

Second-Year Physics
Advanced Mechanics
13 lectures, First Semester 2008
Preliminary Course Outline

Aims & Objectives: The purpose of this course (which is a new topic for 2008) is to extend the students' grasp of classical mechanics developed in First Year, particularly on the topics of orbit theory, rotational dynamics, and gravity fields, and to develop problem solving skills. There will be a strong focus on examples and problems. There is no set textbook.

Assessment: This will be by means of assignments worth a total of 30% and an examination worth 70%.

Outcomes: Expected outcomes include

- understanding of selected topics in classical mechanics, including orbital motion, motion in rotating reference frames, rigid-body dynamics, and gravitational interactions
- an introductory knowledge of cartesian tensor methods
- well-developed problem solving skills in classical mechanics

Preliminary Syllabus

- 1. Orbit Theory – motion under central forces:** first integrals of the motion; a formal solution; qualitative description of the motion; the orbital differential equation; the Kepler problem – inverse-square-law orbits; the virial theorem; Rutherford scattering.
- 2. Particle Dynamics:** motion in a resistive medium; motion in rotating reference frames; centrifugal and Coriolis effects; the Foucault pendulum.
- 3. Introduction to Cartesian Tensors:** scalar and cross products in index notation; Kronecker delta and epsilon tensor; tensor identities for scalar and cross products.
- 4. Rigid-Body Dynamics:** the inertia tensor; rotational kinetic energy; principal axes; the Euler equations; precession.
- 5. Gravitational Interactions:** potentials of shells and spheres; potentials of nearly spherical bodies; interaction of nearly spherical bodies; field of the oblate Earth; Sun-Earth-Moon interaction: precession of the equinoxes and nutation; binary star systems.

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29 April 2008