Universidad Zaragoza

29916 - Mechanics

Información del Plan Docente

Academic Year	2017/18
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.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

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

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

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

Thus, this course is divided in two consecutive and interconnected parts: kinematics (motion description with no concern about its causes) and kinetics (causes, analysis, modelling 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.

5.2.Learning tasks

Teaching activities will be developed in three levels: theory classes, problem classes and laboratory sessions, with 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.

5.3.Syllabus

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

- 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 centre 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. 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.

5.4.Course planning and calendar

5.5.Bibliography and recommended resources

BB	Agulló Batlle, Joaquim. Mecánica de la partícula y del sólido rígido / Joaquim Agulló Batlle ; versión en castellano de Ana Barjau Condomines . 2ª ed. corr. y amp. Barcelona : OK Punt, D.L. 2000
BB	Lladó París, Juan. Mecánica : Grado en Ingeniería de Tecnologías Industriales / Juan Lladó París, Beatriz Sánchez Tabuenca. Zaragoza : Copy Center, D.L. 2013
BC	Cardona Foix, Salvador. Teoría de máquinas / Salvador Cardona Foix, Daniel Clos Costa . 2ª ed. Barcelona : UPC, 2008
BC	García Prada, J. C.. Problemas resueltos de teoría de máquinas y mecanismos / J. C. García Prada, C. Castejón Sisamón, H. Rubio Alonso Madrid : Thomson-Paraninfo, D. L. 2007
BC	Lamadrid Martínez, Adelardo de. Cinemática y dinámica de máquinas / Adelardo de Lamadrid Martínez y Antonio de Corral Saiz . 7a. ed. Madrid : [los autores], 1992|e(Madrid :|fE.T.S. de Ingenieros Industriales de Madrid)
BC	Mabie, Hamilton H.. Mecanismos y dinámica de maquinaria / Hamilton H.

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	Mabie, Fred W. Ocvirk . 2a. ed., 2a reimpr. Mexico [etc.] : Limusa, cop. 2000
BC	Norton, Robert L. : Diseño de maquinaria : síntesis y análisis de máquinas y mecanismos / Robert L. Norton ; revisión técnica, Miguel Ángel Ríos Sánchez, Cuitláhuac Osornio Correa, Mario Acevedo Alvarado . - 5ª ed. México [etc.] : McGraw-Hill, cop. 2013
BC	Sclater, N; Chironis, N. Mechanisms and mechanical devices sourcebook. - 4ª Mc Graw Hill, 2007.