MTH 5106: Dynamics of Physical Systems

List of Topics[1]

1. Introduction;
    a. Space, time and speed scales
    b. Vectors: displacement, velocity and acceleration
    c. Plane polar coordinates; Taylor's expansion and approximations
2. Newton's Laws
    a. Units and dimensional balance
    b. Forces; gravitational attraction
3. Momentum
    a. System of particles
    b. Momentum conservation
    c. Impulse
4. Work
    a. Integrating the equation of motion
    b. Work-energy theorem
5. Potential energy
    a. Small oscillation
    b. Conservation of energy
    c. Particle collisions
6. Gradient
    a. Physical meaning
    b. Force from potential energy
    c. Stokes' theorem and conservative force
7. Harmonic oscillator
    a. Simple oscillator
    b. Damping
    c. Forcing
8. Angular momentum
    a. Torque
    b. Fixed-axis rotation
    c. Physical pendulum
9. Central force
    a. Planetary orbits (Kepler's Laws)
    b. Energy equation and diagrams
10. Rigid body motion
    a. Gyroscope
    b. Angular momentum conservation
    c. Moment of inertia
11. Non-inertial reference
    a. Uniformly rotating frame
    b. Centrifugal and Coriolis forces
    c. Accelerating frame and general relativity

[1] Exact topic and order may change slightly.