PHYSICS

The following syllabus has been prepared in accordance with the criteria announced by the Higher Education Commission of Pakistan & Lead Universities.

PAPER-I (3RD YEAR)

For B.Sc. Part-I

1. It is recommended that B.Sc. Physics should comprise of 4 theory papers, labeled as Physics-I, II, III, IV and 4 Practical papers labeled as I, II, III, IV respectively.
2. Examinations for physics I and I1 would be held in the 1st year of B.Sc. while for physics III and IV would be held in the 2nd year of B.Sc.
3. The Subject to be covered in these papers are as follows:

a.	Paper-I	Vector Analysis, Mechanics and Theory of relativity.
b.	Paper-II	Waves and Oscillations, Thermodynamics and Statistical Mechanics
c.	Paper-III	Electricity and Magnetism
d.	Paper-IV	Electronics and Modern Physics.

The marks distribution is as followed:

a. B.Sc. Part-I

Theory Paper-I	38 marks
Theory Paper-II	37 marks
Practical Paper	25 marks

b. B.Sc. Part-II

Theory Paper-III	38 marks
Theory Paper-IV	37 marks
Practical Paper	25 marks

4. The committee deliberated at length on the role of examinations. It was the general consensus that unless the pattern and quality of examinations are seriously

addressed by the respective universities, the goal of meaningful improvement would not be attained.

5. The committee decided on the following guidelines, for examinations, keeping in view both practical considerations and the demand for increased conceptual and analytical content.

(i) Total time for each paper = 3 hours

(ii) No. of questions to be attempted = 5 out of 8

DETAIL OF EACH PAPER

Each paper would have 3 parts : Section I, II, III

Section-I

Comprising short conceptual questions (compulsory)

No. of questions = 1

No., of parts in questions = 5

(Attempt 4 parts out of 5, each part carries 2 marks) 2 x4 = 8 marks

Section-II

Theoretical questions ; (to be include mathematical derivation and qualitative explanation of phenomenon based on the particular law or relationship.

Total No. of questions = 3

No. Of questions to be attempted = 2

(Each question carries 8 marks) 2 x 8 = 16 marks

Section-III

Problems:

Problems related to test of the type and style in Halliday, Resnick & Krane. (Exact reproduction is not necessary) Problems should be suitably chosen to required application of the physics taught, as well as being a test of comprehension and quantitative skills.

No. of questions = 4

No. of questions to be attempted = 2

(Each question carries 7 marks) 2 x 7 = 14 marks

Thus a total of 5 questions out of 8 have to be attempted, as specified above viz. 1 from Section-I, 2 from Section-II and 2 from Section-III.

DETAIL OF COURSE Paper-I

VECTOR ANALYSIS, MECHANICS, AND THEORY OF RELATIVITY (38 marks)

1. Vector Analysis: Review of Vector in 3 dimensions and Operations; Direction; Cosines; Spherical polar coordinates; Vector and scaler triple product gradient of a scalar, Divergence and curl of a vector, Physical significance of each type; Divergence and Flux of a vector field, curl and line integral (mutal relation). Vector identities. Divergence Theorem, Stokes' Theorem: Derivation, physical importance and applications to specific cases. Converting from differeiniai to integral forms.

2. Particle Dynamics: Dynamics of Uniform, circular motion the banked curve. Equations of motion. Deriving kinematic questions x(v), V(t) using integrations. Constant and variable forces and special examples. Time dependent forces: Obtaining x(t), v(t) for this case using integration method. Effect of drag forces on motion: Applying Newtons Laws to obtain V(t) for the case of motion with time dependent (Integration approach) drag (viscous) forces; terminal velocity. Projectile motion with and without air resistance. Non inertial frames and Pseudo forces, Qualitative discussion to develop understanding. Calculation of pseudo forces for simple cases (linearly accelerated references frame). Centrifugal force as an example of pseudo force; Coriolis force.

3. Work, Power and Energy: Work done by a constant force, work done by a variable force (1-2 dimension): (Essentially a review of grade-XII concepts use of integration technique to calculate work done (e.g. in vibration of a spring obeying Hookes' Law). Obtaining general expression force (2-dimensional case) and applying to simple cases e.g. pulling a mass at the end of a fixed string against gravity. Work energy theorem. General proof of work energy theorem: Qualitative Review of work energy theorem. Derivation using integral calculus. Basic formula; and applications. Power, Energy changes with respect to observers in different inertial frames. Conservation of Energy in 12, and 3 dimensional Conservative systems, Conservative and non Conservative forces: Conservation of energy in a system of particles: Law of conservation of total energy of an isolated system.

4. Systems Of Particles: Two particle systems and generalization to many particle systems: Centre of mass: Its position velocity and equation of motion. Centre of mass of solid objects. Calculation of Centre of Mass of solid objects using integral calculus. Calculating C.M. of,

   i) Uniform Rod. ii) Cylinder iii) Sphere

   Momentum Changes in a system of variable mass: Derivation of basic equation; application to motion of a rocket (determination of its mass as a function of time).

5. Collisions: Elastic Collisions. Conservation of momentum during Collision:

a) One dimensions.(Concept)

b) Two dimensions(Oblique Collisions) (Mathematical treatment)

Inelastic collision. Collisions in centre of Mass reference frame: One and two dimensions. Simple applications: obtaining. Velocities in c.m. frame.

6. Rotational Dynamics: Relationships between linear & angular variables; scalar and vector form. kinetic energy of rotation; Moment of Inertia. Parallel axis theorem, Perpendicular axis: Prove and illustrate; apply to simple cases. Determination of moment of inertia of various shapes i. e. for disc, bar and solid sphere, Rotational dynamics of rigid bodies: Equations of rotational motion and effects of application of torques. Combined rotational and transnational motion: Rolling without slipping

7. Angular Momentum: Angular Velocity, Conservation of angular momentum, effects of Torque and its relation with angular momentum, stability of spinning objects, Discussion with examples. The spinning Top: Effects of torque on the angular momentum, precessional motion.

8. Gravitation: Gravitational effect of a spherical mass distribution. Mathematical treatment, Gravitational Potential Energy, Develop using integration techniques; calculation of escape velocity, Gravitational field & Potential, Universal Gravitational Law, Radial and transversal velocity and acceleration. Motion of Planets and Keplers' Laws.(Derivation & explanation) Motion of Satellites. Energy considerations in planetary and satellite motion, Qualitative discussion on application of gravitational law to the Galaxy.

9. Bulk ProDerties of Matters. Elastic Properties of Matter, Physical basis of elasticity. Tension, Compression & shearing. Elastic Modulus; Elastic limit. Poisson's ratio, Relation between three types of elasticity, Fluid Statics, Variation of Pressure in fluid at rest and with height in the atmosphere, Surface Tension, Physical basis; role in formation of drops and bubbles, Viscosity, Physical basis, obtaining the Coefficient of viscosity, practical example of viscosity; fluid flow through a cylindrical pipe (Poisenille's law).

10. SDecial Theory of Relativity. Ineratial and non inertial frame, Postulates of Relativity. The Lorentz Transformation, Derivation, Assumptions on which inverse transformation derived. Consequences of Lorentz transformation, Relativity of time; Relativity of length, Relativity of mass. Transfermission of velocity, variation of mass with velocity, mass energy relation and its importance, relativistic momentum and Relativistic energy, (Lorents inveriants)

$E2=c^2p^2+m^2c^4$

PAPER-II, Part-I (3RD YEAR)

Section 1 Compulsory

4 questions out of 5 marks (2X4=8) Section II

2 questions out of 3 marks(2X8=16) Section III

2 out of 4 marks (2X6 1/2=13)

Total Marks 37

WAVES & OSCILLATIONS,

THERMODYNAMICS AND STATISTICAL MECHANICS

1. Harmonic Oscillations: Simple harmonic oscillation (SHM), Obtaining and solving the basic equations of motion x(t), v(t), a(t). Longitudinal and transvers Oscillatins, Energy considerations in S.H.M. Application of SHM:Torsional Oscillator; Physical pendulum, simple pendulum. SHM and uniform circular motion, combinations of Harmonic motions: Lissaajous patterns. Damped Harmonic Motion: Equation of damped harmonic motion, Quality factor, discussion of its solution. Forced Oscillations and resonances. Equation of forced oscillation, discussion of its solution. Examples of resonance.

2. Waves in physical Media: Mechanical waves, Travelling waves, Phase velocity of travelling waves; Sinusoidal waves; Group speed and dispersion. Waves speed, Mechanical analysis, Transfer, wave equation, Discussion of solution. Power and intensity in wave motion, Derivation & discussion, Principle of superpositon (basic ideas), Interference of waves, standing waves. Phase changes on reflection; Natural frequency, resonance.

3. Sound: Beats Phenomenon, Analytical treatment,

4. Light: Nature of light Visible light (physical characteristics). Light as an Electromagnetic wave: Speed of light in matter; physical aspects, path difference, phase difference etc.

5. Interference : Coherence of sources; Double slit interference, analytical treatment. Adding of Electromagnetic waves using phasors. Interference from thin films, Newtons rings (analytical treatment). Febry-perot Interferometer: Working and analytical treatment, Fresnels Biprism and its use.

6. Diffraction: Diffraction at single slit; Intensity in single slit diffraction using phasor treatment and analytical treatment using addition of waves. Double slit interference & diffraction combined. Diffraction at a circular aperture. Diffraction from multiple slits:

Discussion to include width of the maxima. Diffraction grating:
Discussion, use in spectrographs. Dispersion and resolving power of gratings. Introduction to Holography:

7. Polarization: Basic definition, production of polarization by polarizing sheets, by reflection, by double refraction and double scattering. Description of polarization states. Linear, Circular, elliptic polarization. Specific rotation of plane of polarization. Use of Polarimeter

8. Statistical Mechsnics: Statistical Distribution and iviean values:
Mean free path and microscopic calculations of mean free path. Distribution of Molecular speeds, Distribution of energies: Maxwell distribution; Maxwell-Boltzmann energy distribution; Internal energy of an ideal gas.Brownian motion, Qualitative description. Diffusion, Conduction and Viscosity.

9. Heat and TemDerature: Temperature, Kinetic theory of the ideal gas, Work done on an ideal gas, Review of previous concepts. Internal energy of an ideal gas: To include the Equipartition of energy. Intermolecular forces. Qualitative discussion. Van der Waals equation of state.

10. Thermodynamics: Review of previous concepts. First law of Thermo-dynarnics, and its applications to adibatic, isothermal, cyclic and free expansion. Reverible and irreversible processes, Second Law of thermodynamics, Carnot theorem, Camot engines. Heat engine. Refrigerators. Calculation of efficiency of heat engines. Thermodynamic temperature scale: Absolute zero: Entropy, Entropy in reversible process Entropy in irreversible process. Entropy & Second Law. Entropy & probability. Thermodynamic functions:
Thermodynamic functions (Internal energy, Enthalpy, Gibb's functions, Entropy, Helmholtz functions) Maxwell's relations, Tds equations, Energy equations and their applications. Low Temperature Physics, Liquification of gases: Joule-Thomson effect and its equations. Thermoelectricity,Thermocouple, Seabeck's effect, Peltier's effect, Thomson effect.

PAPER-III, Part-II (4th YEAR)

ELECTRICITY AND MAGNETISM 38 marks

1. Electric Field: Field due to a point charge; due to several point charges, Electric dipole. Electric field of continuous charge distribution e.g Ring of charge; disc of charge; infinite

line of charge. Poit charge in an electric field. Dipole in an electric field: Torque on, and energy of, a dipole in uniform field. Electric flux; Gauss's law; (Integral and differential forms) and its application. (Integral forms).Charged isolated conductors; conductor with a cavity, field near a charged conducting sheet. Field of infinite line of charge; Field of infinite sheet of charge. Field of spherical shell. Field of spherical charge distribution.

2. Electric Potential: Potential due to point charge. Potential due to collection of point charges. Potential due to dipole. Electric potential of continuous charge distribution. Poisson's and Laplace equation without solution. Field as the gradient or derivative of potential. Potential and field inside and outside an isolated conductor

3. Capacitors and dielectrics: Capacitance; calculating the electric field in a capacitor. Capacitors of various shapes, cylindrical, spherical etc. and calculation of their capacitance. Energy stored in an electric field. Energy per unit volume. Capacitor with dielectric: Electric field of dielectric: An atomic view, Application of Gauss' Law to capacitor with dielectric.

4. D C Circuits: Electric Current, current density J , resistance, resistivity, and conductivity, Ohm's Law, energy transfer in an electric circuit. Equation of continunity. Calculating the current in a single loop, multiple loops; voltages at various elements of a loop:

   Use of Kirchoffs 1st & nd law, Thevenin theorem, Norton theorem and Superposition theorem, Growth and Decay of current in an RC circuit. Analytical treatment.

5. Magnetic Field Effects and Magnetic ProDerties of Matter:

   agnetic force on a charged particle, Magnetic force on a current recall the previous results.(Do not derive). Torque on a current loop. Magnetic dipole: Energy of magnetic dipole in field. Discuss quantitatively, Lorentz Force with its applications i.e. Biot-Savart Law: Analytical treatment and appli-cations to a current loop, force on two parallel current changing conductors. Ampere's Law: Integral and differential forms, applications to solenoides and toroids. (Integral form), Gauses' Law for Magnetism: Discussing and developing concepts of conservation of magnetic flux; Differential form of Gauses Law. Origin of Atomic an Nuclear magnetism. Basie ideas, Bohr Magnetron. Magnetization: Magnetic Materials: Paramagnetism, Diamagnetism, Ferromagnetism Discussion. Hysteresis in Ferromagnetic materials.

6. Inductance: Faraday's Law of Electromagnetic Induction: Review of emf, Faraday Law and Lenz's Law, Induced electric fields:

Calculation and application using differential and integral form, Inductance, "Basic definition". Inductance of a Solenoid; Toroid. LR Circuits: Growth and Decay of current; analytical treatment. Energy stored in a magnetic field: Derive. Energy density and the magnetic field. Electromagnetic Oscillation: Qualitative discussion. Quantitative analysis using differential equatins. Forced electromagnetic oscillations and resonance.

7. Alternating Current Circuits: Alternating current: AC current in resistive, inductive and capacitative elements. Single loop RLC circuit: Series and parallel circuits i.e. acceptor and rejector, Analytical expression for time dependent solution. Graphical analysis, phase angles. Power in A.0 circuits: phase angles; RMS values power factor. Circuit transients. RL, RC & RCL transients.

8. Electro Magnetic Waves (Maxwell's Equations): Summarizing the electro-magnetic equations: (Gauss's law for electromagnetism; Faraday Law; Ampere's Law). Induced magnetic fields & displacement current. Development of concepts, applications. Maxwell's equations: (Integral & Differential forms) Discussion and implications. Generating an electro- magnetic wave. Travelling waves and Maxwell's equations. Analytical treatments; obtaining differential form of Maxwell's equations: obtaining the velocity of light from Maxwell's equations. Energy transport and the Poynting Vector. Analytical treatment and discussion of physical concepts.

PAPER-IV, Part-II (4th YEAR)

ELECTRONICS & MODERN PHYSICS (Written) 37 marks

1. Electronics: Fundamental types of Lattice, Unit cell:Basic crystal structure, energy band in solid and energy gaps p-type, n-type semiconductor materials, P-n junction diode its structure, characteristics and application as rectifiers. Transistor, its basic structure and operation, transistor biasing for amplifiers, characteristics of common base, common emitter, common collector, load line, operating point, hybrid parameters (common emitter). Transistor as an amplifier (common emitter mode). Positive & negative feed back R.C. Oscillators. Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

2. Origin of Quantum Theory: Black body radiation, Stefan boltzmann, wien and planck's law-consequences. The quantization of energy, quantum numbers, correspondence principle, Einstein's photon theory The Compton effect. Line spectra Explanation using quantum theory.

3. Wave Nature of Matter: Wave behaviour of particle, wave function (its definition and relation to probability of particle), De. Broglie hypothesis and its testing. Davisson- Germer Experiment and J.P. Themson Exp. Wave packets and particles, localizing a wave in space and time.

4. Quantum Mechanics: Postulates of Quantum Mechanics, Quantum operators, linear operators & their properties i.e. momentum operator, energy operator. Eigen value equation. Eigen operators and eigen function. Schrodinger equation (time dependent and time independent with derivat!ca) and its applications to step potential, free particle, barrier, tunneling (basic idea) particles in a well, probability density using wave function of states.

5. Atomic Physics: Bohr's theory (review) Fank. Hertz experiment, energy level of electrons, Atomic spectrum, Angnlar momentum of electrons, vector atom model, orbital angular momentum. Spin quantization, Bohr's Magnetron. X-ray spectrum, (Continuous and discrete) Moseley's law, pauli exclusion principle table and its use in developing the periodic table.

6 Nuclear Physics: Basic properties of a nucleus, Mass No Atomic No. Isotopes Nuclear force (Basic Idea) Nuclear Radii, Nuclear Massess. Binding energnes, mass defed. Nuclear Spin and Magnetism.

7. Natural Radioactivity: Laws of radioactive decay, half life, mean life, chain dfslUiegration, Alpha, Beta decay (basic idea) Measunng ionizing radiation (units i.e. curies, Rad etc.)

8. Nuclear Reactions: Basic Nuclear reactions, Q-value, exotheronic, endothermic Nuclear fission, Liquid drop nodel, Nuclear Reactors (Basic). Thromonuclear Fusion T.N.F. in Stars.

9. Introduction to Quantum Optics (Laser) and Plasma Physics:+Basic concept of plasma and its applications, controlled thermonuclear fusion, and its requirements for a T.N. reactor. Basic concepts and characteristics of LASER, different types of laser, working of He-Ne Laser.

Practical for B.Sc. (General Physics)

The following practicals are recommended for both B.Sc, Part-I & II. Minimum number of practicals to be performed is 6 and each practical paper carries 10 marks: Teachers are requested to emphasize on graphical analysis, error calculation and on system of S.I. units in the beginning of session.

Division of Marks for Practical in each paper.

Experiment	**10 + 10=20** ma¯a¯k,¯,
Viva + N.B.	3 + 2=5marks

B.Sc. Part-1 Practicals

PAPER-I MECHANICS

1. Modulus of Rigidity by Static & Dynamic method (Maxwell's needle, Barton's Apparatus)
2. To study the damping features of an Oscillating, system using simple pendulum of variable mass
3. Measurement of viscosity of liquid by Stoke's I Poiseulli's method.
4. Surface tension of water by capillary tube method.
5 To determine the value of "a" by compound pendulumikater's Pendulum
6. To study the dependence of Centripetal force on mass, radius, and angular velocity of a body in circular motion.
7. Investigation of phase change with position in traveling wave and measure the velocity of sound by C.R.O.
8. Determination of moment of inertia of a solid/hollow cylinder and a sphere etc.
9. To determine thermal emf and plot temperature diagram.
10. Determination of temperature coefficient of resistance of a given wire.
11. Determination of'J" by Callender - Barnis method.
12. The determination of Stefan's constant.
13. Calibration of thermocouple by potentio meter.
14. To determine frequency of AC supply.
15. To determine Horizontal Vertical distance by Sextant.
16. The determination of wavelength of Sodium -D lines by Newton's Ring.
17. The determination of wavelength of light/laser by Diffraction grating.
18. Determination of wavelength of sodium light by Fresnel's bi-prism.
19. The determination of Resolving power of a diffraction grating.
20. To study the characteristics of Photo emission and determination of Planck's constant using a Photo cell.
21. The measurement of Specific rotation of sugar by Polarimeter and determination of sugar concentration in a given solution.

22. Determination of the radius of lycopodium particles.

B.Sc. Part-II Practicals

ELECTRICITY AND MAGNETISM AND MODERN PHYSICS, ELECTRONICS

1. Measurement of resistance using a Neon flash bulb and condenser
2. Conversion of a galvanometer into Voltmeter & an Ammeter
3. Calibration of an Ammeter and a Voltmeter by potentiometer

4. Charge sensitivity of a ballistic galvanometer
5. Comparison of capacities by ballistic galvanometer
6. To study the B.H. curve & measuring the magnetic parameters.
7. Measurement of low resistance coil by a Carey Foster Bridge.
8. Resonance frequency of an acceptor circuit
9. Resonance frequency of a Rejecter Circuit.
10. Study of the parameter of wave i.e. Amplitude, phase and time period of a complex signal by CRO.
11. Measurement of selfimutual inductance.
12. Study of electric circuits by black box.
13. Determination of elm of an electron
14. Ionization potential of mercury.
15. Characteristics of a semiconductor Diode (Compare with (Si & Ge diode)
16. Setting up of half & full wave rectifier & study of following factors
    i. Smoothing effect of a capacitor
    ii. Ripple factor & its variation with load.
    iii. Study of regulation of out put voltage with load.
17. To set up a single stage amplifier & measure its voltage gain and band width.
18. To set up transistor oscillator circuit and measure its frequency by an oscilloscope.
19. To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth table.
20. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate.
21. Characteristics of a transistor.
22. To study the characteristic curves of a G. M. counter and use it to determine the absorption co-efficient off3particle :n Aluminum.
23. Determination of range of a particles
24. Mass absorption coeff of Pb for y-rays using G.M counter.
25. Use of computer in the learning of knowledge of GATE and other experiments.

Book for B.Sc.General Phsics

1. Fundamental of Physics by Halliday, Resnick and krane

Books Recommended

1. College Physics by Sears, Zemansky and Young Physics (5th Edition) by Giancoli
3. Physics by Serway
4 vectr'r Anniycis by **Cpiegel Crshanni Piihliching** *Cn*
5. Concepts of Modern Physics by A. Beiser
6. Modem Physics by H.C. Ohanian.
7. Basic Electronics by Grobe.
8. Electronic devices by Floyed
9. Introduction to Electromegnetic Field and Waves by Corson and Loran.
10. Introduction to Electromegnetic Field and Waves by Reitz and Milford.
12. Mechanics by Dr. Rafique Ahmad
13. Essentials of Modern Physics by Acosta, Cowan and Graham