29811 - Mechanics

Información del Plan Docente

Academic Year	2017/18
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.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 is concerned about the relationship between the forces acting on a mechanical system (vehicle, robot, mechanism...) and the motion which is produced by the forces system, 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).

Kinematics will be extended to 3D systems as it was explained d 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 three hours per week in the classroom (lectures, examples, problems) and five laboratory sesions during semester about 2D and 3D dynamic systems.

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

5.2.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) Master classes (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) Problems classes (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) Cabinet sessions (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 practical sessions the student will work in movement calculation and geometrical resolutions. The set of practical sessions will be assessed together with other exercises as indicated above.

Practical sessions programmed by EINA (5 sessions; 3 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

In 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)

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) (60 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) Evaluation tests (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.

5.3.Syllabus

Lecture topics

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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

- Force and moment. Torsor of forces.

- Active and passive forces.

- Basic models for mechanical elements: springs, dumpers, 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 theorem

- Work and energy. Kinetic and potential energy.

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

5.4.Course planning and calendar

Schedule sessions and academic work presentation

Master classes, problem classes, and practical sessions in cabinet will be given according to EINA schedule (schedules available on EINA website).

Each teacher will inform about his tutorial schedule.

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

References and course material

1. Slides and notes of the course (Available in ADD)

2. Suggested problems and scripts of practical sessions (Available in ADD)

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3. Reference book:

- J. Lladó, B. Sánchez, "Mecánica" Copy Center Digital, 2013

4. Complementary books: consult references and bibliography

5.5.Bibliography and recommended resources

Basic references:

- Lladó París, Juan. Mecánica : Grado en Ingeniería de Tecnologías Industriales / Juan Lladó París, Beatriz Sánchez Tabuenca. Zaragoza : Copy Center, D.L. 2013.
- 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

Other references:

- Cardona Foix, Salvador. Teoría de máquinas / Salvador Cardona Foix, Daniel Clos Costa . 2ª ed. Barcelona : UPC, 2008
- 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)
- 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
- Mabie, Hamilton H.. Mecanismos y dinámica de maquinaria / Hamilton H. Mabie, Fred W. Ocvirk . 2a. ed., 2a reimpr. Mexico [etc.]: Limusa, cop. 2000