisms and a Febry Perot elaction [20 L]

Double refraction uniaxial crystal, electromagnetic theory. Phase retardation plans, double image prism. Rotation of plane of polarization, origin of optical rotation in liquids of crystals [6 L]

7. Electronic devices [15 L] - Intrinsic semi conductors electrons & holds, Fermi level, Temperature dependence of electron & hole concentrations, doping, impurity states n & p type semi conductors, conductivity, mobility, Hall effect, Hall coefficient. Metal semiconductor junction, p – n junction, majority & minority carriers, diodes, zenar and tunnel diodes, transistor, solar cell.
8. Electronics [15 L] - Diode, as a circuit element, load and concept, rectification ripple factor, zeper diode, voltage stabilization, IC voltage regulation, characteristics of a transistor in CB, CR and CC mode, graphical analysis of CE configuration, low frequency equivalent ckt, h – parameters bias stability, thermal run away [15 L].
9. Tutorials [10 L]

Paper – III [Practical] **Full Marks – 100** **Time – 6 Hrs.**

Group – A (30 Marks)

1. To find the moment of inertia of body.
2. To find the modules of rigidity of a wire (a) Dynamical (b) statistical method.
3. To find the coefficient of linear expansion of a rod by optical lever.
4. To determine the pressure coefficient of air.
5. To find the refractive index of (a) material of the lens (b) a liquid.
6. To measure the focal length of a concave lens by combination method.
7. To measure the frequency of a tuning fork by a sonometer.
8. To measure the horizontal component of earth's magnetic field by magnetometer.
9. To measure the resistance of a suspended coil galvanometer by half defection method and calculate in figure of merit.
10. To draw I – V characteristic curve of a resistor and a (ii) p – n diode and compare.
11. To use a potentiometer to measure (I) current (ii) potential drop (iii) resistance.
12. To determine the reduction factor a tangent galvanometer.

Group – B (40 Marks)

1. To study young's modules of a bar.
2. To study is viscosity of water by capillary flow method.
3. To measure the surface tension of water by capillary rise method.
4. To determine the 'u' of a prism by spectrometer.
5. To measure the wave length by Newton's ring.
6. To calibrate a polarimeter and hence to determine the concentration of sugar solution
7. To measure the temperature coefficient of a coil by carryfroster's bridge.
8. To draw the e – t curve.
9. To draw the reverse characteristic of a zenar diode.
10. To draw the I – V curve of a bridge rectifier.
11. To draw the output characteristic of a transistor in CE mode.
12. To find the variation of impedance of L & C with frequency by A.C. millivoltmeter in LCR series ckt.
13. To measure the magnetic field by a Hall probe.

Group – C – Computer programming (10 Marks)

1. Elementary Fortran Program, flow charts & their interpretation.
2. To print out all natural even odd numbers between its limits.
3. To find the maximum, minimum and range of a set of numbers.
4. To compile a frequency distribution & evaluate mean, median, mode standard derivation etc.
5. To evaluate sum of finite series and area under a curve.

LNB – 10 Marks

Viva – 10 Marks

Part – III

Paper – IV [120 L] **Full Marks – 75** **Time – 3 Hrs.**

Full Marks – 75 (University written Exam 67 + College Internal Assessment 8)

1. Relativity [14 L] - Reference system, inertial frames, Galilean invariance and conservation laws, propagation of light Michelson – Morey expt. search for other, Postulates of special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity mass energy equivalence, particle with a zero rest mass.
2. Statistical Physics [14 L] - Statistical basis of thermodynamics, probability & thermodynamic probability, principle of equal a priori probabilities, probability distribution and its narrowing with increase in number of particles [5 L]

   Maxwellian distribution of speed in ideal gas – Distribution of speeds velocities, experimental verification, distinctions between mean, rms and most probable speed values. Doppler broadening of spectral lines [4 L]

   Indistinguishibility of particle and its consequence. Bose Einstein and Fermi Dirac conditions, application to liquid Helium, free electron in metals and photons in black body chamber. Fermi level and Fermi energy [5 L]
3. Quantum Mechanics [22 L] - Failure of classical physics to explain black body spectrum, photo electronic effect. Ritz combination principal in spectra, stability of an atom. Planck radiation law. Einstein's explanation to photo electronic effect, Bohr's quantization of angular momentum and its application to hydrogen atom, limitation of Bohr's theory. Wave particle duality – de Broglie hypothesis & matter waves. Wave and group velocity evidence of interferes and diffraction of particles. Experimental demonstration of matter waves [14 L]

   Consequence of de Broglie concept, quantization in hydrogen atom, energies of practice in a box, wave packet, Heisenberg's uncertainly for p and x, its extension to energy and time [4 L]

   Schrödinger's equation, Postulatory basis of quantum mechanics, operators expectation values, transition probabilities, applications to particle in a one and three dimensional boxes, transmission across a potential barrier [4 L]
4. Atomic physics [14 L] - spectra hydrogen, deuteron and alkali atoms. Singlet and triplet fine structure in alkaline earth spectra, LS & JJ couplings week spectra, continuous x – ray spectrum, and its dependence on voltage Duane and Hunt's law, characteristics X – ray. Mosely's law doublet structure of x – ray spectra, x – ray absorption spectra.

5. Molecular physics [10 L] - Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of inter nuclear distance, pure rotational and rotational vibrational spectra.

   Raman effect, stokes and anti stoke lines, complementality character of Raman and infrared spectra, experimental arrangement for Raman spectroscopy.

6. Nuclear Physics [14 L] - Interaction of charged particles and neutrons with matter, nuclear detectors, GM counter, proportional counter and Scintillation counter, cloud chamber, spark chamber, emulsions.

   Structure of nuclei, basic properties (p, u, Q and binding energy), deuteron binding energy, p – p and n – p scattering and general concept of nuclear forces. Beta decay, range of a particle, geiger Nuttal law, Gamow's explanation of b decay, a delay and continuous and discreet spectra. Nuclear reactions, channels, compound nucleas, discreet reaction, shell model liquid drops model, fission and fusion energy production in stars by p – p carbon cycle.

7. Solid State Physics [24 L] - Crystalline and glassy terms, liquid crystals glass transition crystal structure, periodicity, lattices and basis, fundamental and translation vectors, unit cell. Laue's theory of X- ray diffraction, Bragg's law, Laue patterns [8 L]

   Bonding - Potential between a pair of atom, Lennard Jones potential, concept of cohesive energy, covalent, vander waals, ionic and metallic crystals [3 L]

   Magnetism - Atomic magnetic moment, magnetic susceptibility, dia, para and Ferromagnetism, Ferromagnetic domains, hysteretic [3 L]

   Thermal Properties - Lattice Vibrations, simple harmonic oscillators, second order expansion of Lennard gones potential about the minimum, vibration of one dimensional monatomic chain under harmonic and nearest neighbor interaction approximation [5 L]

   Bond structure - Electrons in periodic potential nearly free electron model energy bands, energy pals, metals, insulator and semi conductors. Motion of electron, free electron, conduction electron, electron collisions, mean free path, conductivity and ohm's law. Density of states, Fermi energy, Fermi velocity [5 L]

8. Laser [8 L] - Purity of spectral lines, coherence length and coherence time spatial coherence of a source, Einstein's A & B coefficients. Spontaneous and induced emissions, condition for laser action, population inversion, Pulse laser and tunable laser, spatial coherence and directionality, estimates of beam temporal coherence and spectral energy density.

Paper – V (Practical) **Full Marks – 25** **Time – 3 Hrs.**

Project Type Experiment – 15, Project Paper – 5, Viva – 5

Project type experiments (At least two should done by a students)

1. To convert an ammeter into a voltmeter and a voltmeter into ammeter meter.
2. To construct an adjustable voltage power supply using IC & to study its regulation.
3. To measure the internal resistance or an analog voltmeter and to increase its internal resistance using on OP and AMP.
4. To calibrate a temperature sensor and to use the sensor to control the temperature of a heat bath.
5. To use OP AMP as inverting, non inverting, differential amplifier and as an adder.
6. To develop a photo sensor using a photo transistor followed by an amplifier and use the same to control the switching of a bulb.
7. To use database package & word processor.
8. Computer programming
   (a) Solve in simultaneous equation by elimination method.
   (b) Convert a given integer into binary & octal system & vice versa.

N. B. - Examination will be done in home centre and be evaluated by internal & external examiners jointly.

Modalities of Internal Assessment :

(i) The total marks allotted for such internal assessment is fixed at 10 (Ten) for each theory paper of 100 marks. For a paper of less than 100 marks, the marks of internal assessment will be proportionately less.

(ii) These marks should be awarded to the students by all the subject teachers of their own college on the basis of marks obtained by them in class tests taken periodically. The programme of the Class Test will have to be distributed evenly throughout the entire session.

(iii) The total marks of each such class test will be 20 (Twenty) and the total time allotted will be 45 minutes i.e. one class period.

(iv) The question papers for such class tests will be prepared by the department teachers and be printed / typed/xeroxed before the examination. All the teachers, of the department are required to be involved in the examination process. The Department Incharge is required to Co-ordinate the entire process.

(v) The number of such class tests held throughout the session shall not be less than 5 (Five) per paper for each year of Honours Course students and not less than 2 (Two) per paper for each year of General Course students.

(vi) The blank answer papers will be supplied by the college authorities. After completion of evaluation process, the answer papers will have to be preserved by the college authorities so that the University authorities can inspect the same at any time.

(vii) These marks on internal assessment for each of the theoretical papers separately will have to be sent to the Controller of Examinations of the University before the final examination, the last date of which will be fixed by the Controller of Examinations. No marks will be accepted after such last dates are over. The marks should be in full integer.

(viii) The marks on internal assessment for practical papers need not be sent as there is a practice of awarding such marks on the basis of laboratory note books submitted by the students during their practical examinations.

Modalities of questions to be set :

(i) Each paper of 90 marks (10 marks for internal assessment) will consist of -

(a) Long answer type questions - 30 marks having maximum 15 marks (10×3) in each question.

(b) Semi long answer type questions - 40 marks having maximum 8 marks in each question.

(c) Short answer type question - 20 marks having maximum 4 marks in each question.

(ii) Each type of these questions will necessarily be from all portions of the syllabus and not from a particular portion.

These three types of questions will be set in different groups such as

(a) Group –A : Long answer type questions.

(b) Group - B : Semi long answer type questions.

(c) Group - C : Short answer type questions.

Again there may be Sub-Groups like A (a) and A (b) as required by the contents of syllabus.