Classical Mechanics (PHYS 350): Review

Fall 2011 v1.0

This is a thumbnail sketch of the material uncovered this semester. Focus your study on the methods of Lagrangian and Hamiltonian mechanics and the applications. These applications include rigid body motion, nonlinear dynamics, physics in non-inertial reference frames, dynamics of central potentials, and coupled oscillations. To review I recommend starting with problems, referring back to the text, class notes, or solutions when you need a reminder.

Truth in Advertising Clause: The following list is not guaranteed to be complete.

Core Items:

(1) Topics in Newtonian Dynamics:
   (a) Linear and quadratic damping
   (b) Rocket Motion
   (c) Gravitational physics
   (d) Phase space

(2) Non-linear dynamics:
   (a) Phase space explorations of chaotic systems
   (b) Sensitivity on initial conditions - Lyapunov exponents
   (c) Driven, damped pendulum and double pendulum

(3) New formulations of Dynamics – Action, Lagrangian, Hamiltonian:
   (a) Variational principle: derivation of the Euler or Euler-Lagrange equations of motion
   (b) Setting up the Lagrangian
   (c) Degrees of Freedom:
   (d) Hamiltonians
   (e) Constants of motion - cyclic coordinates
   (f) Effective Potentials

(4) Systems of particles:
   (a) Separating CM translations and body rotations
   (b) Effective Potential in central potential problems
   (c) Scattering
   (d) Kepler's Laws
   (e) Magical $1/u$ equation

(5) Dynamics in Non-inertial Reference Frames:
   (a) Accelerations in non-inertial frames and fictitious forces
   (b) Statics and choice of coodinates
   (c) Coriolis Effect

(6) Dynamics of Rigid Bodies:
   (a) Inertia Tensor
   (b) Euler Equations
   (c) Euler angles
   (d) Motion of symmetric tops: Precession and nutation

(7) Coupled Oscillations:
   (a) Normal modes: frequencies and coordinates
   (b) Simple 2D systems
   (c) Arbitrary numbers coupled oscillators