

Instructor: Stefano Profumo  
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### Course Web Page

[http://scipp.ucsc.edu/~profumo/teaching/phys210\\_12/phys210\\_12.html](http://scipp.ucsc.edu/~profumo/teaching/phys210_12/phys210_12.html)

### Class Hours

Tuesdays and Thursdays, 2:00PM - 3:45PM, ISB 231

### 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

### Required 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)
- *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

		<b>Topic</b>	<b>Reading</b>
1	9/27	Preliminary remarks; Lagrangian formalism	1.1-1.4
2	10/2	Lagrangian methods: examples; Hamilton's principle	1.5-1.6; 2.1
3	10/4	Calculus of variations; Hamilton's principle with constraints	2.2-2.5
4	10/9	Symmetries and conservation laws	2.6-2.7
5	10/11	Central force problem; Closed orbits; Virial theorem	3.1-3.7
6	10/16	Scattering in a central force field	3.10-3.11
7	10/18	Lenz vector; Three-body problem; Numerical methods	3.9; 3.12
8	10/23	Coordinate transformations; Euler angles	4.1-4.5
9	10/25	Infinitesimal and finite rotations; Coriolis effect	4.6-4.10
10	10/30	Inertia tensor; Rigid-body motion	5.1-5.6
11	11/1	Small oscillations and related examples	6.1-6.4
12	11/6	Legendre transformation and Hamilton equations of motion	8.1-8.2; 8.4
13	11/8	Principle of least action; Canonical transformations	8.5-8.6; 9.1-9.2
14	11/13	Canonical transformations: examples; Poisson brackets	9.3-9.7
15	11/15	Symmetry groups; Liouville's theorem; Hamilton-Jacobi theory	9.8-9.9; 10.1-10.2
16	11/20	Hamilton Jacobi theory and applications	10.3-10.6

17	11/27	Fields and transformation laws; stationary action and fields	1*, 2*
18	11/29	Classical field theory; the electromagnetic field	3*, 8*
19	12/4	Further general properties of Field Theories	9*
20	12/6	Course Review	

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

### Course Grading and Requirements

There will be four homework sets, handed out on the following dates:

- HW#1: handed out on 10/9, due on 10/16
- HW#2: handed out on 10/23, due on 10/30
- HW#3: handed out on 11/13, due on 11/20
- HW#4: handed out on 11/27, due on 12/4

Each one of the homework sets will count 10% towards the final evaluation. There will be one midterm exam, tentatively scheduled for Tuesday November 6, 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", scheduled for Thursday, December 13, 12:00–3:00 P.M..