MAE 30B
Dynamics and Vibrations (4 units)

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

Course Coordinator(s): Marko Lubarda and Maziar Ghazinejad

Textbooks/Materials:

1. Beer and Johnston, Vector Mechanics for Engineers - Statics, McGraw-Hill, 2012, 10th ed.
2. Hibbeler, R.C., "Engineering Mechanics: Statics", Pearson Prentice Hall, 2010, 12th ed.

Catalog Description: Dynamics: energy methods for motion of particles and rigid bodies, including virtual work, power, and Lagrange's equations. Impact and impulses. Systems of particles. Introduction to 3-D dynamics of rigid bodies. Introduction to vibrations: free and harmonically forced vibrations of undamped and damped single degree of freedom systems.

Prerequisites: MAE 30A

Course Type: Required

Course Objectives:

Objective 1
1.1 Students will demonstrate an understanding of Newtonian mechanics and basic equations underlying kinematics and kinetics of particles and rigid bodies.

Objective 2
2.1 Students will demonstrate the ability to isolate rigid bodies and to draw their appropriate free body diagrams.
2.2 Students will demonstrate an ability to identify known and unknown kinematic and kinetic variables.
2.3 Students will demonstrate an ability to identify and effectively account for kinematic constraints such as rolling and/or sliding, and their kinetic consequences.
2.4 Students will demonstrate that they can apply and combine the appropriate principles referred to in Objective 1 to the solution of problems.

Objective 3
3.1 Students will demonstrate an understanding of work-energy principles as applied to moving particles and rigid bodies.
3.2 Students will be able to evaluate the kinetic energy of rigid bodies as well as the potential energy associated with gravity and spring forces.
3.3 Students will demonstrate an ability to apply impulse-momentum relations to rigid bodies. where appropriate.

3.4 Students will demonstrate an ability to analyze free and forced vibration of single degree of freedom systems

Course Topics:

1. Analyze position, velocity, and acceleration of particles undergoing general motion in different systems of coordinates
2. Draw Free-body diagrams for particles; apply the equations of motion for a particle in general motion; analyze the kinetics of a particle undergoing general motion.
3. Calculate the work of a force and apply the principle of work and energy to a particle or system of particles.
4. Determine the potential energy of conservative forces and apply the principle of conservation of energy to a particle or system of particles
5. Determine the linear momentum and the angular momentum of a particle.
6. Apply the principles of linear impulse & momentum and angular impulse & momentum; Use conservation of angular momentum to solve problems
7. Understand and analyze the mechanics of impact; analyze the motion of bodies undergoing a collision
8. Analyze the kinematics of a rigid body undergoing general plane motion; Determine the velocity and acceleration of a rigid body undergoing general plane motion using an absolute and relative motion analysis
9. Use the instantaneous center to determine the velocity of any point on a rigid body in general plane motion.
10. Determine the mass moment of inertia of a rigid body or a system of rigid bodies
11. Draw Free-body diagrams for a rigid body; apply the equations of motion for a rigid body in general motion; analyze the kinetics of a rigid body undergoing general motion.
12. Apply the principle of work and energy and the principle of conservation of energy to a rigid body
13. Develop formulations for the linear and angular momentum of a rigid body.
14. Apply the principle of linear and angular impulse and momentum of a rigid body. Use conservation of linear/ angular momentum for solving rigid body kinetics problems
15. Analyze the free vibration of single degree of freedom systems using equations of motion and energy methods
16. Analyze the forced vibration of single degree of freedom systems.

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