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Syllabus 2023-24
Panjab University

BSc
(PHYSICS)
FIRST SEMESTER

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PHYSICS

B.Sc. (GENERAL) FIRST YEAR (1st and 2nd Semester) EXAMINATION, 2023-24

General Instructions for teachers, students and paper setters :

1. There will be three papers of theory and one laboratory (practical course). Each of the theory papers is allocated 25 marks including 3 (three) marks for the Internal assessment. **The Practical examination is of 50 marks including 5 (Five) marks for the Internal assessment and will be held along with the second semester examination.**
2. The number of lectures per week will be three for each theory paper and six for practicals.
3. The examination time for each theory paper as well as practical paper will be three hours.
4. Each theory paper will consist of **seven** questions comprising of three sections. First two sections will comprise of **three** questions from each of Units I and II of syllabus, and the third section will comprise of **one compulsory** question of **ten** short answer type parts covering whole syllabus. The question paper will be set for 44 marks - **All the questions in first and second sections will carry 9 (nine) marks each and the compulsory question will carry 8 marks.** Student will attempt two questions from each of the first two sections and any eight parts of the compulsory question. **After evaluation of the answer books out of 44 marks, the marks will be given out of 22 marks.**
5. The numerical problems/exercises in the question paper should be 25-30%.
6. Student will attempt two questions from each Unit (I-II) and any six parts of question seven.
7. The use of Non-programmable calculators will be allowed (paper setter should explicitly mention this in the question paper) in the examination centre but these will not be provided by the University/College. Mobile phones and pagers are not allowed in the examination hall.

Papers, marks and teaching hours allocation :

Paper A :	Mechanics	Total Teaching hrs. 30
Paper B :	Vibrations, Waves and EM Theory	Total Teaching hrs. 30
Paper C :	Electricity and Magnetism	Total Teaching hrs. 30
	Physics Practicals	Total Teaching hrs. 45

* marks allotted for internal assessment.

PHYSICS

SEMESTER – I

Paper A: MECHANICS-I (30 Hrs.)

UNIT-I

Cartesian and spherical polar co-ordinate systems, Two- and three-dimensional coordinate systems, area, volume, displacement, velocity, and acceleration in these systems, solid angle.
Centre of mass, linear momentum, angular momentum, torque, potential energy and kinetic energy of a system of particles.
Relationship of conservation laws of linear momentum, angular momentum and energy, and symmetries of space and time.

UNIT-II

Various forces in nature, relative strengths and spatial dependence,
Motion under force obeying inverse square law, equivalent one body problem.
Motion under central forces, equation of motion under central force, equation of orbit and turning points, Kepler's Laws.
Elastic collision in Lab. and C.M. systems, relationships of velocities, angles, and kinetic energies in these two systems, cross section of elastic scattering, Rutherford scattering.

Books Suggested :

Essential Readings :

1. Mechanics, H.S. Hans & S.P. Puri.
2. Mechanics, Berkeley, Vol. I, C. Kittle.

Further Readings :

1. *An Introduction to Machines,* Daniel Kleppner & Robert J. Kolenkow (TMH).
2. *Introduction of Classical Mechanics,* R.G. Takwale & P.S. Puranik (TMH, 2000).

Paper B: VIBRATIONS, WAVES & E.M. THEORY-I (30 Hrs.)

UNIT-I

Simple harmonic motion, energy of a SHM, Compound Pendulum, Torsional Pendulum, Electrical Oscillations, Transverse Vibrations of a mass on a string, composition of two perpendicular SHM of same period and of period in ratio 1: 2. Decay of free vibrations due to damping, differential equation of motion, types of damping, determination of damping co-efficient; Logarithmic decrement, relaxation time and Q- Factor. Electromagnetic damping (Electrical oscillator).

UNIT-II

Differential equation for forced mechanical and electrical oscillators, Transient and steady state behaviour. Displacement and velocity variation with driving force frequency, variation of phase with frequency, resonance. Power supplied to an oscillator and its variation with frequency. Q-value and band width. Q-value as an amplification factor. Stiffness, coupled oscillators, Normal co-ordinates and normal modes of vibration, Inductance coupling of electrical oscillators.

Books Suggested :

Essential Readings :

1. *Text Book of Vibrations and Waves* by S.P. Puri (Macmillan India Ltd.).
2. *Physics of Vibrations and Waves* by H.J. Pain, ELBS & John Wiley, London.

Further Readings :

1. *Vibrations and Waves* by A.P. French (Arnold Heinemann India, New Delhi).
2. *The Mathematics of Waves and Vibrations* by P.K. Ghosh (Mcmillan India).
3. *Waves and Oscillations* by N. Subrahmanayam & B. Lal (Vikas Pub., Delhi).

Paper–C : ELECTRICITY AND MAGNETISM-I (30 Hrs.)

UNIT-I

Basic ideas of Vector Calculus, Gradient, Divergence, curl in Cartesian coordinates and their useful relations, physical significance and applications, Conservative field, Greens's theorem in a plane, Laplacian in Rectangular coordinates. Stoke's theorem, Gauss's divergence theorem, Coulomb's Law for point charges and continuous distribution of charges, electric field due to dipole, line charge, charged ring, circular disc and sheet of charge, Gauss's Law and its differential form.

UNIT-II

Work and potential difference, Potential difference as line integral of field, Electric potential due to dipole and quadrupole and its applications in Electrostatic field, Electric field as gradient of scalar potential, curl $\mathbf{E} = 0$. Calculation of $\mathbf{E}$ due to a point charge and dipole from potential. Poisson and Laplace's equation, Concept of electrical images. Calculation of electric potential and field due to a point charge placed near an infinitely conducting sheet.

Polarisation of matter, atomic and molecular dipoles, induced dipole moment and atomic polarizability. Electric susceptibility and polarization vector. Relation $K = 1 + \chi$, Gauss's law for dielectrics. Displacement vector, Div. $\mathbf{D} = 0$, Energy stored in dielectric medium.

Books Suggested :

Essential Readings :

1. *Electricity & Magnetism* by A.S. Mahajan & A.A. Rangwala (Tata McGraw Hill).
2. *Fundamentals of Electricity and Magnetism* by Arthur F. Kipp.
3. *Electricity and Magnetism, Berkeley Physics Course, Vol. II* by E.M. Purcell.
4. *Introduction to Classical Electrodynamics* by David Griffith, Prentice Hall.

Further Readings :

1. *Electricity & Magnetism,* 4th Edition, W.J. Duffin.
2. *EM Waves and Radiating Systems,* Edward C. Jordan and K. G. Balmain, Prentice Hall.

PHYSICS PRACTICALS

The activities given in the section "Analysis of Experimental Data" are compulsory for all the students in the First semester.

The students are required to perform all the Nine experiments from each of the Units I and Unit II. The Practical examination will be held along with the second semester examinations.

The aim of project work is to develop the scientific and technical temper in the students and as such it may consist of development of a laboratory experiment, fabrication of a device or electronic circuit etc. The student will prepara a project report of about 10 pages. Assessment of the project work will be done on the basis of effort put in the execution of the project, report prepared, and viva-voce.

General Guidelines for Physics Practical Examinations :

Total : 50 marks

1. The distribution of marks is as follows :

(i)	One full experiment out of section–A requiring the student to take some data, analyse it and draw conclusions. (Candidates are expected to state their results with limits of error).	20
(ii)	One exercise based on experiment or Computer Programming from the Unit assigned to the student for the semester	7
(iii)	Viva-Voce and Record (Practical file)	10
(iv)	Project	8
(v)	Internal Assessment	5

Note for Examiners :

2. The marks scored under each head must be clearly written on the answer sheet.
3. There will be one session of 3 hours duration. The paper will have two sections. Section-A will consist of 4 experiments from each of Unit I and Unit II, out of which an examinee will mark 3 experiments from either of units and one of these is to be allotted by the external examiner.
4. Section–B will consist of exercises which will be set by the external examiner on the spot. The length of the exercises should be such that any of these could be completed in one hour.
5. The examiner should take care that the experiment allotted to an examinee from section–A and exercise allotted from section–B are not directly related to each other.
6. Number of candidates in a group for practical examination should not exceed **12**.
7. In a single group, no experiment to be allotted to more than three examinees in the group.

Analysis of Experimental Data (Compulsory for all students in first semester):

Objectives :

(i) Knowledge of propagation of errors.
(ii) Knowledge of significant figures, Determination of standard deviation and probable error and their use in interpretation of the experimental result.
(iii) Familiarity with the method of least square fitting of experimental data to a curve.

LIST OF EXPERIMENTS :

UNIT-I

MECHANICS

I. Measurements :

Objectives :

(i) Measurements of time, length, thickness and curvature, pressure, humidity
(ii) Concepts of least count, horizontal, vertical and angular alignments

Activities :

(i) To measure internal/external diameter of a hollow cylinder using Vernier calipers
(ii) To measure thickness of wire
(iii) To measure curvature of a lens
(iv) To measure pressure using Barometer
(v) To measure humidity using dry and wet thermometer

II. Rotation :

Objectives :

(i) Study of rotational motion.
(ii) Establishing relationship between different quantities.

Activities :

(i) To study the dependence of moment of inertia on distribution of mass (by noting time periods of oscillations using objects of various geometrical shapes but of same mass).

(ii) To establish relationship between torque and angular acceleration using fly wheel.

III. One-Dimensional Collisions :

Objectives :

(i) Conservation of linear momentum and kinetic energy in elastic collisions.
(ii) Dependence of fraction of kinetic energy transferred on the masses of colliding bodies.
(iii) Idea of coefficient of restitution.

Activities :

To determine energy transfer, coefficient of restitution and verify laws of conservation of linear momentum and kinetic energy in elastic collisions using one dimensional collisions of hanging spheres.

IV. Compound Pendulum :

Objectives :

(i) Idea of equivalent simple pendulum.
(ii) Concepts of centre of suspension and oscillation.
(iii) Dependence of time period on moment of Inertia .
(iv) Radius of gyration.
(v) Determination of g.

Activities :

(i) Measure time period as a function of distance of centre of suspension (oscillation) from centre of mass, plot relevant graphs, determine radius of gyration and acceleration due to gravity.
(ii) Find the value of g by Katers' or Bar pendulum.

V. Torsion Pendulum :

Objectives :

(i) Idea of torsional vibration, dependence of time period on M.O.I. and restoring torque.
(ii) Modulus of rigidity.

Activity :

Measure time period of oscillation of a Maxwell needle and determine modulus of rigidity of the material of a given wire.

VI. Damped Oscillator :

Objectives :

(i) Study damped oscillations.
(ii) Coefficient of damping, quality factor etc.

Activities :

To measure/obtain logarithmic decrement, coefficient of damping, relaxation time, and quality factor of a damped simple pendulum.

VII. Elasticity :

Objective :

Knowledge of elastic constants and related quantities.

Activities :

(i) Study of bending of beams and determination of Young's Modulus.
(ii) Determination of Poisson's ratio for rubber/plastic.

VIII. Standing waves :

Objective :

Standing waves on a string and in air.

Activities :

(i) Melde's experiment.
(ii) Kundt's tube.

IX. Viscosity :

Objective :

Knowledge of viscosity of liquids.

Activity :

Determination of coefficient of viscosity of a given liquid by Stoke's method and study its temperature dependence.

Computer based activities : Elementary C language programs, flowcharts and their interpretation.

1. To print out all natural even/odd numbers from a given series of natural numbers.
2. Numerical solution of equations of motion.
3. To calculate first ten prime numbers.

UNIT-II

ELECTRICITY AND MAGNETISM

I. Objective :

Measurement of resistance, voltage, current and electric energy.

Activities :

(i) To use a multimeter for measuring AC and DC voltage and resistance.
(ii) Measurement of resistance of LDR - To study inverse-square law (concept of solid angle and inverse square law) using linear LDR and light source.
(iii) Observations and measurements using an Electric energy meter. To find wattage of given bulb or heater.
(iv) To study the efficiency of an electric kettle or heater element with varying input voltage.

II. Low Resistance Measurements :

Objectives :

(i) Inadequacy of Wheatstone bridge to measure low resistances.
(ii) Acquaintance with a method of measuring low resistances.

Activity :

To determine low resistance with Carey Fosters Bridge.

III. Magnetic Field :

Objectives :

(i) Familiarity with the magnetic field produced by a solenoid.
(ii) Dependence of solenoidal field on number of turns and current.
(iii) Permeability of air.

Activities :

To study the magnetic field produced by a current carrying solenoid using a search coil and calculate permeability of air.

IV. Electromagnetic Induction :

Objective :

Verification of laws of electromagnetic induction.

Activity :

To study the induced e.m.f. as function of the velocity of the magnet.

V. Magnetism and current :
Objectives and Activities :

Force on a conductor carrying current in a magnetic field.

VI. LCR Circuits :

Objective :

Study of phase relationship between currents and voltages in ac circuits.

Activity :

Study of phase relationships using impedance triangle for LCR circuit and calculate impedance.

VII. Resonant Circuits :

Objective :

Concepts of resonance and Q-value.

Activities :

(i) Resonance in a series LCR circuits for different R-value and calculate Q-value.
(ii) Resonance in a parallel LCR circuits for different R-value and calculate Q-value.
(iii) To determine the dielectric constant of a solid by resonance method.

VIII. Capacitance :

Objectives :

(i) Measurement of capacitance, dielectric constant.
(ii) Concept of time constant and time base circuit.
(iii) Knowledge of a-c Bridges.

Activities :

(i) Capacitance by flashing and quenching of a neon lamp.
(ii) Measurement of capacitance, determination of permittivity of a medium, air and relative permittivity by De-Sauty's bridge.

IX. Self Inductance :

Objectives :

(i) Knowledge of a-c bridges.
(ii) Concept of self-inductance.

Activities :

(i) To determine L using Anderson Bridge.

Computer based activities: Elementary C language programs, flowchart and their interpretation.

1. To rearrange a list of numbers in ascending and descending orders.
2. To compile a frequency distribution and evaluate moments such as mean; standard deviation etc.
3. To evaluate sum of finite series and the area under a curve.

Texts and Reference Books :

1. *"B.Sc. Practical Physics by C.L. Arora, S.Chand & Co. (2014).*
2. *"A Laboratory Manual of Physics for Undergraduate Classes"* by D.P. Khandelwal.
3. *"Programming with C, Schaum series"* by Byron Gottfried & Jitender Chhabra

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