# Syllabus for B.Sc.-I (PHYSICS) w.e.f. June-2022

## B. Sc. Part-I Semester-I

## BPT22-101: Mechanics (Credits: 02)

**Learning Objectives: Students will be able to:**

1. Learn vectors, vector derivatives, scalars and ordinary & partial differential equations.
2. Understand Newton's laws of motions
3. Understand conservation of energy, Centre of mass, motion of rockets and examples.
4. Understand concept of rotational motion and M. I. of various bodies

**Unit I: Vectors Algebra and Elementary Calculus** (9)

Vector algebra, Scalar and vector products, Derivatives of a vector with respect to parameters(velocity and acceleration definition only)

**Unit II: Ordinary Differential Equations**

Differential equations; degree, order, linearity and homogeneity of differential equation, ordinary and partial differential equations, $1^{st}$ order homogeneous differential equations, $2^{nd}$ order homogeneous differential equation with constant coefficients, problems.

**Unit III: Dynamics of a system of particles**: (9)

Frames of reference, Newton's Laws of motion, Conservation of linear and angular momentum, work and energy theorem, conservation of energy (Single Particle), Dynamics of a system of particles (linear momentum, angular momentum and energy), Centre of mass, Motion of rocket (qualitative treatments only), problems.

**Unit IV: Rotational Motion:** (9)

Angular velocity, angular momentum and Torque, Kinetic energy of rotation and moment of Inertia, Moment of Inertia of spherical shell; solid cylinder (only about the axis of symmetry), Motion of spherical shell and solid cylinder rolling down an inclined plane, Green Symmetrical theorem problems.

**REFERENCE BOOKS**:


1. Walker, Halliday and Resnick *Principles of Physics* (Hoboken, New Jersey : John Wiley & Sons,Inc., 2017 ),(Units I: pp 34, II: pp. 80 - 105, III: pp. 34 -51 to IV: pp. 265 - 275).
2. Charles Kittel et al.,*Mechanics,*(New York: Berkeley Physics Course, Vol. 1, Tata McGrawHill Publications,2007),(Unit III: pp. 54 - 164).
3. K.F..Riley, M.P. Hobson , S. J.Bence ,*Mathematical Methods for Physics*,(Cambridge:Cambridge University Press,2006), (Unit I: pp. 212 -240, pp. 468 - 553).

**Learning Outcomes:**

**Unit – I**: **After completion of the unit**, **Student is able to:**

1. Define scalar, vector and their products
2. Understand derivative of a vector with respective to parameters.

**Unit – II**: **After completion of the unit**, **Student is able to:**

1. Define order, degree of differential equation
2. Define differential equation and able to distinguish ordinary and Partial differentialequation. Define and understand $1^{st}$ and $2^{nd}$ order homogenous differential equation.

**Unit – III**: **After completion of the unit**, **student is able to:**

1. Understand inertial and non-inertial frame of reference.
2. Understand physical significance of Newton's laws of motion.
3. Define linear momentum, angular momentum, work and energy.
4. Understand work energy theorem and conservation of energy.
5. Understand motion of particle and system of particles.
6. Define center of mass and center of gravity.
7. Understand concept of motion of rocket.

**Unit – IV**: **After completion of the unit**, **Student is able to:**

1. Define angular velocity, torque, inertia and moment of inertia.
2. Understand the distinction between inertia and moment of inertia.
3. Calculate the moment of inertia of a given body about axis of rotation.
4. Understand the rolling motion of spherical shell and solid cylinder.

## B. Sc. Part-I Semester-I

## BPT22-102: Electrostatics (Credits: 2)

**Learning Objectives: Students will able to:**

1. Study gradient, divergence, curl and their physical significance.
2. Study integrals of vector fields and corresponding various theorems.
3. Study electrostatic field, electrostatic theorem.
4. Study dielectric medium and three electric vectors.

**Unit I: Vector Analysis I** (9)

Concept of scalar and vector fields: Del operator, Gradients, divergence, curl and theirphysical significance, problems.

**Unit II: Vector Analysis II** (9)

Vector Integration: Line, surface and volume integrals of vector fields, Gauss-divergence theorem, Stoke's theorem and Green's theorem, problems.

**Unit III: Electrostatics** (9)

Electrostatic field, electric flux, polar and non-polar molecules, Gauss's theorem of electrostatics, Electric potential as line Integral of electric field, Potential due to point charge, Concept of electric dipole, physical examples (polar molecules), uniformly charged Spherical shell and solid sphere. Calculation of electric field from potential, energy density in electrostatic field,problems.

**Unit IV: Dielectrics** (9)

Dielectric medium, Polarization, displacement vector, Gauss's theorem in dielectrics, parallel plate capacitor completely filled with dielectrics. Relation between three electric vectors $\vec{E}$, $\vec{D}$ and $\vec{P}$.

**Reference Books:**


1. D. C. Tayal, Electricity and Magnetism (New Delhi: Himalaya Publishing House, 1988), 29 -216.
2. B. B. Laud, Electromagnetics (New Delhi: New Age International Publishers, 1987), 1-62.
3. J. Yarwood & J. H. Fewkes, Electricity & Magnetism (Oxford: Oxford University Press, 1991),214 - 304.
4. David J. Griffith, Introduction to Electrodynamics (New Jersey: Prentice Hall Publisher, 1998),1- 560.
5. B. D. Gupta, Mathematical Physics (Mumbai: Vikas Publication House, 2009), 1-179.

**Learning Outcomes:**

**Unit I**: **After completion of the unit**, **Student is able to:**

1. Define dell operator, gradient, divergence and curl.
2. Understand significance of gradient, divergence and curl.

**Unit II**: **After completion of the unit**, **Student is able to:**

1. Understand line, surface and volume integrals.
2. Understand Gauss' divergence, Stoke's and Green's theorems.

**Unit III**: **After completion of the unit**, **Student is able to:**

1. Understand basic concept of electrostatic field, electric flux and electric dipole.
2. Understand concept of electric dipole and its examples.
3. Understand energy per unit volume in electrostatic field.

**Unit IV**: **After completion of the unit**, **Student is able to:**

1. Define dielectric medium, polarization and displacement vector.
2. Understand relation between three electric vectors.

## B. Sc. Part-I Semester-II

## BPT22-201: Gravitation and Properties of Matter (Credits: 2)

**Learning Objectives:** Students will be able to:

1. Understand motion of particle in central force field, Kepler's laws and basic idea of GPS system. Learn tubes of flow and variation of viscosity of liquid with temperature and pressure.
2. Study bending of beam and determination of Y, n and σ by Searle's method.
3. Understand angle of contact and wettability of the liquid. Experimental determination of surface tension and examples.

**Unit I: Gravitation** (9)

Newton's Law of Gravitation, Motion of particle in central force field (motion in a plane, angular momentum is conserved, areal velocity is constant), Kepler's laws (statements only), Satellite in circular orbit and its applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS), problems.

**Unit II: Viscosity** (9)

Introduction, rate of flow of liquid in a capillary tube, tubes of flow (streamline and turbulent), Poiseuille's formula (derivation) and determination of coefficient of viscosity of liquid by Poiseuille's method, variation of viscosity of liquid with temperature and pressure, problems.

**Unit III: Elasticity** (9)

Bending of beam, Bending moment, Cantilever (without considering weight of cantilever), Beam supported at both ends (without considering weight of beam), Tensional pendulum, Work done in twisting a wire, Twisting couple on a cylinder, Determination of modulus of rigidity, Determination of Y, n and σ by Searle's method, problems.

**Unit IV: Surface Tension** (9)

Surface tension (definition), Angle of contact and wettability, Relation between surface tension, excess pressure and radius of curvature, Experimental determination of surface tension by Jaeger's method, Applications of surface tension, problems.

**Reference Books:**

1. S. G. Sterling and A. J. Woodal, Physics (Longman's & Green Co. Ltd., 1958), Unit I: pp 47 to 66, II: P 85 to 104, III: P 67 to 84, IV: 104 to 121

2. Robert Resnick, Jearl Walker, David Halliday, Principles of Physics, (Wiley Eastern Ltd. 2017), Unit I: P 308 to 331

3. D. S. Mathur, Elements of Properties of Matter, (S Chand & Company, 2010), Unit I: 230 to 283, II: 428 to 464, III: 284 to 360, IV: 486 to 542

4. Brij Lal and N. Subrahmanyam, Properties of Matter, (Eurasia Publishing House Limited, 1993), Unit I: P 122 to 170, II: P224 to 270, III: P 173 to 218, IV: P 273 to 313

**Learning Outcomes:**

**Unit I**: **After completion of the unit**, **Student is able to:**

1. Understand motion of particle in central force field.
2. Understand concept of satellite in circular orbit, geosynchronous orbits.
3. Study GPS.

**Unit II**: **After completion of the unit**, **Student is able to:**

1. Understand streamline and turbulent flow.
2. Understand Poiseuillie's formula and its application to calculate coefficient of viscosity.

**Unit III**: **After completion of the unit**, **Student is able to:**

1. Understand concept of cantilever and torsional oscillations.
2. understand concept of torsional pendulum to determine rigidity modulus and moment ofinertia
3. determine Y, n & $\sigma$

**Unit IV**: **After completion of the unit**, **Student is able to:**

1. Understand the concept of wettability.
2. Determine surface tension by Jaeger's method.
3. Understand applications of surface tension.

## B. Sc. Part-I Semester-II

## BPT22-202: Electricity & Magnetism (Credits: 2)

**Learning Objectives:** Students will be able to:

1. Study LCR series circuit and AC bridge.
2. Study magnetostatics and magnetic properties of materials.
3. Learn electromagnetic induction laws.
4. Study Maxwell's equations and electromagnetic wave propagation.

**Unit I: AC Circuits** (9)

Complex numbers and their application in solving AC series LCR circuit, Complex impedance, Reactance, Admittance and Susceptance, Resonance in LCR series circuit, Sharpness of resonance, (qualitative treatment only ), Q-factor ( definition only ), AC Bridge-Owen's Bridge, problems.

**Unit II: Magnetism** (9)

Magnetostatics : Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Ampere's circuital law, properties of magnetic materials – Magnetic intensity, magnetic induction, permeability, susceptibility, brief introduction of dia, para, and ferro magnetic materials, problems.

**Unit III: Electromagnetic Induction: (9)**

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual induction,Ballistic Galvanometer, construction and working (Revision), expression for charge flowing throughballistic galvanometer, correction for damping in galvanometer, Constants of ballistic galvanometer.

**Unit IV: Maxwell's equations and Electromagnetic Wave propagation** (9)

Equation of continuity of current, displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation, through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

**Reference Books:**


1. D. C. Tayal, *Electricity and Magnetism* (New Delhi: Himalaya Publishing House, 1988),293- 601.
2. B. B. Laud, *Electromagnetics* (New Delhi: New Age International Publishers, 1987), 110-165.
3. David J. Griffith, *Introduction to Electrodynamics* (New Jersey: Prentice Hall Publisher, 1998),202-331.
4. S. G. Starling and A. J. Woodall, *Physics* (London :The English Language Book SocietyPublication,1963), 1073 – 1089.
5. J. Yarwood & J. H. Fewkes, *Electricity & Magnetism* (Oxford: Oxford University Press, 1991),152 -196.
6. N. Subramanyam, Brij Lal , *Textbook of Electricity and Magnetism,* (Agra: Ratan Prakashan,1966).
7. Matthew N.O. Sadiku, *Elements of Electromagnetics* (London : Oxford University Press, 2007).

**Learning Outcomes:**

**Unit I**: **After completion of the unit**, Student **is able to**

1. Understand applications of complex numbers in solving AC series circuit.
2. Define complex impedance, reactance, admittance and susceptance.
3. Understand concept of Wein's bridge.

**Unit II**: **After completion of the unit**, **Student is able to**

1. Learn applications of Biot-Sawart Law in straight conductor, circular coil & solenoid.
2. Understand concept of divergence & curl of magnetic field.
3. Study dia, para and ferro magnetic materials.

**Unit III**: **After completion of the unit**, **Student is able to**

1. Understand concept of self and mutual inductance
2. Study the theory of ballistic galvanometer with different constants .
3. To study energy stored in magnetic field.

**Unit IV**: **After completion of the unit**, **Student is able to**

1. Understand concept of conservation of charge.
2. Learn divergence and curl of electric & magnetic fields in Maxwell's equations.
3. Study the EM wave propagation through vacuum & isotropic dielectric medium.

## Physics Practical II: BPP22-203: (Credits: 4)

## Group I-Mechanics and Electrostatics

**Course Objectives: Students should**

1. Learn measuring skills in practical.
2. Determine M. I. and acceleration due to gravity.
3. Understand the measurement of electrical quantities by using multimeter.
4. Determine high resistance, capacitances and impedance.

**Experiments:**

1. Measurements of length (or diameter) using Vernier caliper, Screw gauge and Travelling Microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine Moment of inertia of a disc using auxiliary annular ring.
4. To determine 'g' by bar pendulum.
5. To determine 'g' by Kater's pendulum.
6. To study the motion of a spring and calculate (a) spring constant (b) value of 'g'.
7. To use a multimeter for measuring (a) Resistance, (b) AC and DC voltages, (c) DC current,and (d) checking electrical fuses.
8. To determine Constants of B.G.
9. To compare capacitances using De Sauty's bridge.
10. Impedance of series LCR circuit.

**REFERENCE BOOKS:**


**1.** Worsnop, B. L., and H. T. Flint., *Advanced practical physics for students* ,(London : Methuen &Co., Ltd,1962)

**2.** Gupta, S. L., and V. Kumar., *Practical physics*.( Meerut:Pragati Prakashan,27th Edition.1973)

**3.** Chattopadhyay, D., and P. C. Rakshit.. *An advanced course in practical physics*.(Calcutta:New Central Book,2007)

**4.** White, Marsh W., and Kenneth V. Manning, *Experimental college physics; a laboratory manual*,(New York:McGraw-Hill Publication,1954)


**Course Outcomes: After completion of the unit**, **Students will be able to:**

2. Learn measuring skills in practical.
3. Understand theoretical concepts by performing experiments.
4. Develop awareness of minimizing errors.
5. Handle various instruments

## Group II: Properties of Matter and Electricity and Magnetism

**Course Objectives:** Students should

1. Develop practical skills.
2. Determine Young's modulus, modulus of rigidity and Poisson's ratio.
3. Determine viscosity and surface tension of the liquid.
4. Study series and parallel LCR circuits.
5. Determine frequency of AC mains and magnetic field of solenoid.

**Experiments:**

1. Young's modulus of material of bar by vibration.
2. Modulus of rigidity of material of wire by torsional oscillations.
3. Y and n of wire by Searle's method.
4. Poisson's ratio for rubber using rubber tube.
5. Coefficient of viscosity Poiseiulle's Method.
6. Surface Tension by Jaegar's method.
7. To study a series LCR circuit and determine its (a) resonant frequency (b) quality factor Q.
8. To study a parallel LCR circuit and determine its (a) anti-resonant frequency (b) qualityfactor Q.
9. Frequency of AC mains by sonometer.
10. Measurement of field strength B and its variation in a solenoid ($\frac{dB}{dx}$).

**REFERENCE BOOKS:**


1. Worsnop, B. L., and H. T. Flint, 1969, *Advanced practical physics for students*, (London :Methuen & Co., Ltd,1962)
2. Gupta, S. L., and V. Kumar, 1973, *Practical physics*.(Meerut:PragatiPrakashan,27th Edition.1973)
3. Chattopadhyay, D., and P. C. Rakshit.. *An advanced course in practical physics*.(Calcutta:New Central Book,2007)
4. White, Marsh W., and Kenneth Verne MANNING, *Experimental College Physics ,Third edition* (New York:McGraw-Hill Book Co.,1954)


**Course Outcomes:**

**After completion of the unit, Students are able to:**

1. Handle electrical instruments
2. Understand measuring skills in electrical instruments.
3. Understand theoretical concepts by performing experiments.
4. Develop awareness of minimizing errors.

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