Theoretical Dynamics

Administrivia

Instructor: Prof. Paulo Bedaque, bedaque@umd.edu, 3147 Physical Sciences Complex
Grader:
Lecture times/place: TuTh 12:30pm - 1:45pm, Hornbake 0115
Office hours: Tuesday after class or some other time arranged by emailing the instructor.
Piazza: All the communication between the instructor/TA and the students regarding assignments will be handled through piazza.com. Every student will receive an email requesting them to join in. I you do not receive this email from piazza.com let the instructor know so he can add you name to the list. Piazza is also used to ask questions, comments to the instructor and to the students. It allows for mathematical notation and the instructor will make every effort to respond any question posted there promptly.
Textbook(s): We will not follow closely any book. David Tong's "Lectures on Classical Dynamics" is a good source covering a similar material at a similar level and can be found and downloaded free at http://www.damtp.cam.ac.uk/user/tong/dynamics.html. Landau & Lifschitz's "Mechanics" and Kibble & Berkshire's "Classical Mechanics" are also good sources. However, most of the m material is fairly standard and the students is encouraged to use any other book suitable to his/her skills and taste. In addition, I'll make available my private lecture notes. They are not meant as a substitute for a polishes textbook but they may be useful to know what I discussed in class, especially if you miss classes.
Homework: I plan to assign homework every week. The difficulty of the problems will vary from routine practice to tiny research projects. Some of them will involve some basic programming. If you are completely inexperienced with computers or do not have access to one, let the instructor know at t he beginning of the semester.
Grades: The grade will be determined by two exams (90%) and the homework (10%). Details/date of the exams will be discussed in class.

Tentative Syllabus

- Newtonian Mechanics
  Forces, equations of motion, conservation laws
  Motion in one dimension
  Numerical solution of the equations of motion

- Lagrangian Formalism
  Constraints: holonomic and non-holonomic

Principle of minimal action, Lagrange equations
Conservation laws revisited: Noether's theorem
Keplerian motion
Small oscillations from harmonic oscillators to field theory
Rotations

- Hamiltonian Formalism
  Hamilton equations, Liouville's theorem
  Symplectic integrators
  Hamilton-Jacobi theory, integrability, action-angle variables
  Adiabatic invariants
  Liapunov exponents, chaos

- Continuous Media
  First order hydrodynamics, Euler's equations
  Second order hydrodynamics, Navier-Stokes equation
  Elastic media: strain and stress tensors, equilibrium of deformable bodies and elastic waves