Topics

I.) Basic Theory

a.) Principle of Least Action, Generalized Coordinates, Lagrange's Equations
b.) Symmetries and Conservation Laws, Noether's Theorem
c.) Mechanical similarity, Virial theorems
d.) Hamiltonians and Hamilton's equations
e.) Phase space flow, Liouville's Theorem, Poincare Recurrence Theorem
f.) Fermat's Principle, Eikonal Theory

II.) Hamilton-Jacobi Theory

a.) Paths, paths vs. trajectory, abbreviated action
b.) Describing the evolution of Action
c.) Hamilton-Jacobi Equation
d.) Separating the H-J equation, integrability, role of symmetry

III.) Applications

i.) Oscillations

a.) coupled oscillators, normal coordinates and modes, intuition from symmetry
b.) Pondermotive potential and force
c.) Parametric oscillators and instability
d.) Adiabatic Invariants and applications: WKB, basic theory, magnetic mirror

ii.) Basics of Continuua

a.) strings, chains: modes and continuum limit, acoustic and optical modes
b.) Lagrangian and Hamiltonian equations for string, Wave equation and its solution
c.) Wave Energy and Momentum, Energy Theorem, Wave Action Density: Variational Approach

iii.) Introduction to Elasticity

a.) Strain, stress tensors, Hooke's Law, Equilibrium condition
b.) Simple examples in elasticity
c.) Equilibrium for Solid Bodies: isotropic bodies, plates, rods
d.) Elastic Waves, Vibrations of Plates, Rods, Shells
e.) Intro to Vibration-induced acoustic radiation