Shiksha Mandal's

Bajaj College of Science, Wardha (Autonomous)
Syllabus for B. Sc. I (SEM-I) w.e.f. 2023-24
PHYSICS DSC I: MECHANICS

(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Course Description:

PHYSICS DSC 1: MECHANICS is designed for students of undergraduate course. This course will be of 60 hours theory and 60 hours practical. 4 credits are allotted to the theory course whereas 2 credits are allotted for practical.

Course Objective:

Basics of Astronomy course will facilitate undergraduate students:

- To know vectors and scalars and their fundamentals.
- To study Newtonian motions.
- To study conservation of momentum and energy.
- To study rotational motion
- To study gravitational Force.
- To study Simple harmonic motions.
- To study free, damped and forces Oscillations.
- To study elasticity and its applications.
- To calculate elastic modulus.
- To calculate g, spring constant and frequency

Course Learning Outcome:

Upon completion of course student will be able to:

- CO1: Identify vectors and scalars.
- CO2: Relate Newtonian motions with day-to-day physics.
- CO3: Understand conservation of momentum and energy in daily life.
- CO4: Define and employ rotational motion.
- CO5: Recognize Simple harmonic motions.
- CO6: Memorize elasticity and its applications.
- CO7: Perform accurate measurement using vernier calliper and screw gauge.
- CO8: Use various methods to calculate elastic modulus.
- CO9: Compute g, spring constant and frequency
- CO10: Solve problems related with viscosity and surface tension.

Course Contents (Theory)

Unit I

Laws of Motion: Vector algebra. Scalar and vector products, Velocity and Acceleration, Inertia, Contact Forces, Friction, Newton's laws of motion, impulse, Coriolis forces, its consequences and applications, Motion in a plane, Dynamics of a system of particles, Centre of Mass and its applications. **(10 Lectures)**

Unit II

Momentum and Energy: Conservation of momentum, Work and energy, Conservation of energy. Elastic and inelastic collision, Angular velocity and angular momentum. Torque. Conservation of angular momentum, single stage and multistage rockets. **(10 Lectures)**

Unit III

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **(10 Lectures)**

Unit IV

Oscillations: Introduction to linear and angular S.H.M., Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Composition of two perpendicular linear SHMs for 1:1 and 1:2 (without mathematical derivation), Lissajous's figure, Formation of Lissajous's figure using CRO, applications of Lissajous's figure, Free Damped and Forced oscillation. **(10 Lectures)**

Unit V

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional Pendulum-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method. Bending of beam, Bending moment, Internal and external bending moment, Cantilever, Maxwell's needle. **(10 Lectures)**

Unit VI

Fluids: Introduction, Streamline and turbulent flow, Equation of continuity, Bernoulli's theorem and its applications, Poiseuille's Law, Reynold's number, Terminal, Velocity, Stoke's law, Variation of viscosity with temperature, Introduction of Surface Tension, Angle of contact and wetting, Surface energy, Surface tension by Quincke's and Capillary rise methods, Modern applications of Viscosity and Surface Tension: Hydrophobic surfaces, Fluid Merging Viscosity Measurement. **(10 Lectures)**

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
- Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Concepts of Physics: H.C. Verma, Bharati Bhavan Publishers.
- Mechanics: D.S. Mathur, S. Chand and Company.
- Physics for Degree Students, C.L. Arora, P.S. Hemne, S Chand Publication.
- Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
- Mechanics, by-B. M. Roy, Das Ganu Publications.
- Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VIth Edition. Pearson Education /Prentice Hall International, New Delhi.
- Waves and Oscillations, by Stephenson.
- A Text Book of Oscillations, waves and Acoustics, by Dr. M. Ghosh, Dr. D. Bhattacharya.
- Oscillation, waves and sound, by Sharma and Saxena.

PHYSICS DSC 1 LAB: MECHANICS
60 Lectures

1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2. To determine the Modulus of rigidity (η) of a Wire by Maxwell's needle.
3. To calculate moment of inertia of ring using torsional pendulum.
4. To determine the Modulus of rigidity (η) by statical method.
5. To determine the Modulus of rigidity (η) by tortional pendulum
6. To calculate the acceleration due to gravity by Simple pendulum.
7. To calculate the acceleration due to gravity by compound pendulum.
8. To study the Lissajous's figure.
9. To determine the Young's Modulus (Y) by bending of beam.
10. To determine the Young's Modulus (Y) by cantilever.
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.
12. To determine the surface tension (T) of the liquid by Fergusson method.
13. To determine the surface tension (T) by capillary rise method.
14. To determine the coefficient of viscosity (η) by using Poiseuille's method.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
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10. To determine the Young's Modulus (Y) by cantilever.
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Syllabus for B. Sc. I (SEM-II) w.e.f. 2023-24

PHYSICS DSC-II: ELECTRICITY AND MAGNETISM

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Course Description:

This course can be taken by undergraduate students as a major course to understand the basic concepts of electricity and magnetism The course covers vector calculus, electrostatics, magnetostatics, electromagnetic induction and an introduction to Maxwell's equations (including wave solutions) as well as electric and magnetic fields in matter.

Learning Objectives:

This course aims to introduce students to the fundamental mathematical concepts related to vector calculus and their applications in the field of electrostatics. Through this course, students will gain an understanding of the concepts of magnetostatics and magnetic properties, as well as the principles of electromagnetic induction. Additionally, students will learn about the generation of electromagnetic waves and the principles of electrodynamics. By the end of this course, students will have a solid foundation in these key concepts and be well-equipped to apply them for solving problems.

Course Learning Outcomes (COs):

Upon completion students will be able to:

CO1: Understand the basic mathematical concepts related to electromagnetic vector fields.

CO2: Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.

CO3: Apply the principles of magnetostatics to the solutions of problems relating to Magnetic field density.

CO4: Understand the difference between magnetic materials from magnetic properties.

CO5: Understand the concepts related to Faraday‘s law and induction concepts for its applications in transformer to seek employment.

CO6: Apply Maxwell‘s equations to solutions of problems relating to wave propagation.

Course Contents (Theory)

Unit I

Vector Calculus: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.

(10 Lectures)

Unit II

Electrostatics I: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

(10 Lectures)

Unit III

Electrostatics II: Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor filled with dielectric.

(10 Lectures)

Unit IV

Magnetic properties and Magnetostatics:

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. Lorentz force, Force on a current carrying conductor in a magnetic field. Biot-Savart's law & its applications- straight conductor, circular coil. Ampere's circuital law and its applications- straight conductor, solenoid and toroid carrying current.

(10 Lectures)

Unit V

Electromagnetic Induction

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual induction, Measurement of self and mutual inductance. Energy stored in magnetic field. Transformer (types, theory, characteristics, applications, losses)

(10 Lectures)

Unit VI

Electrodynamics:

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.

(10 Lectures)

Reference Books:

- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn.1998, Benjamin Cummings.
- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.

PHYSICS DSC- II LAB: ELECTRICITY AND MAGNETISM (Credits 02)

1. To study the magnetic field on the axis of current carrying circular coil.
2. To calculate the magnetic field on the axis of solenoid.
3. To calculate the magnetic susceptibility of paramagnetic materials.
4. To study the variation of magnetic field of a magnet as a function of distance.
5. To calculate the dielectric constant.
6. To calculate the self-inductance of the coil.
7. To study the characteristics of transformer.
8. To calculate the capacitance of the capacitor.
9. To study the various relationships of capacitance of capacitor using pHET simulations.
10. To calculate the magnetic moment of a bar magnet using vibration magnetometer.

Activities:

1. To use multimeter and CRO for measuring (a) Resistances, (b) ac and dc voltages, (c) dc current.
2. Fabrication of inductor and measurement of its inductance.

(60 Lectures)

Reference Books

- Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
- A textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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PHYSICS MINOR 2: ELECTRICITY AND MAGNETISM

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Course Description:

This course can be taken by undergraduate students as a major course to understand the basic concepts of electricity and magnetism The course covers vector calculus, electrostatics, magnetostatics, electromagnetic induction and an introduction to Maxwell's equations (including wave solutions) as well as electric and magnetic fields in matter.

Learning Objectives:

This course aims to introduce students to the fundamental mathematical concepts related to vector calculus and their applications in the field of electrostatics. Through this course, students will gain an understanding of the concepts of magnetostatics and magnetic properties, as well as the principles of electromagnetic induction. Additionally, students will learn about the generation of electromagnetic waves and the principles of electrodynamics. By the end of this course, students will have a solid foundation in these key concepts and be well-equipped to apply them for solving problems.

Course Learning Outcomes (COs):

Upon completion students will be able to:

CO1: Understand the basic mathematical concepts related to electromagnetic vector fields.

CO2: Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.

CO3: Apply the principles of magnetostatics to the solutions of problems relating to Magnetic field density.

CO4: Understand the difference between magnetic materials from magnetic properties.

CO5: Understand the concepts related to Faraday‘s law and induction concepts for its applications in transformer to seek employment.

CO6: Apply Maxwell‘s equations to solutions of problems relating to wave propagation.

Course Contents (Theory)

Unit I

Vector Calculus: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.

(10 Lectures)

Unit II

Electrostatics I: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

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Unit III

Electrostatics II: Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor filled with dielectric.

(10 Lectures)

Unit IV

Magnetic properties and Magnetostatics:

Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials. Lorentz force, Force on a current carrying conductor in a magnetic field. Biot-Savart's law & its applications- straight conductor, circular coil. Ampere's circuital law and its applications- straight conductor, solenoid and toroid carrying current.

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Unit V

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Faraday's laws of electromagnetic induction, Lenz's law, self and mutual induction, Measurement of self and mutual inductance. Energy stored in magnetic field. Transformer (types, theory, characteristics, applications, losses)

(10 Lectures)

Unit VI

Electrodynamics:

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.

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PHYSICS MINOR 2 LAB: ELECTRICITY AND MAGNETISM (60 Lectures)

1. To study the magnetic field on the axis of current carrying circular coil.
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4. To study the variation of magnetic field of a magnet as a function of distance.
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9. To study the various relationships of capacitance of capacitor using pHET simulations.
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2. Fabrication of inductor and measurement of its inductance.

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