

ENGRD 203 / T&AM 203 Dynamics

Credit: 3 hours

Course (catalog) description: Fall, spring. 3 credits.

Newton and Euler dynamics of a particle and rigid body. Kinematics: velocity, acceleration, polar coordinates, angular velocity and acceleration, and motion relative to a moving frame. Principles of linear and angular momentum balance and work-energy. Examples include particle ballistics, pendula, wheels, pulleys, gears, mass-spring-dashpot, simple vehicle dynamics, simple mechanisms, and dynamic balance.

Required or Elective course: Elective, but may be required in some Majors.

Prerequisite(s): T&AM 202 (Mechanics of Solids), coregistration in MATH 293 (Engineering Mathematics), or permission of instructor.

Textbook(s) and other required material:

1. *Engineering Mechanics: Dynamics*, J.L. Meriam and L.G. Kraige, John Wiley & Sons, Fifth Edition, 2002, or equivalent.
2. *Lab Manual*, T&AM, self-produced.

Course objectives:

For students to learn how to use elementary particle and rigid body dynamics to make predictions about the forces and motions of simple moving objects, structures and machines.

Topics covered:

- Free-body diagrams
- Kinematics of a particle, including Cartesian, path and polar coordinates
- Relative and constrained motions
- $\mathbf{F} = m\mathbf{a}$
- Vibrations of single-dof systems
- Principles of work-energy, linear and angular impulse-momentum for a particle
- Finite systems of particles
- Planar rigid-body kinematics
- Relative velocity and acceleration for rigid bodies
- Motion with respect to rotating axes
- Planar rigid-body kinetics
- Fixed-axis rotation in 2D and 3D
- Principles of work-energy and impulse-momentum for rigid bodies
- 3-D kinematics of rigid bodies, including vector angular velocity and acceleration
- General motion of a rigid body
- Inertia matrix
- Angular momentum and $\mathbf{M} = d\mathbf{H}/dt$
- Lab topics: 1 DOF vibrations, Normal modes, Slider-crank kinematics, Gyroscope phenomenology.

Class/laboratory schedule: Two 50-minute lectures and one 50-minute recitation each week. Labs meet four times during the semester for 2 hours each.

Contribution of course to meeting the professional component: Basic engineering sciences with experimental experience.

Course outcomes and their relation to ABET program outcomes (a-k):

Upon completion of the course, students should be able to:

1. Draw free-body diagrams, distinguishing forces from inertial effects;
2. Describe particle motion in 1-D, 2-D and 3-D employing Cartesian and path coordinates, and moving reference frames;
3. Characterize 2-D and 3-D kinematics of rigid bodies, including vector angular velocities and accelerations;
4. Apply Newton/Euler laws to the motion of particles and rigid bodies;
5. Use the principles of linear/angular impulse-momentum and work-energy to solve dynamics problems;
6. Recognize simple harmonic motion for 1-degree-of-freedom mechanical systems.

Outcome Assessment: In addition to analyzing student surveys administered by the College, the instructor will assess the six outcomes of the course by considering student results in specific questions on homeworks, exams and laboratory reports.

Person(s) who prepared this description and date of preparation:

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Most recent revision: March 11, 2004