Physics 210 **Graduate Classical Mechanics** **Fall 2016**

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Course Web Page

`http://scipp.ucsc.edu/~profumo/teaching/phys210_16/phys210_16.html`

Class Hours

Wednesdays and Fridays, 3:20PM - 4:55PM, ISB 235
Classes on Wed Sept 28, Fri Sep 30, Fri Oct 14, Fri Nov 18 are canceled, and are rescheduled for Mon Oct 3, Mon Oct 10, Mon Oct 17, Mon Oct 24, ISB 235, 10:20 -11:55 AM.

Course Description

This course is a graduate-level introduction to the theoretical techniques of classical mechanics. Emphasis will be given in particular to those principles and mathematical constructions relevant to modern physics (including quantum mechanics and general relativity), as well as to more classical physical applications. A list of topics that will be covered in this course includes:

- Variational Principles
- Lagrangian Formulation
- Applications: the Central Force Problem, the Motion of Rigid Bodies, Small Oscillations
- Hamiltonian Formulation
- Canonical Transformations
- Hamilton-Jacobi Theory and Action-Angle Variables
- Classical Field Theory

Recommended Textbook (on reserve)

- *Classical Mechanics, 3rd edition* by H. Goldstein, C. Poole, and J. Safko

Other Textbooks

- *Classical Field Theory* by D.E. Soper (highly recommended for Classical Field Theory part)
- *Classical Dynamics: a contemporary approach* by J.V. José and E.J. Saletan (recommended)
- *Analytical Mechanics for Relativity and Quantum Mechanics* by O.D. Johns (recommended)
- *Mathematical Methods of Classical Mechanics* by V.I. Arnold

- *Analytical Mechanics* by A. Fasano and S. Marmi
- *The Elements of Mechanics* by G. Gallavotti
- *Theoretical Mechanics* by E. Neal Moore
- *Classical Mechanics* by V. Barger and M. Olsson
- *Mechanics* by L.D. Landau and E.M. Lifshitz
- *The Classical Theory of Fields* by L.D. Landau and E.M. Lifshitz

Note: the Relevant Library Sections are QA805 and QC125

Course Outline

	Topic	Reading
1	Preliminary remarks; Lagrangian formalism	1.1-1.4
2	Lagrangian methods: examples; Hamilton's principle	1.5-1.6; 2.1
3	Calculus of variations; Hamilton's principle with constraints	2.2-2.5
4	Symmetries and conservation laws	2.6-2.7
5	Central force problem; Closed orbits; Virial theorem	3.1-3.7
6	Scattering in a central force field	3.10-3.11
7	Lenz vector; Three-body problem; Numerical methods	3.9; 3.12
8	Coordinate transformations; Euler angles	4.1-4.5
9	Infinitesimal and finite rotations; Coriolis effect	4.6-4.10
10	Inertia tensor; Rigid-body motion	5.1-5.6
11	Small oscillations and related examples	6.1-6.4
12	Legendre transformation and Hamilton equations of motion	8.1-8.2; 8.4
13	Principle of least action; Canonical transformations	8.5-8.6; 9.1-9.2
14	Canonical transformations: examples; Poisson brackets	9.3-9.7
15	Symmetry groups; Liouville's theorem; Hamilton-Jacobi theory	9.8-9.9; 10.1-10.2
16	Hamilton Jacobi theory and applications	10.3-10.6
17	Fields and transformation laws; stationary action and fields	1*, 2*
18	Classical field theory; the electromagnetic field	3*, 8*
19	Further general properties of Field Theories	9*
20	Course Review	

** indicates chapters of Soper's "Classical Field Theory"*

Course Grading and Requirements

There will be four homework sets. Each one of the homework sets will count 10% towards the final evaluation. There will be one midterm exam, tentatively scheduled for Wednesday November 9, under "quals" conditions, which will count 20%. The remaining 40% will be based on your performance in the final exam, also to be held under "quals conditions", in December.