DIM-SAP-233 Introduction to Dynamics

SEMESTER: Spring

CREDITS: 6 ECTS (4 hrs. per week)

LANGUAGE: English

DEGREES: SAPIENS program

Course overview

Students who successfully complete this course will be able to:

- develop strategies to analyse the dynamics of particles and rigid bodies
- apply the laws of dynamics to analyse and interpret the dynamics of particles and rigid bodies
- use the computer to analyse the motions of particles and rigid bodies of open-ended problems

Prerequisites

Students are expected to have a good understanding of:

- classical mechanics (Newton's Laws, work and energy, systems of particles, and rotations);
- basic statics (forces, moments, couples; resultants of force systems; equilibrium analysis and free-body diagrams; analysis of forces acting on members of trusses, frames; Coulomb friction; centroids and center of mass);

and to:

- be familiar with curve sketching, exponential and trigonometric functions.
- be able to differentiate and integrate simple functions
- be familiar with partial derivatives and basic complex number algebra.

Course contents

1. **Kinematics of Particles**. Mathematical preliminaries. Kinematics definitions. Rectilinear motions. Cartesian coordinates. Angular motion. Normal-tangential coordinates. Polar coordinates. Relative Motions. Constrained motion along a line.
2. **Kinematics of Rigid Bodies**. Rigid body motions. Rotation about a fixed line. General plane motions: velocities. Instantaneous centers. General Motions: accelerations. Sliding contact motions. Motion relative to rotating axes.
3. **Kinetics of Particles**. Basic equation of motion, free body diagrams. Rectilinear motions. Curvilinear motions. Work energy principle. Work done by particular forces. Energy conservation principles. Momentum and impulse principles. Conservation of linear momentum. Impact problems. Angular impulse and momentum.

4. **Kinetics of Rigid Bodies**. Momentum principles for a system of particles. Equations of motion. Mass moment of inertia. Work energy principles. Momentum and impulse principles.
5. **Three-Dimensional Dynamics of Rigid Bodies**. Kinematics. Euler's equations. Mass moment of inertia matrix.
6. **Introduction to Euler's equations**. Euler's equations. Euler's angles, gyroscopic systems.
7. **The simple oscillator and its applications.**
8. **Introduction to Software as a help for problem resolution.**
    a. Matlab.
    b. Solidworks.

Textbook

- "Engineering Mechanics: Dynamics", 7th edition, J. L. Meriam and L.G. Kraige.

Grading

The grade will be determined by at least two midterms (35%), homework (40%), and the final examination (25%). The exams are all closed notebook and closed textbook. The course will not be graded on a curve, i.e., there is no bound on the numbers of A's, B's, C's etc.

In some special cases, and explicitly agreed between the student and the Professor, the final exam may be substituted by a final project.

The retake exam will bear the weight 40% on the total grade, meanwhile the midterms will have 30 % and the homework 30%. In some special cases, and explicitly agreed between the student and the Professor, the retake exam may be substituted by a final project.