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| Instructor: | Stefano Profumo |
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| Teaching Assistant: | Jonathan Kozaczuk |
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| Grader: | Juan Ledesma |
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### Course Web Pages

- http://scipp.ucsc.edu/∼profumo/teaching/phys105_12/phys105_12.html
- eCommons Webpage

### Class Hours

Lectures: Tu-Th, 8:00 AM - 9:45 AM, PhysSciences 110
Discussion Sections: Wed, 5:30 PM - 6:40 PM, Nat Sci Annex 101

### Course Description

- Motion in one dimension
- Energy and Angular Momentum
- Central conservative forces
- Rotating frames
- Potential theory
- The two-body problem
- Many-body systems
- Rigid bodies
- Lagrangian mechanics

- Small oscillations and normal modes
- Hamiltonian mechanics
- Dynamical systems, order and chaos in Hamiltonian systems

**Prerequisites**

- Physics: 5A/L, 5B/M, 5C/N, 116A, 116B

**Required Textbook** (on reserve)

- *Classical mechanics* by T. W. B. Kibble and F. H. Berkshire (5th edition, 4th edition fine too)

**Other Textbooks**

- *Classical Dynamics* by S.T. Thornton and J.B. Marion (recommended, but very expensive!)
- *Classical Mechanics, 3rd edition* by Goldstein, Poole, and Safko (a graduate-level very complete textbook)
- *Classical Dynamics: a contemporary approach* by J.V. José and E.J. Saletan (advanced, but recommended)
- *Mathematical Methods of Classical Mechanics* by V.I. Arnold (very advanced, but recommended for those with an inclination towards math)
- *Analytical Mechanics* by A. Fasano and S. Marmi (as above - this is the book your Instructor learned this stuff from)
- *Mechanics* by L.D. Landau and E.M. Lifshitz (very good, but very "Soviet")
- *The Elements of Mechanics* by G. Gallavotti
- *Theoretical Mechanics* by E. Neal Moore
- *Classical Dynamics of Particles and Systems* by J. Marion
- *Classical Mechanics* by V. Barger and M. Olsson

*Note: the Relevant Library Sections are QA805 and QC125*

## Course Outline

| | Date | Topic | Reading |
|---|---|---|---|
| 1 | 9/27 | Introduction | Ch.1 |
| 2 | 10/2 | Linear motion | Ch.2 |
| 3 | 10/4 | Energy and angular momentum | Ch.3 |
| 4 | 10/9 | Central conservative forces | Ch.4 |
| 5 | 10/11 | Rotating frames | Ch.5 |
| 6 | 10/16 | Potential theory | Ch.6 |
| 7 | 10/18 | The two-body problem | Ch.7 |
| 8 | 1023/ | Many-body systems | Ch.8 |
| 9 | 10/25 | Rigid Bodies I | Ch.9.1-9.5 |
| 10 | 10/30 | Rigid bodies II | Ch.9.6-9.9 |
| 11 | 11/1 | Lagrangian Mechanics I | Ch.10.1-10.3 |
| 12 | 11/6 | Lagrangian Mechanics II | Ch.10.4-10.6 |
| 13 | 11/8 | Small Oscillations and normal modes | Ch.11 |
| 14 | 11/13 | Hamiltonian mechanics I | Ch.12.1-12.4 |
| 15 | 11/15 | Hamiltonian mechanics II | Ch.12.5-12.8 |
| 16 | 11/20 | Dynamical Systems I | Ch.13.1-13.4 |
| 17 | 11/27 | Dynamical Systems II | Ch.13.5-13.7 |
| 18 | 11/29 | Order and chaos I | Ch.14.1-14.4 |
| 19 | 12/4 | Order and chaos II | Ch.14.5-14.6 |
| 20 | 12/6 | Course Review | ∼Whole Book! |

## Course Grading and Requirements

Student evaluations will be based on their performance in the following three tasks. The tasks and their relative weights in determining the students' overall course grades are given below (see however below for special "reward points"):

(i) **35%** Weekly Homework (9 problem sets)

(ii) **25%** Midterm Exam (Thursday, October 25, 8:45 AM – 9:45 AM)

(iii) **40%** Final Exam (Monday, December 10, 8:00 AM – 11:00 AM)

**Homework**

Weekly homework assignments will be posted on the eCommons website each Thursday (with the exception of Thanksgiving Thursday November 22) and are due in class, at the beginning of class on the Thursday of the following week. The homework problem sets are (effectively) not optional, and will consist of a few problems from Kibble and Berkshire. You are encouraged to discuss the class material and homework problems with your classmates and to work in groups, but all submitted problems should represent your own work and understanding. Late homework can be submitted to the grader, but will not contribute any points to the final grade. I will grant **one** late homework exception-to-policy, for exceptional, well-motivated and documented reasons. The Grader will grade each homework, and is responsible for the given grade. Grades for each homework problem will consist of 2 points (mostly correct), 1 point (less than 50% correct) or 0 points. Homework solutions may be made available on the course website on the homework due date or shortly thereafter. The TA is responsible for the homework solutions.

**Discussion Section and Reward Points**

Discussion Section will be typically devoted to discussing problems in the assigned homework. The discussion will be lead by the TA, who will survey the audience and suggest which homework problems to examine at the beginning of the section. The problems will then be discussed at the board by "volunteers", who will be awarded "Reward Points" (at the discretion of the TA). Reward Points will be counted as an extra credit towards the final, overall course grade and can contribute up to 10% of the overall grade.

**Midterm and Final**

The midterm exam and the final exam will be held in the same classroom as the lectures. The midterm will be a 1 hour written exam in class (regular lecture time) on Thursday October 25, on chapters 1-8, while the final (Monday December 10, 8:00AM-11:00AM) will be three hours long and cover the complete course material. Both the midterm and the final will be closed-book, but you will be allowed one page, A4 format, front and back, of notes. Only non-graphical, non-programmable calculators will be allowed (it will be up to the discretion of the Instructor to decide whether a calculator is or not allowed). Laptop computers and more or less smart cellular phones of any kind will not be allowed. A practice midterm and final will be handed out a week before the exams. You must take the final exam to pass the course. The midterm will be worth 25% of the grade, the final 40%

**Final Grade**

The minimal score not to fail the class is 60%.

The final grade will reflect the following breakdown:

- 9 homework assignments: **35%**
- Midterm exam: **25%**
- Final exam: **40%**
- Rewards points: **potential +10%**

The final grade will follow the percent guideline below:

- 60% to 70%: **C** range
- 70% to 85%: **B** range
- 85% to 100%: **A** range