Mechanics (PHY 6247)

Instructor: Dr. Pedro Marronetti
Charles E. Schmidt College of Science
Room SE 440. (297-3386)
pmarrone@fau.edu

Classes: MWF / 10:00 – 10:50 AM. Classroom: SC 180

Office Hours: MWF / 11:00 – 12:00PM

Course Website: Blackboard Assigned

Assessment Procedures:

The final grade will be determined by the successful completion of all the homework assignments (20% of the final grade) and a Midterm exam (40%) and a Final exam (40%). The deadline for all the homework assignments is December 4, 2008 (Reading day).

Course Description:

This class provides a formal introduction to classical mechanics, Euler-Lagrange equations, Hamilton's equations of motion used to describe central force motion, perturbation theory and Noether's theorem. It will cover also an introduction to Special Relativity and the theory behind small oscillations analysis.

The course will cover the following subjects:

- *Survey of Elementary Principles of Mechanics*
  Mechanics of a particle and systems of particles. Constraint classification. D'Alembert principle.
- *Variational Principles, Lagrange's Equations and Hamilton's Principle*
  Lagrange's equations. Hamilton's principle. Calculus of variations techniques. Extension of Hamilton's principle to non-holonomic systems. Conservation theorems. Symmetry. Energy function and its conservation.
- *Central Forces*
  One-body problem. Equations of motion and first integrals. Classification of orbits. Virial theorem. Kepler's problem. Three-body problems.
- *Kinematics and Dynamics of Rigid Bodies*
  Coordinates systems and orthogonal transformations. Euler angles. Cayley-Klein parameters. Euler's theorem. Finite and infinitesimal rotations. Angular momentum and kinetic energy of

rotations. Tensors. Inertia tensor and the moment of inertia. Euler equations of motion.

- *Hamiltonian Equations of Motion*

  Legendre transformation and the Hamiltonian equations of motion. Cyclic coordinates and the conservation theorems. Derivation of Hamilton's formulation from Variational principles. Principle of least action.

- *Canonical Transformations*

  Equations of canonical transformations. Symplectic approach. Poisson brackets. Equations of motions in the Poisson bracket formulation. Angular momentum relations. Liouville's theorem.

- *Canonical Perturbation Theory*

  Time –dependent and time-independent perturbation theory. Adiabatic invariants.

- *Theory of Special Relativity*

  Basic postulates. Lorentz transformations. Velocity addition. 4-vectors and tensors. The metric tensor. 1-forms. Forces in Special Relativity. Relativistic angular momentum. Lagrangian formulation of relativistic systems. Covariant formulations. Brief introduction to the Theory of General Relativity.

- *Oscillations*

  Eigenvalue problem and principal axes of transformation. Frequencies of free vibration. Normal coordinates. Beyond small oscillations.

Bibliography

Classical Mechanics, 3rd Ed.
H. Goldstein, C. Poole and J. Safko