

# Physics 229 – *Classical Mechanics*

## Spring 2008 – ***Tentative Syllabus:***

Text: “Classical Mechanics”, Kibble & Berkshire, 5<sup>th</sup> Edition

Mar 31-Apr 2 **Classical Mechanics – the Big Picture**, Chapter 1: [Lecture 1] Review concepts of space-time, forces, masses and Newton’s laws; 1, 2 and N-body systems.

Apr 4 - 7 **1-D (Linear) Motion**, Chapter 2: Review 1-D motion, solutions of linear 2<sup>nd</sup> order inhomogeneous differential equations using complex notation (damped, driven harmonic oscillators; see Lectures 4,5, 10 – 15 in Phys. 227-8); Behavior of conservative but nonlinear systems (solutions by constants of motion); Collisions.

Apr 9 -16 **Motion in 2- & 3-D: Energy and Angular Momentum**, Chapter 3: Review motion in 3 spatial dimensions as described by vector and scalar quantities (energy, momentum and angular momentum) (see Lectures 6-9 in Phys.227-8); the relation of symmetries and conserved quantities (central forces, rotational invariance and conserved angular momentum) (see Lectures 16, 17 & 19 in Phys 227-8); the Calculus of Variations of the Methods of Hamilton & Lagrange (see Lecture 20 in Phys. 227-8).

Apr 18 - 21 **Central Conservative Forces**, Chapter 4: Discuss 3-D motion in a central (typically  $1/r$ ) potential using the symmetries and conservation laws to simplify the analysis; Orbits, Scattering and Cross Sections.

Apr 25-30 **Rotating Frames**, Chapter 5: Transformations of the physics (equations of motion) between different reference frames (symmetries); Special features of rotating (non-inertial) reference frames (apparent gravity, Coriolis force and weather, the Larmor effect and angular momentum).

### **Apr 28 Mid Term Exam I**

Apr 30-May 2 **Potential Theory**, Chapter 6: Using a scalar field, the potential (energy), to simplify the analysis of gravitational and electrostatic problems (potentials due to extended charge and mass distributions); applications to the earth (why isn’t it a sphere) and the tides; the Field Equations (for the potential, see Lectures 21 – 26 in Phys 227-8).

May 5 **The Two-Body Problem**, Chapter 7: The Center of Mass system and relative coordinates; more on collisions and cross sections.

May 7 **Many-Body Systems**, Chapter 8: Examples of 2 (and more) body systems (e.g., the earth and moon system) analyzed with the methods of Lagrange.

May 9      **Rigid Bodies**, Chapter 9: Systems with even more bodies (with approximately fixed relative distances – i.e., all of us) as described by motion of CM and motion about CM; Moments of inertia, Principal axes, orientation and motion described by the (infamous) Euler angles.

May 12-16    **Lagrangian Mechanics**, Chapter 10: Systems described by generalized coordinates, a Lagrangian and the Euler-Lagrange equations (precessing tops, pendula, charged particles in a magnetic field and strings; recall Lecture 20 in Phys 228).

May 19-21    **Small Oscillations and Normal Modes**, Chapter 11: Motion around an equilibrium, coupled oscillators, motion and modes of a string (see Lectures 17 & 18 in Phys 228).

**May 28      Mid Term Exam II**

May 23-28    **Hamiltonian Mechanics**, Chapter 12:

May 30-Jun 2 **Dynamical Systems and Their Geometry**, Chapter 13:

Mon May 26 **Memorial Day Holiday**

Jun 4 - 6      **Order and Chaos in Hamiltonian Systems**, Chapter 14

**Jun 11                      FINAL EXAM 2:30 – 4:30 PM**