

MAE 155

Intermediate Dynamics

Text: Donald T. Greenwood, *Principles of Dynamics* (Second Edition), Prentice Hall.

Course Contents

Kinematics. [Greenwood's Chapter 2, Notes] Relationships among position, velocity, acceleration, and time. Rotating unit vectors and reference frames, angular velocity vectors in two and three dimensions.

Dynamics of a single particle. (Review) [Greenwood's Chapter 3] Newton's second law, work-energy, linear impulse-momentum, angular impulse-momentum. This is prerequisite material. Greenwood's Chapter 3 will be discussed very little in class. Some review problems will be assigned, and students should not hesitate to ask for help.

Dynamics of a system of particles. [Greenwood's Chapter 4] Newton's second law and the principle of equal and opposite reactions, work-energy, linear and angular impulse-momentum for systems of particles. Applications include particle impact.

Lagrange's equations. [Greenwood's Chapter 6, Notes] Generalized coordinates, holonomic and nonholonomic constraints. Generalized forces and generalized momentum. Lagrange's equations of motion for systems of particles. Lagrange multipliers for problems with nonholonomic constraints.

Rigid-body dynamics. [Greenwood's Chapters 7 and 8, Notes] Equations of motion of a rigid body. Inertia matrices, rotation of axes, principal axes. Angular momentum and kinetic energy of a rigid body. Euler's equations, modified Euler's equations, Lagrange's equations, impulse-momentum, work-energy. Applications include gyroscopic motion.

Homework

This is a problem-solving course, and there are many challenging homework problems. The only way to learn dynamics is to work many problems. The homework problems will prepare students for the examinations. Students who do not work and understand the homework problems have no chance of passing the examinations.