SYLLABUS
PHY 6246, Classical Mechanics
Fall 2007
Michael D. Johnson

Lecture: MAP 306 TR 1:30 – 2:45 PM
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Office hours: Mon 8:30–10:00 AM Wed 8:30 – 10 AM
Final exam: Tuesday, December 4, 1:00 – 3:50 PM in MAP 306

Textbook: Jorge V. José and Eugene J. Saletan, *Classical Dynamics: A Contemporary Approach*, Cambridge University Press, 1998, ISBN 0521636361. This is in paperback. You may be able to purchase a used hardcover edition.

Classical mechanics has been a traditional part of graduate physics education for generations. Physicists were thought to need this knowledge, first, as part of their basic foundation, and second (and perhaps more important) for the insight that classical mechanics gives into quantum mechanics. But classical mechanics has been reinvigorated by new discoveries in nonlinear dynamics and chaos, and is once again a vibrant field of research in its own right.

The goals of this class grow out of these observations. The objectives are for you to learn how to solve classical mechanics problems at an advanced level; to gain insight into the relationship between classical and quantum mechanics; to understand related ideas in research papers and seminars; and to be prepared to begin research in the field.

One interesting aspect of this is that the modern discoveries are related to developments in the broader mathematical area of nonlinear dynamics (not necessarily the dynamics of any mechanical system). Contributions to this have been made by mathematicians as well as physicists and others. Therefore another objective of this course will be for you to learn enough about the mathematics (largely differential geometry, e.g., manifolds, tangent bundles) to make the mathematical literature accessible. If your research is in this area you will quickly see that this course only gives the basic background needed to get started; you will then need to dig much deeper into the literature to develop real expertise.

An important part of the course will be weekly homework assignments. You may work in groups, but must hand in individual reports that demonstrate your own understanding.

I will make every effort to be available during my scheduled office hours, but my administrative duties may occasionally interfere. Please phone ahead to make sure that I am in my office. You are also very welcome to contact me by email at any time. This in fact is usually the quickest way to get an answer. Please talk with one another as well.

Grades: The final grade will be determined by:

Homework	30%
Mid-Term Exam	30%
Final Exam	40%

I will use plus and minus grades (A, A-,B+,B, . . .).

Planned Topics

- Ch. 1: Fundamentals of mechanics (very quickly)
- Ch. 3: Variational derivation of Lagrange's equations (section 3.1)
- Ch. 2: Mathematical interlude (section 2.4)
- Ch. 2: Langrangian formulation
- Ch. 3: Topics in Lagrangian mechanics
- Ch. 4: Scattering and linear oscillations (briefly)
- Ch. 5: Hamilton formulation
- Ch. 5: Canonical transformations
- Ch. 6: Hamilton-Jacobi method
- Ch. 6: Integrable systems
- Ch. 7: Nonlinear dynamics, chaos, and the KAM theorem

Useful Books: No single textbook suits everyone. Please get in the habit of working with multiple sources. I have found the following books useful and placed them on reserve in the library:

Goldstein, Poole, and Safko, *Classical Mechanics* (or an earlier edition)

L.D. Landau, *Mechanics*

E. Ott, *Chaos in dynamical systems*

T. Frankel, *The Geometry of Physics: An Introduction*