

29811 - Mechanics

Información del Plan Docente

Academic Year	2018/19
Subject	29811 - Mechanics
Faculty / School	110 - Escuela de Ingeniería y Arquitectura 326 - Escuela Universitaria Politécnica de Teruel
Degree	440 - Bachelor's Degree in Electronic and Automatic Engineering 444 - Bachelor's Degree in Electronic and Automatic Engineering
ECTS	6.0
Year	2
Semester	First 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 is concerned about the relationship between the forces acting on a mechanical system (vehicle or robot in 3D, mechanism in 2D) and the motion which is produced by these actions, that is to say, a course of Newtonian Dynamics.

This subject is divided in two consecutive and interconnected parts: kinematics (motion description without be concerned about causes) and kinetics (causes analysis and modelling and resolution of dynamic problem).

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Kinematics will be extended to 3D systems as it was explained before (Eulerian angles for example), and for kinetics 3D models using Newtonian laws will be solved. Energy principles will be only applied to 2D systems with one DOF for clarity.

The student will course theoretical classes where the main subject contents are presented and discussed, classes for solving problems where practical applications of the theoretical concepts are developed and solved, and lab sessions where the theoretical concepts are applied.

At the same time, the student will solve some programmed exercises in small groups, promoting collaborative learning, following the basic topics from movement description to dynamical analysis.

4.2.Learning tasks

The offered program to help to the student to reach the objectives consists of:

FACE TO FACE WORK: 2.4 ECTS (60 hours)

1) Theory session (T1 type) (30 hours face to face)

During these sessions theoretical and practical concepts are shown. These concepts consist on the mechanical systems explained by means of real examples. Student participation will be encouraged through questions and brief discussions. Basic documentation of the course will be available through the ADD.

2) Practice session (T2 type) (15 hours face to face)

Problems and real cases will be developed with the participation of students. Problem solving will always be coordinated in time with the theoretical contents.

Students will be encouraged to work previously the problems.

3) Laboratory session (T3 type) (15 hours face to face)

In these sessions, the student will follow a practical script which he must prepared in advance in order to complete the concepts explained during master classes and problem classes. During lab sessions the student will work in movement calculation and geometrical resolutions. The set of lab sessions will be assessed together with other exercises as indicated above.

Laboratory sessions programmed by EINA (6 sessions; 2.5 hours per session)

- Position and orientation: importance in robotics
- Mechanism I: generalities, types and applications

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- Mechanism II: generalities, types and applications
- Mass geometry: calculation and applications
- Case Study: approach and solving a dynamic problem

Laboratory sessions programmed by Escuela Universitaria Politécnica de Teruel (EUPT):

- Position and orientation: importance in robotics
- SolidWorks introduction
- Movement analysis I
- Movement analysis II
- Dynamic

PERSONAL WORK: 3.6 ECTS (90 hours)

1) Academic Works (T6 type) (30 personal hours)

The professor will suggest during the course, a set of activities which the students must solve to be assessed. Each student must present an individual academic dossier and a work made by group. Each student will dispose of two tutorial hours to guide this work.

2) Personal study work (T7 type) (55 personal hours)

Personal study of the theoretical part and realization of problems. The personal work of student will be encouraged by the homogeneous distribution during the semester of a set of learning activities. A uniform distribution over time is suggested because of the structure of the course in which every concept is linked with the following. Tutorial sessions are included in personal study work to guide to the student in the identification of learning problems, orientation in the course, attention to exercises and other assignments.

3) Assessments (T8 type) (5 hours face to face).

Evaluation tests are tools to assess the student and they are useful in order to the student can check the knowledge and understanding degree of the course. A first test has been included during the semester to reach this objective.

4.3.Syllabus

Lecture topics

1. Particle kinematics

- Kinematic workframes: relative and absolute motion
- Kinematic vectors: position, velocity, acceleration

2. Bases and orientation

- Vectorial bases and orientation. Eulerian angles and mechanical systems rotations.
- Derivative of an arbitrary vector

3. Relative motion

- Velocity and acceleration using a moving reference frame
- Motion from a moving reference system: case studies

4. Kinematics of rigid bodies

- General equations
- Rolling without slipping

5. Mechanical systems kinematics

- Generalized coordinates and degrees of freedom
- Constrains. Holonomic and non holonomic systems.

6. 2D kinematics of rigid bodies.

- Planar kinetics. Mechanisms.
- Instant centre of rotation.

7. Forces in Newtonian mechanics

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- Force and moment. Torsor of forces.
- Active and passive forces.
- Basic models for mechanical elements: springs, dampers, engines, friction...

8. Body parameters.

- Centre of inertia. Examples.
- Inertia tensor. Moments and products of inertia. Steiner's theorem.
- Moment of inertia tensor.

9. Newtonian kinetics of rigid body systems

- Equations of motion: Newton-Euler laws
- Case studies in 3D motion

10. Work-energy principles

- Work and energy. Kinetic and potential energy.
- Work and energy principle application to planar systems. Case studies.

4.4. Course planning and calendar

Schedule sessions and academic work presentation

The course calendar is defined by the University of Zaragoza. Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the EINA website (<http://eina.unizar.es>) and EUPT website (<https://eupt.unizar.es/>).

Each teacher will inform about his office hours .

The other activities will be planned depending on the number of students and will be announced long in advance.

References and course material

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1. Slides and notes of the course (Available in ADD)
2. Suggested problems and scripts of practical sessions (Available in ADD)
3. Reference book:
 - J. Lladó, B. Sánchez, "Mecánica" Copy Center Digital, 2013
4. Complementary books: consult references and bibliography

4.5. Bibliography and recommended resources