Syllabus: PHYS 508 Analytical Dynamics
Prof. Grant Bunker

PHYS 508

Analytical Dynamics

Hamilton's Principle, Lagrange's formalism, function, and equations. Invariance properties and conservation laws. One dimensional motion. Central force problem. Small harmonic oscillations. Nonlinear oscillations. Scattering theory. Rigid body motion. Non-inertial reference frames. Hamilton's formalism, function, and equations. Canonical transformations. Hamilton-Jacobi theory. Integrable systems and canonical perturbation theory.

LECTURE: 3 **LAB:** 0 **CREDITS:** 3

Textbook: Classical Mechanics 3rd edition Goldstein, Poole, Safko

1) Elementary principles, D'Alembert's, from Newton -> Lagrange
2) Variational Principle
3) Central Forces
4) Rigid Body kinematics
5) Rigid Body Dynamics
6) Oscillations
7) Special Relativity
8) Hamiltonian Formulation
9) Canonical Transformations
10) Hamiton-Jacobi theory, Action-Angle variables
11) Chaos nonlinear dynamics
12) Canonical Perturbation Theory
13) Continuous field**s**

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Class Format
•Reading and Lectures
•In-class problem solving + Homework Problems 30%
•Midterm 35% and Final 35%

We will make use of IIT's Mathematica site license
(either install on your computer (preferred), or use Mathematica Online)

A bit more description of key concepts:
Review, fundamentals, systems of particles, conservation laws
geometric vs algebraic modes
generalized coordinates and types of constraints
calculus of variations, finding first integrals, examples
Hamilton's principle (principle of least action)
Lagrangian formulation and equations (->QM)
constraints and constraint forces from Lagrange multipliers
symmetries and conservation laws, ``mechanical similarity", virial theorem
two body problem, velocity dependent forces,
central forces, kepler problem, classical scattering
non-inertial frames, rigid body motion
chaos and nonlinear dynamics, bifurcations, period doubling route to chaos
Hamiltonian formulation and equations, phase space (->QM)
Poisson brackets, symmetry generators, conservation laws (->QM)
Liouville's theorem, phase space distribution function evolution (-> Stat Mech)
Canonical transformations, Hamilton-Jacobi equation (->QM)
Canonical perturbation theory
Continuum mechanics and/or relativity if there is time