Universidad de Alcalá

TEACHING GUIDE

Mechanical systems

Degree in
Industrial Electronics and Automatics Engineering

Universidad de Alcalá

Academic Year 2022/2023

1st Year - 2nd Semester

Approved by the School Board on June 3, 2022

TEACHING GUIDE

Course Name:	**Mechanical systems**
Code:	**600006**
Degree in:	**Industrial Electronics and Automatics Engineering**
Department and area:	**Teoría de la Señal y Comunicaciones** **Mechanical Engineering**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**1st Year, 2nd Semester**
Teachers:	Por definir
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

Mechanism and machines form the core and power for industrialization and hence a basic area in industrial engineering. Current industrial production and automation would be impossible without machines. Therefore, an adequate engineering teaching must comprise, for whatever specialization, a solid comprehension of principles and basics of mechanical systems. Countless electronic applications are used for measuring, controlling and monitoring machines, mechanisms and mechanical parameters

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/351/2009:

en_TR2 - Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and gives them versatility to adapt to new situations.

en_TR3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.

en_TR4 - Knowledge to carry out measurements, calculations, assessments, appraisals, appraisals, studies, reports, work plans and other similar works.

en_TR5 - Ability to handle specifications, regulations and mandatory standards.

en_TR9 - Ability to work in a multilingual and multidisciplinary environment.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/351/2009:

en_CI8 - Knowledge and use of the principles of resistance of materials

Learning Outcomes

After succeeding in this subject the students will be able to:

RASM7: To calculate kinetics and power relationships in a mechanism.

RASM8: To distinguish among the different kinds of kinematic chains and to obtain by calculations the adequate transmission conditions.

RASM9: To describe the different types of gear and to calculate their dimensional parameters.

RASM10: To list the different types of speed reducers and to select the appropriate one depending on the power and speed conditions.

RASM11: To describe the mechanical couplings as joining systems between shafts and axles. To distinguish the coupling according to their transmitted power and their capacity to compensate axles misalignments.

RASM12: To explain the operation of a clutch, to know the different types and to calculate the forces that appear in their operations.

RASM13: To analyze the operation of a brake, to know the different types of brakes and to calculate the involved forces and the braking time.

RASM14: To list the bearing applications, their types and to calculate the life working hours.

RASM15: To list the applications of a crank mechanisms and to understand and to calculate the forces that appears during operation.

RASM16: To analyze cam mechanisms, the different types of cams and followers and to design an Archimedes spiral cam.

RASM17: To describe the operation of a kinematic chain consisting of different types of elements that transmit the motion from the motor to the final use connection.

RASM18: To use with solvency the technical documentation that specialized manufacturers of mechanisms provide for the calculation of their products.

3. CONTENTS

Contents Blocks	Total number of hours
INTRODUCTION TO MECHANISM Clasification, uses and degrees of freedom. Kinematic pairs. Homokinetic joint and couplings.	6 hours
KINEMATIC AND DYNAMIC OF MECHANISMS Four bars. Grashof condition and 6 bars mechanisms. Kinetics and dynamics analysis, synthesis and uses os mechanisms. Crankshaft mechanism. Kinetics and dynamics of rotational systems. Static and balancing of rotors.	34 hours
MOTION TRANMISSION Sliding bearings and rolling bearings. Introduction to tribology. Rolling bearings. Design rules, types and selection. Cams Gears: trains, planetary, differential, belts and chains. Clutches, brakes, couplings	16 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The teaching strategy of the course is divided into 3 sections: classroom learning, learning in small groups and finally the working sessions in the laboratory.

Sessions of large group in the classroom:

Working sessions in the classroom, in large groups, will consist of lectures where the main concepts of the theory of circuits will be presented. The aim is to introduce students to the theoretical foundations of circuit analysis in a guided and reflective way. The understanding of these concepts will culminate with the use of them in both the laboratory and the problem solving sessions in small groups.

Teaching materials will be essential to create reflective learning environments, where students and teachers can undertake a critical analysis that allows the student to autonomously relate concepts.

The order of presentation of the contents will evolve from the simple to the complex, in order to avoid a high degree of abstraction that might cause a student lack of interest in the course. In any case, it is very convenient, during the working sessions in the classroom, to establish linkages with other subjects in the curriculum, and to provide possible experience on the contents, which will help to attract students' attention and will encourage their interest in the subject.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default,

according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

Continous Assessment:

The main assessment tools will be:

1. **Partial Exercise test 1 (PEP1)**. Practical and theoretical exercises resolution of part of the contents.
2. **Partial Exercise test 2 (PEP2)**. Practical and theoretical exercises resolution of part of the contents.
3. **Final examination (PEF)**. Practical and theoretical exercises resolution.

Assessment through final exam:

In the case of evaluation by means of a final exam, the evaluation elements to be used will be the following:

1. **Partial Exercise test 1 (PEP1)**. Practical and theoretical exercises resolution of part of the contents.

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined::

CE1: The student i sable to analyze kinematic and dynamically a mechanical system. The student is able to calculate accurately the mechanical involved magnitudes.

CE2: The student is able to design useful, efficient and practical mechanical systems.

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

1. Ordinary call
    a. Continuous assessment, with three assessment exams (PEP1 and PEP2).
    b. Final assessment (PEF)
2. Extraordinary call. Final assessment (PEF)

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR4, TR5, TR9 y CI7	RASM7-18	CE1, CE2	PEP1	30%
			PEP2	30%
			PEF	40%

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR2, TR3, TR4, TR5, TR9 y CI7	RASM7-18	CE1, CE2	PEF	10%

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- A.G. Erdman y G.N. Sandor. Diseño de mecanismos, análisis y síntesis. Prentice Hall, 3ra Edición, 1998.
- A. Bedford y W. Fowler. Mecánica para Ingeniería. (Estática y Dinámica). Pearson Education 5ª 2008.
- Beer-Johnston Mecánica vectorial para ingenieros, Mc. Graw-Hill.

6.2. Additional Bibliography

- J. Agulló Batlle, Mecánica de la partícula y del Sólido Rígido, Publicaciones OK PUNT, Barcelona, 2000.
- Norton, Robert L. Diseño de maquinaria Síntesis y análisis de máquinas y mecanismos, Editorial MacGraw-Hill, 2013.
- A. Simón, A. Bataller, A.J. Guerra, J.A. Cabrero. Fundamentos de Teoría de Máquinas. Ed. Bellisco, 3ª edición 2009.
- Joseph Edward Shigley y John Joseph Uicker. Teoría de máquinas y mecanismos. Jr. Editorial MacGraw-Hill
- G.Niemann. Elementos de máquinas. Volumen I ..Editorial Labor, S.A
- Joseph Edward Shigley; Larry D. Mitchel. Editorial MacGraw-Hill. Quinta edición.

- Machine Theory, J.L. Pérez Díaz et al , Diseño de ingeniería mecánica. OCW uc3m, http://ocw.uc3m.es/ingenieria-mecanica/machine-theory

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.