MAE 30A
Statics & Introduction to Dynamics (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours of outside preparation.
12 hours/week total

Course Coordinator(s): Qi, Huihui and Lal, Ratnesh

Textbooks/Materials:

1. Beer and Johnston, Vector Mechanics for Engineers - Statics, McGraw-Hill, 2019 (12th Edition)
2. Hibbeler, R.C., "Engineering Mechanics: Statics", Pearson Prentice Hall, 2016 (14th Edition)

Catalog Description: Statics: statics of particles and rigid bodies in 3-D. Free body diagrams. Moment of a force, couples, equivalent systems of forces. Distributed forces, centroids, and centers of gravity. Introduction to dynamics: 3-D relative motion, kinematics, and kinetics of particles. Newton's equations of motion. Equilibrium problems with friction.

Prerequisites: Math 31BH or Math 20C and Phys. 2A

Course Type: Required

Course Objectives:
Objective 1
1.1 Students will demonstrate an understanding of force balance in case of equilibrium (Newton's first law of motion), the principle of action and reaction (Newton's third law), and the principle of transmissibility of force for rigid bodies. Students will understand the notions of force as a sliding vector and couple as a free vector.
1.2 Students will demonstrate the ability to model and analyze 2D and 3D supports constraining the movement of rigid bodies and determine the corresponding reactions.
1.3 Students will demonstrate the ability to make simplifying assumptions in constructing first- approximation models of simple engineering structures such as bridges, trusses, frames, and machines.
1.4 Students will demonstrate the ability to isolate portions of a structure and to draw their appropriate free-body diagrams and to evaluate internal forces.
1.5 Students will demonstrate the ability to apply knowledge referred to in 1.1-1.4 to formulate and solve equilibrium equations for particles and rigid bodies in 2D and 3D.

Objective 2

2.1 Students will demonstrate the ability to find centroids of simple and composite shapes.

2.2 Students will demonstrate the ability to replace systems of forces and couples with reduced equivalent systems.

2.3 Students will demonstrate the ability to apply the knowledge referred in 2.1 and 2.2 to facilitate the determination of support reactions and the solution to equilibrium problems involving concentrated and distributed loads.

Objective 3

3.1 Students will demonstrate the ability to apply the method of joints and the method of sections to determine internal forces in members of statically determinate trusses.

3.2 Students will demonstrate the ability to analyze statically determinate frames and machines by creating free-body diagrams of isolated portions of these structures and by applying equilibrium equations to determine internal forces at connecting sites.

Objective 4

4.1 Students will demonstrate an understanding of Newton's laws of motion and basic equations underlying kinematics and kinetics of particles.

4.2 Students will demonstrate the ability to identify known and unknown kinematic and kinetic variables.

4.3 Students will demonstrate the ability to construct free-body diagrams, impose Newton's second law of motion, and solve for the unknown variables.

4.4 Students will demonstrate an understanding of tangential and normal acceleration, and the ability to analyze dynamics of particle in curvilinear motion.

4.5 Students will demonstrate the ability to use polar coordinate representation in the solution to particle dynamics problems.

4.6 Students will demonstrate the ability to identify and effectively account for kinematic constraints, such as occur in particle motion in a curved groove, and their kinetic consequences.

Objective 5

5.1 Students will learn how to analyze and solve statics and particle dynamics problems with friction.

Course Topics:

1. Statics of particles
2. Moment of a force, couples, equivalent systems of forces
3. Equilibrium of rigid bodies in 2D and 3D
4. Distributed forces, centroids, and centers of gravity
5. Static analysis of trusses, frames, and machines
6. Kinematics and kinetics of particles
7. Statics and particle dynamics problems with friction

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