

Phys 355 - Classical Mechanics - 3 credits

Bulletin Description:

Basic concepts, single and coupled oscillators, variational calculus, Lagrangian and Hamiltonian dynamics, central force motion, accelerated coordinate systems. Prereq: PHYS 252 and MATH 265. Co-req: MATH 266.

Course Objectives:

The course familiarizes students with the theoretical methods and techniques of classical mechanics at an intermediate level. This includes a variety of mathematical and computational techniques -- especially the Lagrangian and Hamiltonian formalisms -- for setting up and solving differential equations to determine the motion of individual particles and systems of particles. Students develop problem-solving skills needed to master the rigor of theoretical physics and understand the fundamental roles of symmetries and conservation relations in classical mechanics.

Content Listing:

- **Basic concepts:** Newton's laws, energy, momentum, angular momentum, rockets
- **Single Oscillators:** harmonic oscillations, damped oscillations, driven oscillations, resonance
- **Variational calculus:** functional minimization, Euler-Lagrange equations, constraints
- **Lagrangian dynamics:** generalized coordinates and momenta, holonomic constraints, action integral, Hamilton's principle, conservation laws
- **Central force motion:** relative coordinates, reduced mass, bounded versus unbounded motion, Kepler equation, Virial theorem
- **Accelerated coordinate systems:** pseudo-forces in rotating frames, Coriolis effect
- **Coupled oscillators:** normal modes, eigenvalues, principal axis transformation, normal coordinates
- **Hamiltonian dynamics:** Hamilton equations, principle of least action, conservation theorems

If time permits special topics can be included. Examples include: collision theory, nonlinear dynamics and chaos, rigid body motion, transition to continuum mechanics, phase space and Liouville's theorem.