University of Maryland

Department of Physics, College Park, MD 20742-4111

Physics 410----Classical Mechannics

Instructor: Prof. Thomas Cohen (I prefer to be addressed as Tom)

Office: 2104 (Physics Building)

Phone: 5-6117 (Office); 301-654-7702 (Home)

E-mail: cohen@Phvsics.umd.edu

TA/Grader: Wang Kong Tse (he prefers to be called James)

Office: 4221 (Physics Building)

Phone: 5-7279

E-mail: wktse@umd.edu

Office Hours

Office hours are immediately following class. I am also generally available in my office and happy to see students; just drop by--or, better yet, give me a call and then drop by.

Course Philosophy

Classical mechanics is one of the most beautiful subjects in physics. One of the charming things about the subject is formal. There are numerous equivalent ways to formulate the theory each with its own technical advantages and each providing useful insights into other parts of physics. This course will emphasize the Lagrangian formulation of classical mechanics which is both elegant in its own right and useful in describing dynamics of systems with constraint. The Lagrangian approach is essential in understanding Feynman's function integral approach to quantum mechanics and is also the main formulation used in relativistic field theory. The course will also emphasize the Hamiltonian approach. This approach is the basis for the canonical treatment of quantum mechanics. The course will also emphasize conservation laws and their ties to symmetries. A number of applications will be discussed including orbits in a central force potential, classical scattering problems, many-body systems, rigid-body motion and

oscillations (including coupled degrees of freedom and nonlinear systems). Some aspects of chaos theory will be treated

Books

The principal text for the course is Thorton&Marion's *Classical Dynamics.* The book is very complete covering these topics and more in considerable detail. The course will not cover all of the topics in the book nor will it follow the order of topics in the book.

Homework

Problem sets will be assigned regularly. Problem sets may require the use of numerical analysis that can be done in *Mathematica* or some other computer program. I strongly encourage students to consult each other on problem sets. Ideally you should attempt all of the problems by yourselves and if you get stuck you should then consult your peers. Homework will count approximately 20% of the final grade.

Exams

There will be a midterm exam and a final exam in this course. The exams will count for approximately 80% of the total course grade.

The exams are currently planned as take-home. Take-home exams have two virtues: they reduce the time pressure on students and allow them to perform at their best and they allow for questions that are less trivial than can be done during a class period. They do have a potential drawback, however. They are impossible to police efficiently against cheating. Thus, we must rely on your integrity. I will ask you to pledge to do the exams alone and to stick to this pledge. I should note that the whole enterprise of science depends on the integrity of the researchers--- when I read a scientific paper I must assume that the researchers didn't cook the books or I won't get anywhere.

Tentative Course Outline

Introduction to the Langrangian and Hamiltona Formulations.

Mathematical tool---the calculus of variations (Chapter 6)
Langrangian & Hamiltonian Dynamics (Chapter 7)
Langranrgian & Hamiltonian's for many-body systems (Chapter 9, sections 1-5)

Gravity & Aspects of Central Force Orbit Problems

Gravity as a 1/r potential (Chapter 5)
Orbits in a central force potential (Chapter 8)
Classical scattering in a central force potential (Chapter 9 Sections 6-7,9-10)

Rigid Body Motion

Mathematical details (Aspects of chapter 1)
Rigid-Body Dynamics (Chapter 10)

Oscillations

One body linear systems (Chapter 3)
Many body linear systems (Chapter 12)
Nonlinear Oscillations and aspects of chaos (Chapter 4)