Topics

I.) Basic Theory

a.) Principle of Least Action, Generalized Coordinates, Lagrange's Equations
b.) Symmetries and Conservation Laws, Noether's theorem
c.) Constraints and constraint forces
d.) Hamiltonians and Hamilton's equations
e.) Phase space flow, Liouville's Theorem, Poincare Recurrence Theorem
f.) paths, paths vs. trajectory
g.) abbreviated action, Fermat's Principle
h.) mechanical similarity, virial theorems

II.) Hamilton-Jacobi Theory

a.) Describing the evolution of the Action
b.) Hamilton-Jacobi Equation
c.) Solution by separation, relation to integrability, role of symmetry
d.) Application to Self-Focusing

III.) Applications

i.) Oscillations

a.) coupled oscillators, normal coordinates and modes, etc., intuition from symmetry
b.) Parametric oscillators and instability
c.) Pondermotive potential and force

ii.) Continuua

a.) chains: modes, continuum limit, acoustic and optical modes
b.) Lagrange equations for string, continuum, reduction to wave equation
c.) Energy theorem, wave energy and momentum, wave momentum evolution
d.) Symmetry in continuum dynamics
e.) D'Alembert's solution to wave equation, separation
f.) Basic Ideas of Fluids
g.) Simple Ideas in Potential and Viscous Flow
h.) Basic Ideas of Elasticity
i.) Elastic Waves

iii.) Rigid Body Dynamics

a.) Rotational kinematics, Inertia Tensor
b.) Rigid body equations
c.) Euler angles, top with one point fixed
d.) Free asymmetric top
e.) Nonlinearly coupled Modes, Manley-Rowe Relation