PHY 6246, Classical Mechanics
Fall 2006, Tu-Th 1:30-2:45, MAP 316

Instructor - Dr. Aniket Bhattacharya

Recommended text: Classical Mechanics, 3rd edition,
Authors: Herbert Goldstein, Charles P. Poole, John L. Safko, *Pearson Education*

Office: MAP 322
Office Hours: Tu-Th 3:00 pm-5:00pm
or anytime

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Preamble: This is a graduate level course in Classical Mechanics. We will follow Goldstein's book for approximately 75% of the topics. Some homework will be assigned from the text, while some other I will pick up from my quesion bank. We will discuss Lagrangian and Hamiltonian dynamics, small oscillations, Canonical transformations, Hamilton-Jacobi theory and if time permits, some topics in classical chaotic system.
Homework will be an indispensable part of the course. Pertinent discussion about the homework is okay as long as it is a learning experience for you. You are always welcome at my office without an appointment.

In addition to the recommended text, you may find the following graduate level text books to be instructive:

1. Classical Mechanics, *by* H. Goldstein (1st edition), *Addison Wesley*
2. Mechanics *by* Landau and Lifshitz, *Pergamon Press*
3. Classical Dynamics, *by* Jorge Jose & Eugene Saletan, *Cambridge University Press*

Course Outline:

- **Survey of the elementary principles:** Mechanics of a system of particles, constrains, D'Aembert's principle and Lagrange's equations, velocity dependent potential and dissipation function, application of Lagrangian formulation.
- **Variational principles, conservation theorems and symmetry properties**
- **The central force problem:** Classification of orbits, Virial Theorem, conditions for closed orbits, the Kepler problem, properties of the Laplace-Runge-Lenz vector, *etc.*
- **Rigid body motion and rotation:** Orthogonal transformation, properties of transformation matrix, the Euler angles, finite and infinitesimal rotation, rate of change of a vector, the Coriolis effect.
- **Small Oscillations:** Generalized framework of solving small oscillation problems having several degrees of freedom will be developed. A few examples will be solved during the lecture period.
- **Hamiltonian formalism of classical mechanics:** Legendre's transformation and Hamilton's equation of motion, cyclic co-ordinates and conservation theorems, principle of least action
- **Canonical Transformation:** Examples of canonical transformation, Poisson's bracket, invariants of canonical transformation, the symplectic approach to canonical transformations, symmetry groups of mechanical systems, Liouville's theorem
- **Hamilton-Jacobi Theory:**

Evaluation & Grade: There will be 6-8 homework sets (50%), two closed book midterms (30%), and a comprehensive final (20%). Test questions for the midterms and the final will be similar to those assigned as homework problems.