UNIVERSITY OF THE PUNJAB, LAHORE, PAKISTAN

University of the Punjab

Associate Degree in Science (2 Years) physics degree program under annual system (Affiliated Colleges of University of the Punjab)

DEPARTMENT OF PHYSICS, UNIVERSITY OF THE PUNJAB, LAHORE, PAKISTAN

BACHELOR OF SCIENCE (Associate Degree in Science) (TWO YEARS) PHYSICS DEGREE PROGRAM FOR AFFILIATED COLLEGES OF UNIVERSITY OF THE PUNJAB

Duration of Degree Course	Two Years (Part-I, Part-II)
Teaching System	Annual System

MISSION STATEMENT

The mission of the program is to prepare students with the latest developments in the subject of physics and its associated technologies. Moreover, it aims at helping the students to design and develop a strong background in fundamentals of physics such as mechanics,electricity, magnetism, thermodynamics, waves, electronics and modern physics. We wish to prepare our students to conduct independent scientific and analytical investigation in the changing discipline and to develop critical and scientific thinking skills needed for a suitable career in academia and industry.

OBJECTIVES

The Associate Degree in Science (Physics) (2 Years) degree program is offered by the Department of Physics as a full-time period of teaching for affiliated colleges of University of the Punjab. The main objectives of the program are

- to equip students with an understanding of fundamental concepts in physics, including: classical mechanics and electromagnetism, thermodynamics and statistical physics, principles of waves and optics, and quantum mechanics.
- to apply knowledge and techniques from physics to solve problems in other physical sciences.
- to identify problems for study, conduct independent studies and be effective members of collaborative teams
- to enhance student experties in setting up experiments, collecting and analyzing data.
- to enable students understand physical aspects of a problem, formulate a strategy for solution utilizing mathematical and computational methods, make appropriate approximations, and evaluate the correctness of their solution.
- to furnish an in-depth understanding of some specialized area of physics through choice of elective courses
- to prepare stundents to know and follow the high professional and ethical standards of scientific work
- to prepare students to join an appropriate and respectable level position in a physics related field, and to maintain their professional skills in rapidly evolving industry and academia.
- to develope research based scientific thinking and to enhance professional skills for teaching, research, managerial positions in wide range of professions in national and international organizations

The program is offered under annual system of examination. The year-wise breakup and outline of courses for this program are given as under. Teaching, laboratory work and examinations are held according to rules and regulations of University of the Punjab.

SCHEME OF STUDIES

SCHEME OF STUDIES (Associate Degree in Science PHYSICS 2 Years Program for affiliated colleges)

Associate Degree in Science (PHYSICS) PART-I (YEAR-I)

EXAM PAPER	TITLE	TOTAL MARKS	EXAM DURATION
Paper A	Vector Analysis, Mechanics and Special Relativity	40	3 Hrs
Paper B	Electricity and Magnetism	40	3 Hrs
Lab-I (Practical Exam)	Mechanics, Electricity and Magnetism	20	4Hrs

Associate Degree in Science (PHYSICS) PART-II (YEAR-II)

EXAM PAPER	TITLE	TOTAL MARKS	EXAM DURATION
Paper C	Thermodynamics, Waves and Optics	40	3 Hrs
Paper D	Electronics and Modern Physics	40	3 Hrs
Lab-II (Practical Exam)	Thermodynamics, Waves, Electronics and Modern Physics	20	4Hrs

EXAM PAPERS

Each exam paper (i.e. Paper A, Paper B, Paper C, Paper D) shall consist of EIGHT (08) questions in total and the candidates shall have to attempt FOUR (04) questions. Each question will carry 10 Marks and will be of 3 parts consisting of basic concept, description of a law or an idea, mathematical erivation of physical laws or a theory and numerical or analytical problems. The marks distribution of each question will be as under

Quistion

(a) Description of a law or an idea, mathematical derivation (6 Marks)
(b) Numerical Problem (3 Marks)
(c) Short question (1 Marks)

EXAM PAPER STYLE

PHYSICS PAPER A (Associate Degree in Science Part-I)
(Vector Analysis, Mechanics and Special Relativity)

There will be EIGHT (08) questions of 10 marks each and the candidate will have to attempt FOUR (04) questions out of 08 by selecting one question from each section. There will be four sections consisting of two questions each.The course distribution of each section is as under:

SECTION	COURSE DISTRIBUTION	NO. OF QUESTIONS
Section I	Vector, Newton's laws, applications of Newton's laws, momentum	02 Questions
Section II	System of Particles, Rotational dynamics, Angular momentum	02 Questions
Section III	Work, Kinetic energy, Potential energy, Conservation of energy	02 Questions
Section IV	Gravitation and Special Relativity	02 Questions

The instructions of exam paper will read

Attempt FOUR questions by selecting ONE question from each section.

PHYSICS PAPER B (Associate Degree in Science Part-I)
(Electricity and Magnetism)

There will be EIGHT (08) questions of 10 marks each and the candidate will have to attempt FOUR (04) questions out of 08 by selecting one question from each section. There will be four sections consisting of two questions each.The course distribution of each section is as under:

SECTION	COURSE DISTRIBUTION	NO. OF QUESTIONS
Section I	Electric field, Gauss's law, Electric potential, Mechanical properties of materials	02 Questions
Section II	Capacitance, DC circuits, Magnetic field	02 Questions
Section III	Magnetic field of current, Faraday's law,magnetic properties of materials	02 Questions
Section IV	Inductance, AC circuits, Maxwell's equations and electromagnetic waves	02 Questions

The instructions of exam paper will read

Attempt FOUR questions by selecting ONE question from each section.

PHYSICS PAPER C (Associate Degree in Science Part-II)
(Waves, Optics and Thermodynamics)

There will be EIGHT (08) questions of 10 marks each and the candidate will have to attempt FOUR (04) questions out of 08 by selecting one question from each section. There will be four sections consisting of two questions each.The course distribution of each section is as under:

SECTION	COURSE DISTRIBUTION	NO. OF QUESTIONS
Section I	Oscillations, Wave Motion, Sound Waves	02 Questions
Section II	Light Waves, Mirrors, Lenses, Interference	02 Questions
Section III	Diffraction, Grattings, Spectra, Polarization	02 Questions
Section IV	Temperature, Molecular properties of gases, First law of thermodynamics, Entropy and second Law of Thermodynamics	02 Questions

The instructions of exam paper will read

Attempt FOUR questions by selecting ONE question from each section.

PHYSICS PAPER D (Associate Degree in Science Part-II)
(Electronics and Modern Physics)

There will be EIGHT (08) questions of 10 marks each and the candidate will have to attempt FOUR (04) questions out of 08 by selecting one question from each section. There will be four sections consisting of two questions each.The course distribution of each section is as under:

SECTION	COURSE DISTRIBUTION	No. OF QUESTIONS
Section I	Nature of Light, Nature of Matter	02 Questions
Section II	Electrons in potential well, Atomic structure	02 Questions
Section III	Nuclear Physics, Energy from nucleus, particle physics and cosmology	02 Questions
Section IV	Semiconductors, Transistor, Feedback and Oscillators	02 Questions

The instructions of exam paper will read

Attempt FOUR questions by selecting ONE question from each section.

LAB-I (PRACTICAL EXAM) (Associate Degree in Science Part-I)
(Mechanics, Electricity and Magnetism)

Distribution of marks of Practical Exam is as under

Description	Marks
Setting up appratus	02
Observations and collection of data	08
Calculations	04
Results, graphs and percentage error	02
Lab Notebook and Viva Voce Exam	04
Total Marks	**20**

LAB-II (PRACTICAL EXAM) (Associate Degree in Science Part-II)
(Thermodynamics, waves, electronics and modern physics)

Distribution of marks of Practical Exam is as under

Description	Marks
Setting up appratus	02
Observations and collection of data	08
Calculations	04
Results, graphs and percentage error	02
Lab Notebook and Viva Voce Exam	04
Total Marks	**20**

OUTLINES OF COURSES

Recommended Text Books

1. *Physics Vol. I & II by Resnick, Halliday and Krane (RHK), 5th Edition, Wiley, (2002).*

Rerference Books

1. *An introduction to vector analysis for Physicists and Engineers by B. Hague, Mathuen and Co. (1970).*
2. *University Physics with Modern Physics by H. D. Young, R. A. Freedman (14th Edition), Addison-Wesley (2015)*

3. *Advanced Engineering Mathematics by D. G. Zill and W. S. Wright (6th Edition), Jones and Bartlett (2018)*
4. *Electronic Devices, by T. L. Floyd, Pearson, 10th Edition, (2017)*

Paper A (Associate Degree in Science Part-I)

Vectors, Mechanics and Special Relativity

Section-I	
Topic	**Description**
Vectors	Derivatives and integration of a vector, gradient of a scalar, divergence and curl of a vector, physical significance of gradient of scalars, divergence and curl of vectors, Green theorem, divergence theorem (without proof), Stokes' theorem (without proof) and physical significance and applications (see Chapter No. 9 of Advanced Engineering Mathematics (5th Edition) by Dennis Zill)
Force and Newton's Laws	Review of motion in one-dimension, classical mechanics, Newton's first law, force, mass, Newton's second law, Newton's third law, weight and mass, applications of Newton's laws in one-dimension (see Chapter No. 3 of HRK)
Motion in Two and Three Dimensions	Motion three dimensions with constant acceleration, Newton's laws in three-dimensional vector form, projectile motion, drag forces and motion of projectiles, uniform circular motion, relative motion (see Chapter No. 4 of HRK)
Applications of Newton's Law	Force laws, frictional forces, the dynamics of uniform circular motion, equation of motion (constant and non-constant) forces, Time dependent forces, drag forces and the motion of projectiles, limitations of Newton's laws (see Chapter No. 5 of HRK)
Momentum	Collisions, linear momentum, impulse and momentum, conservation of momentum, two-body collisions (see Chapter No. 6 of HRK)
Section-II	
Systems of Particles	Two-particle systems, many-particle systems, center of mass of solid objects, Linear momentum of a particle, linear momentum of s system of particles, conservation of linear, work and energy in a system of particles, systems of variable mass (see Chapter No. 7 of HRK)
Rotational Dynamics	Review of rotational kinematics, torque, rotational inertia and Newton's law, rotational inertia of solid bodies, torque due to gravity, equilibrium applications of Newton's law for rotation, non-equilibrium applications of Newton's laws for rotation, combined rotational and translational motion (see Chapter No. 9 of HRK)
Angular Momentum	Angular momentum of a particle, system of particles, angular momentum and angular velocity, conservation of angular momentum, the spinning top (see Chapter No. 10 of HRK)
Section-III	
Work and Kinetic Energy	Work and energy, work done by constant forces, power, work done by a variable force in one- and two-dimensions, kinetic energy and the work-energy theorem (see Chapter No. 11 of HRK)
Potential Energy	Conservative forces, potential energy, conservation of mechanical energy, one-dimensional conservative systems and complete solution, Two- and three-dimensional conservative systems (see Chapter No. 12 of HRK)

Conservative of Energy	Work done on a system by external forces, internal energy of particles, frictional work, conservation of energy in a system of particles, center-of-mass energy (see Chapter No. 13 of HRK)
Section-IV	
Topic	**Description**
Gravitational	Gravitation from the ancients to Kepler, Newton and law of universal gravitation, the gravitational constant *G*, gravity near earth's surface, gravitational effect of a spherical distribution of matter, gravitational potential energy, the gravitational field and potential, the motions of planets and satellites, universal gravitation (see Chapter No. 14 of HRK)
Special Relativity	Troubles with classical physics, the postulates of special relativity, consequences of Einstein's postulates, the Lorentz transformation, measuring the space-time coordinates of an event, the transformation of velocities, consequences of the Lorentz transformation, relativistic momentum, relativistic energy (see Chapter No. 20 of HRK)

Paper *B* (Associate Degree in Science Part-I)

Electricity and Magnetism

Section-I	
Topic	**Description**
The Electric field	Review of electric charge and Coulomb's law, fields, the electric field ***E***, the electric field of point charges, lines of force, the electric field of continuous charge distribution, a point in an electric field, a dipole in an electric field (see Chapter No. 26 of HRK)
Gauss's Law	The flux of a vector field, the flux of the electric field, Gauss's law, a charged isolated conductor, applications of Gauss's law, experimental tests of Gauss's law and Coulomb's law (see Chapter No. 27 of HRK)
Electric Potential Energy and Potential	Electrostatic and gravitational forces, electric potential energy, electric potential, calculating the potential due to point a charge, potential due to collection of point charges, the electric potential of continuous charge distributions, equipotential surfaces, calculating the field from the potential, an isolated conductor (see Chapter No. 28 of HRK)
The Mechanical Properties of Materials	Types of materials, a conductor in an electric fields (static condition/dynamic conditions), Ohmic materials, Ohm's law (a microscopic view), an insulator in an electric field (see Chapter No. 29 of HRK)
Section-II	
Capacitance	Capacitors, capacitance, calculation the capacitance, capacitors in series and parallel, energy storage in an electric field, capacitors with dielectrics, an atomic view of dielectrics, dielectrics and Gauss's law (see Chapter No. 30 of HRK)
DC Circuits	Electric current, electromotive force, analysis of circuits, electric fields in circuits, resistors in series and parallel, energy transfers in an electric circuit, RC circuits (see Chapter No. 31 of HRK)

The Magnetic field	Magnetic interactions and magnetic poles, the magnetic force on a moving charge, circulating charges, the Hall effect, the magnetic force on a current carrying wire, the torque on a current loop (see Chapter No. 32 of HRK)
Section-III	
Topic	**Description**
The Magnetic field of a Current	The magnetic field due to a moving charge, the magnetic field of a current, two parallel currents, the magnetic field of a solenoid, Ampere's law, electromagnetism and frame of reference (see Chapter No. 33 of HRK)
Faraday's Law of Induction	Faraday's experiments, Faraday's law of induction, Lenz' law, motional EMF, generators and motors induced electric fields, induction and relative motion (see Chapter No. 34 of HRK)
Magnetic Properties of Materials	The magnetic dipole, the force on a dipole in a non-uniform field, atomic and nuclear magnetism, atomic and nuclear magnetism, magnetization, magnetic materials, the magnetism of the planets, Gauss' law for magnetism (see Chapter No. 35 of HRK)
Section-IV	
Description	**Description**
Inductance	Inductance, calculating the inductance, LR circuits, energy storage in a magnetic field, electromagnetic oscillations (qualitative and quantitative) , damped and forced oscillations (see Chapter No. 36 of HRK)
Alternating Current Circuits	Alternating currents, three separate elements, the single loop RLC circuit, power in AC circuit, the transformer (see Chapter No. 37 of HRK)
Maxwell's Equations and Electromagnetic Waves	The basic equations of electromagnetism, induced magnetic fields and the displacement current, Maxwell's equations, generating electromagnetic wave, traveling waves and Maxwell's equations, energy transport and the poynting vector, radiation pressure (see Chapter No. 38 of HRK)

Paper C (Associate Degree in Science Part-II)

Waves, Optics and Thermodynamics

Section-I	
Topic	**Description**
Oscillation	Oscillating systems, the simple harmonic oscillator, simple harmonic motion, energy consideration in simple harmonic motion, applications of simple harmonic motion, simple harmonic motion and uniform circular motion, combinations of simple harmonic motions, damped harmonic motion, forced oscillations and resonance (see Chapter No. 17 of HRK)
Wave Motion	Mechanical waves, types of waves, traveling waves, Waves Speed, Waves equation, Power and intensity in wave motion, Principle of superposition, Interference of waves, standing waves, resonance (see Chapter No. 18 of HRK)
Sound Waves	The speed of sound, traveling longitudinal waves, power and intensity of sound waves, standing longitudinal waves, vibrating systems and sources of sound, Beats, the Doppler effect (see Chapter No. 19 of HRK)

Section-II	
Topic	**Description**
Light Waves	The electromagnetic spectrum, visible light, the speed of light, reflection and refraction of light waves, total internal reflection, the Doppler effect for light (see Chapter No. 39 of HRK)
Mirrors and Lenses	Image formation by mirrors and lenses, plane mirrors, spherical mirrors, spherical reflecting surfaces, thin lenses, optical instruments (see Chapter No. 40 of HRK)
Interference	Two-source interference, double slit interference, coherence, intensity in double slit interference, interference from thin films, optical reversibility and phase changes on diffraction, Michelson' interferometer, Michelson' interferometer and light propagation (see Chapter No. 41 of HRK)
Section-III	
Diffraction	Diffraction and the wave theory of light, single slit diffraction, intensity in single slit diffraction, diffraction at a circular aperture, double slit and diffraction combined (see Chapter No. 42 of HRK)
Gratings and Spectra	Multiple slits, diffraction grating, dispersion and resolving power, X-ray diffraction, Holography (see Chapter No. 43 of HRK)
Polarization	Polarization of electromagnetic waves, polarizing sheets, polarization by reflection, double refraction, circular polarization, scattering of light, to the quantum limit (see Chapter No. 44 of HRK)
Section-IV	
Temperature	Temperature and thermal equilibrium, temperature scales, measuring temperatures, thermal expansion, the ideal gas (see Chapter No. 21 of HRK)
Molecular Properties of Gases	The atomic nature of matter, a molecular view of pressure, the mean free path, the distribution of molecular speeds, the distribution of molecular energies, equations of states for real gases, the intermolecular forces (see Chapter No. 22 of HRK)
The first law of thermodynamics	Heat (energy in transit), the transfer of heat, the first law of thermodynamics, heat capacity and specific heat, work done on or by an ideal gas, the internal energy of an ideal gas, heat capacity of an ideal gas, applications of the first law of thermodynamics (see Chapter No. 23 of HRK)
Entropy and second law of thermodynamics	Defining entropy, entropy change for irreversible processes, second law of thermodynamics, entropy and engines, efficiencies of engins, statistical view of entropy (see Chapter No. 24 of HRK)

Paper D (Associate Degree in Science Part-II)

Electronics, Modern Physics and Nuclear Physics

Section-I	
The Nature of Light	Introducing the photon, thermal radiations, the photoelectric effect, Einstein's photon theory, the Compton effect, the photon revealed, photons and waves, slowing down atoms by photon bombardment (see Chapter No. 45 of HRK)
The Nature of Matter	Matter waves, testing DeBroglie's hypothesis, waves and particles, Heisenberg's uncertainty principle, the wave function, Schrodinger's equation, barrier tunneling (see Chapter No. 46 of HRK)
Section-II	
Topic	**Description**
Electrons in Potential Wells	Electrons, free and bound, an electron trapped in a potential well, an electron trapped in a finite well, an electron trapped in an atom, the ground state of Hydrogen, angular momentum of electron in atoms, an excited states of Hydrogen atom, counting the states of Hydrogen (see Chapter No. 47 of HRK)
Atomic Structure	The X-Ray Spectrum of atoms, X-Ray and the numbering of the elements, building atoms, the periodic table, atomic magnetism, the Stern-Gerlach experiment, Nuclear magnetic resonance, magnetism and atomic radiations, Lasers and Laser light (see Chapter No. 48 of HRK)
Section-III	
Nuclear Physics	Discovering the nucleolus, some nuclear properties, radioactive decay, alpha decay, beta decay, Measuring ionizing radiation, natural radioactivity, nuclear reactions, nuclear models (see Chapter No. 50 of HRK)
Energy from the nucleus	The atom and the nucleus, nuclear fission, theory of nuclear fission, basic principles of nuclear reactors , a natural reactor, basic process of thermonuclear fusion, Thermonuclear fusion in stars, Controller thermonuclear fusion, magnetic confinement, inertial confinement (see Chapter No. 51 of HRK)
Particle Physics and Cosmology	Particle interactions, families of particles, conservation laws, the quark model, the big bang cosmology, Nucleosynthesis, the age of universe (see Chapter No. 52 of HRK)
Section-IV	
Topic	**Description**
Semiconductors	Review of conductors, insulators and semiconductors and band theory of solids, N- and P-type semiconductors, the diode, biasing the diode, voltage current characteristics of a diode, Half wave & full wave rectifier, bridge rectifier. Smoothing circuit (RC filter circuit) (see chapter No.1 of *Electronic Devices, by T. L. Floyd)*
Transistor	Basic structure, biasing, operation, brief review of transistor configuration,

	characteristics of common emitter, DC load lines and Q points, construction and operation of amplifier in common emitter mode.
Feedback, Oscillators and Logic gates	Principle of feedback amplifiers, Positive and Negative Feedback, RC feedback oscillator (phase shift, common emitter mode only) OR, AND, NOT, NAND, NOR gates. Symbol, truth table and Boolean equations. Use of diode and transistor for OR, AND, NOT, NAND, NOR gates

LABORATORY EXAM

LAB-I (Mechanics, Electricity and Magnetism)

Subject	Experiment
Mechanics	1. Modulus of Rigidity by Static methods (Barton's Apparatus), by Maxwell needle or by solid cylindrical rod 2. To find surface tension of water by capillary tube method/Jaeger's method 3. To study the damping features of an oscillating system 4. Measurement of viscosity of liquid by Stoke's / Poiseulli's method 5. To determine the value of "g" by compound pendulum / Kater'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 measurement of the velocity of sound by C.R.O., 8. Determination of moment of inertia of a solid/hollow cylinder and a sphere etc., Spring constant by static and dynamic methods
Electricity and Magnetism	9. Calibration of an Ammeter and a Voltmeter by potentiometer 10. Conversion of a pointer Galvanometer into a voltmete and an ammeter 11. Charge sensitivity of a ballistic Galvanometer and comparison of capacities by ballistic galvanometer. 12. To study the B.H. curve and measure the magnetic parameters. 13. Measurement of low resistance coil by a Carey Foster Bridge. 14. Study of the parameter of wave i.e. amplitude, phase and time period of a complex signal by CRO. 15. Measurement of self/mutual inductance. 16. To study the network theorems (Superposition, Thevinin, Norton) 17. To study the application of Lorentz force by CRO (e/m by J. J. Thomson method) 18. Determination of temperature coefficient of resistance of a given wire 19. Determination of Stefan's constant 20. Calibration of thermocouple by potentiometer

(*Note: At least 15 experiments with almost equal weightage of subjects mentioned above be performed by the individual department of affiliated colleges)*

LAB-2 (Waves, Thermodynamics, Electronics and Modern Physics)

Subject	Experiment
Waves and Optics	1. To determine Horizontal/Vertical distance by Sextant 2. The determination of wavelength of Sodium –D lines by Newton's Ring 3. The determination of wavelength of light/laser by Diffraction grating 4. Determination of wavelength of sodium light by Fresnel's bi-prism 5. The determination of resolving power of a diffraction grating 6. The measurement of specific rotation of sugar by Polarimeter and determination of sugar concentration in a given solution 7. To study the combinations of harmonic motion (Lissajous figures) 8. To study the parameters of waves (Beats phenomenon)
Thermodynamics	9. To determine thermal emf and plot temperature diagram 10. To determine the Thermal conductivity of good and bad conductors using Lee's and Searl's apparatus 11. Determination of "J" by Callender – Barnes method
Electronics	12. Characteristics of a semiconductor diode (Compare Si with Ge diode) 13. Setting up of half and full wave rectifier and study of following factors i. Smoothing effect of a capacitor ii. Ripple factor and its variation with load. iii. Study of regulation of output voltage with load. 14. To set up a single stage amplifier and measure its voltage gain and bandwidth. 15. To set up transistor oscillator circuit and measure its frequency by an oscilloscope 16. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT gate. 17. Characteristics of a transistor.
Modern Physics	18. To study the characteristics of Photo emission and determination of Plank's constant using a Photo cell 19. Determination of e/m of an electron. 20. Determination of ionization potential of mercury 21. To study the characteristic curves of a G. M. counter 22. To determine the absorption co-efficient of β-particle in Aluminum by G.M. counter 23. Determination of range of α-particles 24. Mass absorption coefficient of lead for γ-rays using G.M counter

(*Note: At least 15 experiments with almost equal weightage of subjects mentioned above be performed by the individual department of affiliated colleges)*