Last modified: October 10, 2024

AE 6210 - Syllabus

Advanced Dynamics - 3 Credits

General Information

Description

Kinematics of particles and rigid bodies, angular velocity, finite rotation, inertia properties, holonomic and nonholonomic constraints, equations of motion using Newton-Euler approach, Lagrange's equations, and Kane's approach.

Pre- &/or Co-Requisites

Any undergraduate course in dynamics.

Course Goals and Learning Outcomes

Upon successful completion of this course, you will be able to:

1. Derive equations of motion of particles
2. Differentiate vectors in different frames
3. Represent orientation of a body/frame in 3D
4. Derive kinematic equations that relate orientation, angular velocity and angular acceleration of bodies relative to one another
5. Derive kinematic equations that relate position, velocity, and acceleration of points on a rigid body
6. Calculate the mass moment of inertia matrix for a rigid body
7. Derive equations of motion for translation and rotation of rigid bodies under applied loads
8. Analyze and simulate equations of motion

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Description of Graded Components

Your course grade will be based on weekly assignments including around 6 homework, 3 creative assignments, and 3 simulation/visualization assignments.

Grading Scale

Your final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Topics Covered

Note: The exact topics covered in a course may vary with each offering. The example below is typical but subject to change.

- Differentiation of Vectors
- Particle Dynamics and Translational Equations of Motion
- Kinematics of Rigid Bodies
- Representing Orientation in 3D
- Holonomic and Nonholonomic Constraints and Constraint Forces
- Center of Mass and Moments/Products of Inertia
- Formulation of Equations of Motion using Newton-Euler Approach
- Formulation of Equations of Motion using Lagrange's Equations
- Formulation of Equations of Motion using Kane's Approach
- Numerical Simulation of System Dynamics

Course Materials

Note: Course materials may vary with each offering. The example below is typical but subject to change.

Textbook

No textbook required.

Suggested Reference: Roithmayr and Hodges, Dynamics: Theory and Application of Kane's Method, Cambridge University Press, 2016.

Course notes

Slides will be shared on Canvas before the lecture. Annotated slides will be shared after the class.