



## **School of Physics**

**Name of the Academic Program ... I.M.Sc.**

**Course Code: PY111B Title of the Course: Mechanics**

**Number of classes: 42, Lectures: 32, Tutorials: 10, Credits: 3**

**Prerequisite Course / Knowledge (If any): Knowledge of general physics, algebra and calculus**

### **Course Learning Outcomes (CLOs) (5 to 8)**

After completion of this course successfully, the students will be able to:

CLO-1: Apply the concept of an inertial frame to solve physical problems. Apply Newton's laws of motion to physical systems using calculus.

CLO-2: Set up equations and solve simple harmonic oscillator with and without damping.

CLO-3: Apply conservation laws of energy, momentum and angular momentum to solve physical problems.

CLO-4: Apply polar coordinates to analyse problems such as planetary motion.

CLO-5: Apply the concepts of angular velocity vector, angular momentum and moment of inertia tensors to solve the rigid body dynamics

CLO-6: Analyse and Apply concepts of non-inertial frames.

## **Syllabus:**

Unit-1: Review of Vector Algebra, Vector calculus; Coordinate systems.

Unit 2: Newton's laws and Inertial frames; Transformation of a vector under rotation of coordinate axes, Orthogonal transformations, Transformation matrix.

Unit 3: Motion under constant, time-dependent, position-dependent, and velocity-dependent forces; Projectile motion.

Unit 4: Application of Newton's laws: Pulleys, Inclined planes, Friction, Circular motion, Motion in gravitational field, Satellites and Planets

Unit 5: Symmetries and Conservation laws, Work and examples of computation of work, Work - Energy theorem, Conservative and Non-conservative forces, Definition of potential energy, Conservation of energy; Simple harmonic motion; Simple and double pendulum, Compound pendulum; Law of gravitation, Gravitational potential energy, Calculation of gravitational potential energy of systems with different geometries.

Unit 6: Centre of mass, Motion of centre of mass, Conservation of linear momentum, Collisions in one dimension

Unit 7: Momentum, Kinetic energy, Angular Momentum, Special case of a two-particle system, Torque and EOM. Conservation of Angular Momentum, Kepler's Laws of Planetary Motion, Satellites

Unit 8: Kinetic energy and Angular momentum of a system of particles, Degrees of freedom of a rigid body, Kinetic energy and angular momentum of a rigid body, Moment of inertia tensor, Combined rotational and translational motion, Euler's equations; Examples.

Unit 9: Motion in non-inertial frames, Centrifugal force and Coriolis force, Applications, Sideways deviation of a freely falling body, Cyclonic wind.

## **Books Recommended:**

1. Mechanics (Berkeley Physics Course V1), Charles Kittel, Walter Knight, Malvin Ruderman (main Text)
2. University Physics, Sears and Zemansky, Addison Wesley series
3. Analytical Mechanics, Grant R. Fowles.
4. An introduction to Mechanics, D. Kleppner and R. J. Kolenkow (Mc Graw Hill)
5. Introductory Classical Mechanics, David Morin
6. Classical Mechanics, Arya