MA2341 - Advanced Mechanics 1
Michelmas Term - 2015-2016
REVIEW TOPICS

- Mathematical Background:
  - multi-variable calculus, matrix theory
  - cartesian, 2-D polar, 3-D polar, cylindrical coordinates
  - Einstein index/summation notation, Kronecker δ, Levi-Cevita symbols
  - Vector identities
- Essential Topics:
  - Lagrangian, Hamiltonian
  - Hamilton's Principle
  - Euler-Lagrange equations
  - Conserved quantities, cyclic coordinates: Energy, linear momentum, angular momentum.
  - Generalized coordinates and forces
  - Constraints, Lagrange multipliers, Generalized forces of constraint
  - Transformations: rotations, translations, boosts, spatial inversion, time-reversal, Noether's Theorem
  - (pseudo) Scalars, Vectors, and Tensors.
- Calculus of Variations: extremization in the presence of constraints
- One-dimensional motion
  - Allowed regions of motion, turning points
  - Integrating the equations of motion
- Central Force Motion
  - Center of Mass, Reduced Mass
  - Centrifugal barrier, effective potential, turning points
  - Kepler problem, equation for orbits, conic sections
  - conserved quantities, Runge-Lenz vector
- Oscillations
  - Expanding the Lagrangian around stable equilibria, simple harmonic motion

  - Coupled oscillations, normal frequencies, normal modes, normal coordinates.
  - Over damped, under damped, critically damped oscillations
  - Retaining more terms in the expansion, anharmonic oscillations

- Rigid Body Motion
  - Moment of Inertia tensor
  - Parallel axis theorem
  - Principal moments, Principal axis
  - Rotational motion, body coordinates
  - Precession, nutation

- Motion in non-inertial frames
  - Centrifugal force
  - Coriolis force