B.Sc. (Multidisciplinary) Physics as one Subject Semester – I

Discipline-Specific Course-1 (DSC-1): Mechanics and Theory of Relativity (Theory)

Note:*Examiner will set nine questions and the candidates will be required to attempt five questions in all. Question number one will be compulsory containing four short answer type questions covering the entire syllabus. Further, examiner will set two questions from each unit and the candidates will be required to attempt one question from each Unit. All questions will carry equal marks.20% numerical problems are to be set.*

Unit–I

Basics of Mechanics: Mechanics of single and system of particles, Conservation law of linear momentum, Angular momentum and mechanical energy for a particle and a system of particles, Centre of Mass and equation of motion, Constrained Motion. Work and Kinetic Energy Theorem. Conservative and nonconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Unit–II

Generalized Notations: Degrees of freedom and Generalized coordinates, Transformation equations, Generalized Displacement, Velocity, Acceleration, Momentum, Force and Potential, Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. Hamilton's variational principle, Lagrange's equation of motion from Hamilton's principle, Linear Harmonic oscillator, Simple pendulum, Atwood's machine.

Unit–III

Rotational Dynamics: Rotation of Rigid body, moment of inertia, torque, angular momentum, kinetic energy of rotation. Theorems of perpendicular and parallel axes with proof. Moment of inertia of solid sphere, hollow sphere, spherical shell, solid cylinder, hollow cylinder and solid bar of rectangular cross-section. Acceleration of a body rolling down on an inclined plane. Kinetic energy of rotation. Motion involving both translation and rotation.

Unit–IV

Special Theory of Relativity: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector.

Reference/Text Books Suggested:

1. Classical Mechanics by H. Goldstien (2nd Edition).
2. Berkely Physics Course. Vol. 1. Mechanics by E.M. Purcell
3. Concepts of Modern Physics by Arthur Beiser
4. Mechanics by D.S. Mathur
5. University Physics. FW Sears, MW Zeman sky & HD Young 13/e, 1986.Addison-Wesley
6. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
7. Feynman Lectures, Vol. I, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education
8. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

9. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

B.Sc. (Multidisciplinary) Physics as one Subject Semester – I
Discipline-Specific Course-1 (DSC-1): Mechanics (Practical)

List of Experiments:

1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. Moment of Inertia of irregular body using a Torsion Pendulum.
7. Young's Modulus by Bending of Beam.
8. To determine **g** and velocity for a freely falling body using Digital Timing Technique
9. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
12. To determine the elastic Constants of a wire by Searle's method.
13. To determine the value of g using Bar Pendulum.
14. To compare Moment of Inertia of a solid Sphere, Hollow Sphere and solid Disc of same mass with the help of Torsion Pendulum.
15. To determine the bending moment of a cantilever beam with uniformly distributed load, uniformly varying load and point load.

Note: A student has to perform **atleast eight (08)** experiments from the above list.

B.Sc. (Multidisciplinary) Physics as one Subject Semester – II
Discipline-Specific Course-2 (DSC-2): Electricity and Magnetism (Theory)

Note: *Examiner will set 09 questions and the candidates will be required to attempt 05 questions in all. Question number 01 will be compulsory containing 05 short answer type questions covering the entire syllabus. Further, examiner will set 02 questions from each section and the candidates will be required to attempt one question from each section. All questions will carry equal marks.*

Unit–I

Electric Field and Electric Potential:

Scalars and Vectors, dot and cross product, Triple vector product, Scalar and Vector fields, Differentiation of a vector, Gradient of a scalar and its physical significance, Integration of a vector (line, surface and volume integral and their physical significance), Gauss's divergence theorem and Stocks theorem. Derivation of field E from potential as gradient, derivation of Laplace and Poisson equations.

Electric flux, Gauss's Law and its application to spherical shell, uniformly charged infinite plane and uniformity charged straight wire, mechanical force of charged surface, Energy per unit volume.

Unit–II

Magnetic Field: Biot-Savart's Law and its simple applications. Ampere's Circuital Law and its application. Properties of **B**: curl and divergence.Vector Potential.

Magnetic Properties of Matter: Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Electronic theory of dia and Para-magnetism, Domain theory of ferromagnetism (Langvein's theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve.

Unit–III

Electromagnetic induction: Faraday's laws of induction and Lenz's Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Maxwell equation and their derivations, Displacement Current. Vector and scalar potentials, boundary conditions at interface between two different media, Propagation of electromagnetic wave (Basic idea, no derivation). Poynting vector and Poynting theorem.

Unit–IV

DC current Circuits: Electric current and current density, Electrical conductivity and Ohm's law (Review), Applications to dc circuits. Growth and decay of current in a circuit with (a) Capacitance and resistance (b) resistance and inductance (c) Capacitance and inductance (d) Capacitance resistance and inductance.**Alternating Current Circuits:** A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit.

B.Sc. (Multidisciplinary) Physics as one Subject Semester – II

Discipline-Specific Course-2 (DSC-2): Electricity and Magnetism (Practical)

List of Experiments

1.Use of Multi-meter for measuring Resistance, A.C. and D.C. Voltage and Current, checking of electrical fuses.

2. To determine an unknown Low Resistance using Potentiometer.

3. To determine an unknown Low Resistance using Carey Foster's Bridge with calibration.

4. Determination of Impedance of an A.C. circuit and its verification.

5. To determine Frequency of A.C. mains using an electromagnet.

6. To determine Frequency of A.C. mains Electrical vibrator.

7. To determine High resistance by substitution method.

8. To compare capacitances using De'Sauty bridge.

9. To verify the Thevenin and Norton theorems.

10. To verify the Superposition, and Maximum power transfer theorems.

11. To study a series LCR circuit and determine its (a) Resonant frequency, (b) Quality factor.

12. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor.

Note: A student has to perform **atleast eight (08)** experiments from the above list.