Physics 7200 **Advanced Mechanics** **Winter 2012**

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Office hours: 10am - 11am MTh, and by appointment.
Texts: Landau and Lifshitz, *Mechanics*; Goldstein, *Classical mechanics*.
Grading: 17% for each of two one-hour exams, 33% for the final, 33% for the homework.
Homework: assigned weekly and collected on a week later. Late homework will not be accepted.

Course outline

1. **Lagrangian formalism.** Generalized coordinates. The principle of least action. Equation of motion. Lagrangian for a free particle and for a system of particles.
2. **Conservation Laws. Integration of the equations of motion.** Energy. Momentum. Angular momentum. Mechanical similarity. Equilibrium and small oscillations. Potential energy from period of oscillations.
3. **Variational analysis with constraints.** Constraints. Forces of constrains. Brachistochrone problem. Isoperimeter constraints. Catenary problem.
4. **Scattering.** Motion in a central field. Particle decays. Elastic and inelastic collisions. Differential and total cross section. Small-angle scattering.
5. **Oscillations.** Coupled oscillators. Parametric resonance. Motion in fast oscillating field.
6. **Hamiltonian formalism.** Hamiltonian. Hamilton equations. Poisson brackets. The action as a function of the coordinates. Canonical transformations. The Hamilton-Jacobi equations. Adiabatic invariants.
7. **Continuous systems and fields.** The Lagrangian density. Field equations of motion. Energy-momentum tensor. Noether theorem.
8. **Fluid dynamics.** Continuity equation. Euler equations. Bernoulli equation. Potential flow. Navie-Stokes equations.