Universidad Zaragoza

Year : 2020/21

29916 - Mechanics

Syllabus Information

Academic Year: 2020/21
Subject: 29916 - Mechanics
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 435 - Bachelor's Degree in Chemical Engineering
ECTS: 6.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

This course of Mechanics deals with the relationship between the forces acting on a mechanical system (vehicle, robot, mechanisms...) and the resulting motion of the system. Therefore, the emphasis is placed on the dynamic problem under the classical laws of physics (Newtonian Mechanics)

Thus, this course is divided into two consecutive and interconnected parts: kinematics (motion description with no concern about its causes) and kinetics (causes, analysis, modeling and resolution of the dynamic problem). Kinematics will cover not only 2D systems but 3D systems as well (introducing Euler angles). Regarding kinetics, we will solve 3D models using Newton laws. In addition, energy principles will be applied only to 2D systems with one degree of freedom.

4.2.Learning tasks

Teaching activities will be developed in three levels: theory classes, problem classes and laboratory sessions, with an increasing level of student participation. The student will take three hours a week in the classroom (theory lectures and problem classes) and five laboratory sessions during the semester.

- In theory classes, the theoretical basis of mechanical systems will be presented, using real-world, engineering, examples as well as bibliographic references and websites.
- In problem classes, representative problems and case studies will be solved, encouraging student participation by means of oral questions.
- Laboratory sessions will be dedicated to show students a variety of mechanisms and mechanical systems: scotch yoke, four-bar linkage, gyroscope, etc. Students will work with basic mechanism simulation software to understand

the motion of mechanisms.

At the same time, students will be asked to solve some programmed exercises in small groups, thus promoting collaborative learning, to help following the basic topics, which cover from movement description to dynamical analysis.

4.3.Syllabus

The course will address the following topics:

1. Particle kinematics

- Kinematic frames of reference: relative and absolute motion

- Kinematic vectors: position, velocity, acceleration.

- Intrinsic components of acceleration.

2. Bases and orientation

- Vector bases: orientation and angular velocity

- The derivative of an arbitrary vector. Bouré expression

- Orientation in mechanical systems. Euler angles.

3. Relative motion

- Velocity and acceleration using a moving reference frame

- Motion from a moving reference system: case studies

4. Kinematics of rigid bodies

- Kinematics of rigid bodies: general equations

- Rolling without slipping

5. Mechanical systems kinematics

- Generalized coordinates and degrees of freedom

- Constraints. Holonomic and non-holonomic systems.

6. Plane motion of rigid bodies.

- Planar kinetics. Mechanisms.

- Instant center of rotation.

7. Forces in Newtonian mechanics

- Force and moment. Torsor of forces.

- Active and passive forces.

- Basic models for mechanical elements: springs, dumpers, engines, friction...

8. The geometry of rigid bodies.

- Centre of inertia. Examples.

- Inertia tensor. Moments and products of inertia. Parallel axis theorem (Steiner).

-Symmetric and Spherical Rotors.

9. Newtonian kinetics of rigid body systems

- Equations of motion: Newton-Euler laws

- Case studies in 3D motion

10. Work-energy theorem

- Work and energy. Kinetic and potential energy.

- Work and energy principle application to planar kinematics. Case studies.

4.4.Course planning and calendar

Further details concerning the calendar, timetable, classroom and other information regarding this course will be provided during the first day of class.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=29916&year=2020