

MCHE 513: Intermediate Dynamics

Mid-Term Exam – Thursday, November 8th

Covers Chapters 1 – 7.3, including (but not limited to):

Chapter 1 – Basic Considerations

- Newton's Laws
- Basic vector calculus (derivatives of vectors, etc)
- Energy and Momentum
 - Kinetic energy of particles
 - Work-energy principle
 - Momentum of particles
 - Impulse-momentum principle
 - Angular momentum

Chapter 2 – Particle Kinematics

- Path variables and intrinsic coordinates
 - Curves in space
 - Kinematic relationships
- Cartesian coordinates
- Curvilinear coordinate systems
 - Cylindrical coordinates
 - Spherical coordinates
- Mixed kinematical relationships

Chapter 3 – Relative Motion

- Rotational transformations
- Finite rotations
 - Body-fixed
 - Space-fixed
 - About arbitrary axes
- Angular velocity
- Angular acceleration
- Derivatives of arbitrary vectors
- Velocity and acceleration using moving reference frames
- Observations from moving frames

Chapter 4 – Kinematics of Constrained Rigid Bodies

- Describing velocities and accelerations of points on the same body
- Eulerian Angles
- Interconnections
 - Ball-and-socket
 - Pins
 - Collars
- Rolling

Chapter 5 – Inertial Effects for a Rigid Body

- Linear and angular momentum
- Inertia properties (no need to solve integrals)
 - Moments and products of inertia
 - Transformation of inertia properties
 - Principal axes
- Rate of change of angular momentum

Chapter 6 – Newtonian Kinetics of a Rigid Body

- Fundamental equations
 - Forces and point motion
 - Moments and rotation
- Equations of motion (including planar)

Chapter 7 – Introduction to Analytical Mechanics

- Generalized coordinates and kinematical constraints
- Evaluating virtual displacements