PHYSICS

# Classical Mechanics: from Newtonian to Lagrangian Formulation

**Type of Course** : New
**Intended Audience** : Elective / UG of all degrees
**Course Duration** : 30 Hours / 12 weeks

**COURSE OUTLINE:**

This course deals with fundamentals of classical mechanics. Mechanics is one of the core subjects for physics and engineering disciplines. This course starts from basics of Newtonian mechanics. Then we introduce rigid dynamics and finally Lagrangian formulation of dynamics followed by small oscillations. We also offer tutorials to develop problem solving skills. We aim to give a basic understanding of various fields of classical mechanics to our students.

**INSTRUCTOR:**

Prof. Debalmalya Banerjee
Department of Physics
IIT Kharagpur

**ABOUT INSTRUCTOR:**

Prof. Debalmalya Banerjee is an Assistant Professor at department of physics, IIT Kharagpur. I am taking classical mechanics for 2nd year UG students of the department for past 3 years.

**COURSE PLAN:**

Week 1 : Review of basic Newtonian mechanics, kinematics problems, Motion under resistance
Week 2 : Central forces:
Week 3 : Effective potential of central force, Escape velocity
Week 4 : Moving co-ordinate system: pseudo forces, Coriolis and centrifugal force
Week 5 : Dynamics in center of mass frame, introduction to rigid body
Week 6 : Principle moments of inertia, ellipsoid of inertia, parallel and perpendicular axis theorem, Euler's equation of rigid body rotation under external torque
Week 7 : Introduction to Euler angles, pitch, precession and nutation, The heavy symmetric top
Week 8 : Lagrangian dynamics: Forces of constrain, virtual displacement, Principle of virtual wok and D'Alembert's principle
Week 9 : Generalized velocity and force, Lagrange's equation of 2nd kind, Lagrangian, Classification of constrains
Week 10 : Variation principle, calculus of variation
Week 11 : Small oscillation: Introduction to coupled systems, normal modes, Types of equilibrium
Week 12 : Diagonalization of K.E. and P.E. matrices, Normal modes of oscillation