MECH 320: Dynamics

Catalog description: 3.0 units

Kinematics and dynamics of mechanical systems composed of rigid bodies. Moments and products of inertia, forces of interaction, inertia forces and torques. Equations of motion of non-planar systems.

Prerequisites: CIVL 211, MATH 260 (may be taken concurrently)

Course objectives

For students to learn how to predict the motion and forces causing that motion of physical systems which are adequately modeled as collections of particles and rigid bodies with emphasis on formulating equations of motion of complex systems using a rational set of rules.

Course outcomes: Students shall be able to

1. Determine the number of degrees-of-freedom of a mechanical system modeled as a collection of particles and rigid bodies in a reference frame
2. Define a set of coordinates for a mechanical system modeled as a collection of particles and rigid bodies in a reference frame
3. Find a replacement for a set of forces consisting of a single force applied at a specified point and a couple and find the moment of the couple
4. Find an expression for the velocity of a point moving in a plane in terms of given coordinates and unit vectors
5. Find an expression for the acceleration of a point moving in a plane in terms of given coordinates and unit vectors
6. Find an expression for the angular velocity of a rigid body which has a simple angular velocity but no fixed axis of rotation in terms of given coordinates and unit vectors
7. Find an expression for the angular acceleration of a rigid body which has a simple angular velocity but no fixed axis of rotation in terms of given coordinates and unit vectors
8. Locate the center of mass of a homogeneous rigid body which is composed of simple geometrical shapes
9. Find the moment of inertia of a rigid body using a table of moments of inertia, the method of composites and the parallel axis theorem
10. Find the product of inertia of a rigid body using symmetry, the method of composites and the parallel axis theorem
11. Find an expression for the inertia force of a rigid body
12. Find an expression for the inertia moment of a rigid body
13. Draw a planar free-body diagram of a single rigid body showing all contact, distance and inertia forces and moments

Topics covered

1. Review of statics
2. Idealized models, system diagrams, free-body diagrams

3. Reference frames, coordinates, degrees-of-freedom
4. Vector mathematics
5. Position vectors
6. Velocity
7. Acceleration
8. Inertia forces
9. D'Alembert's Principle for a particle model
10. Center of mass
11. Moments of inertia
12. Products of inertia
13. Inertia moments
14. D'Alembert's Principle for a rigid body

Class/Laboratory schedule

One hundred fifty minutes of lecture per week

Contribution of course to meet the professional component

This course contributes to the student's ability to work professionally in the mechanical systems area.

Relationship of course to Mechanical Engineering Program Outcomes

This course contributes principally to Program Outcome A.