Course guide
320159 - SM - Mechanical Systems

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 712 - EM - Department of Mechanical Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Pàmies Gómez, Teresa

Others: Ripoll Garcia, Ruben
Arcos Villamarín, Robert
Ciscar Adalid, Maria

PRIOR SKILLS

Students will be expected to be fully proficient in statics as taught in Physics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).
CED02-DIDP. Ability to define operating conditions for pneumatic and hydraulic systems applicable to machines and mechanical systems. (Common module for the industrial branch).
CED03-DIDP. Ability to propose configurations for pneumatic and hydraulic systems. (Common module for the industrial branch).
CED06-DIDP. Ability to analyze and model the kinematic and dynamic behavior of mechanical systems. (Common module for the industrial branch).

TEACHING METHODOLOGY

- Face-to-face lectures and problem solving sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the lectures, the lecturer will introduce the theoretical fundamentals of the subject, concepts, methods and results, which will be illustrated with relevant examples to facilitate their understanding.
Students will be expected to study in their own time so that they are familiar with concepts and are able to solve the exercises set.
Tools found on the ATENEA platform will be used to foster collaborative learning.
The transversal piece of work on the course will concentrate on the study of an object, machine or real mechanism. It will be completed outside of class time in groups.

LEARNING OBJECTIVES OF THE SUBJECT

Provide students with the knowledge that will enable them to determine the parameters characteristic of a mechanical system.
Examine the elements characteristic of power systems, for subsequent use in statics and dynamics.
Model applied force and bonding actions so that diagrams of the free system can be plotted.
Understand the kinematics and dynamics of simple mechanisms and the basic concepts behind them.
The ultimate aim of the above set of skills is to apply them to the static study of various systems: particles, rigid bodies, trusses and cables. It is essential to acquire these skills as they will subsequently be used in many applications.
Recognize the components of hydraulic and pneumatic systems as well as to design them.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Self study	90,0	60.00
Hours medium group	30,0	20.00

Total learning time: 150 h

CONTENTS

TOPIC 1: INTRODUCTION

Description:
1.1. Fundamental concepts
1.2. Newton's laws
1.3. Vector study
1.4. Statics of particles

Specific objectives:
- Introduction to the subject, learning objectives, syllabus, coursework, assessment system and reading list.
- Introduction of the basic concepts of mechanics.
- Overview of all the vector concepts required to follow the subject.

Full-or-part-time: 6h
Theory classes: 2h
Laboratory classes: 2h
Self study : 2h

TOPIC 2: HYDRAULIC AND PNEUMATIC CIRCUITS

Description:
2.1. Pneumatic / Hydraulic
2.2. Circuit components
2.3. Basic design of the circuits

Specific objectives:
- Basic study of hydraulic and pneumatic circuits.
- Symbology and components used.

Related activities:
AV1, AV3

Related competencies :
CED02-DIDP. Ability to define operating conditions for pneumatic and hydraulic systems applicable to machines and mechanical systems. (Common module for the industrial branch).
CED03-DIDP. Ability to propose configurations for pneumatic and hydraulic systems. (Common module for the industrial branch).

Full-or-part-time: 36h
Theory classes: 8h
Practical classes: 6h
Self study : 22h

TOPIC 3: STATICS OF RIGID BODIES

Description:
3.1. Equilibrium in two dimensions
3.2. Reactions
3.3. Internal forces

Specific objectives:
- Study of the conditions of equilibrium of a system of rigid bodies.
- Type of forces applied.
- Determination of bonding actions.
- Plotting of diagrams of free solids.
- Study of the internal forces that hold solids together.

Related activities:
AV1, AV4

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 37h
Theory classes: 6h
Practical classes: 6h
Self study : 25h

TOPIC 4: TRUSSES

Description:
4.1. Types of truss
4.2. Statics study of anchors
4.3. Knot theory
4.4. Method of sections

Specific objectives:
- Study of forces that hold each part of a truss together.
- Application of various calculus methods.

Related activities:
AV2

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 13h
Theory classes: 2h
Practical classes: 2h
Self study : 9h

TOPIC 5: CABLES

Description:
5.1. Cables with concentrated loads

Specific objectives:
- Study of tension supported by cables.

Related activities:
AV1

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 14h
Theory classes: 2h
Practical classes: 4h
Self study : 8h

TOPIC 6: KINEMATICS AND MECHANISM DYNAMICS

Description:
6.1. Introduction
6.2. Plane kinematics
6.3. Plane dynamics

Specific objectives:
- Definitions of the basic components that make up a mechanism.
- Methodology for calculating velocity and acceleration.
- Introduction to dynamics.
- Transfer of movement

Related activities:
AV1, AV4

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 44h
Theory classes: 10h
Practical classes: 10h
Self study : 24h

ACTIVITIES

AV1

Description:
Resolution of an exercise proposed by the teacher during the class.

Specific objectives:
The estudiante has to be able to apply and consolidate the theoretical
knowledge achieved on the subject. And also must be able to analise the problem and design the plan for the resolution with the established time.

Material:
Class notes, theory's slides and the wording of the exercise.

Delivery:
The averaged mark of all the exercises done during the course corresponds with a 20% of other deliveries assessment.

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).
CED02-DIDP. Ability to define operating conditions for pneumatic and hydraulic systems applicable to machines and mechanical systems. (Common module for the industrial branch).
CED03-DIDP. Ability to propose configurations for pneumatic and hydraulic systems. (Common module for the industrial branch).

Full-or-part-time: 4h
Practical classes: 4h

AV2

Description:
Solve a case proposed by the teacher, develope it in a written format and do the oral exposition.

Specific objectives:
That the student learn to use strategies for preparing and giving oral presentations, writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors. Participate on working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

Material:
Bibliographical resources of the subject, class notes, rubric of the efficient oral and written communication.

Delivery:
The assessment of written and the oral work corresponds to a 15% in the qualification of the other deliveries.

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 9h
Self study: 9h

AV3

Description:
Development of the first examination of the subject.

Specific objectives:
Develope theoretical and practice classroom knowledge and show the level achieved.

Material:
The wording to be solved.

Delivery:
This activity is evaluated as oral and written tests of the global mark of the subject.

Related competencies :
CED03-DIDP. Ability to propose configurations for pneumatic and hydraulic systems. (Common module for the industrial branch).
CED02-DIDP. Ability to define operating conditions for pneumatic and hydraulic systems applicable to machines and mechanical systems. (Common module for the industrial branch).

Full-or-part-time: 2h
Theory classes: 2h

AV4

Description:
Development of the second examination of the subject.

Specific objectives:
Develope theoretical and practice classroom knowledge and show the level achieved.

Material:
The wording to be solved and a formulary indicated by the teacher.

Delivery:
This activity is evaluated as the item oral and written tests of the global mark of the subject.

Related competencies :
CED01-DIDP. Knowledge of fundamental principles of rigid body mechanics and their application to problem solving in the field of engineering (kinematics, statics, and dynamics). (Common module for the industrial branch).

Full-or-part-time: 2h
Theory classes: 2h

ACV 5

Description:
Large group sessions

Specific objectives:
Establish the theoretical principles of the subject

Material:
Notes on Atenea platform and general bibliography on the subject

Full-or-part-time: 66h 30m
Theory classes: 26h
Self study: 40h 30m

AV 6

Description:
Medium groups sessions

Specific objectives:
Solve problems related to the subject

Material:
Problem collection of the subject uploaded on Atenea

Full-or-part-time: 66h 30m
Practical classes: 26h
Self study: 40h 30m

GRADING SYSTEM

- Oral and written tests 65% (25% first exam, 40% second exam)
- Other deliveries 35% (Deliveries made in class (AV1 1) and project (AV2 2))
- Cross Competence (effective oral and written communication) embedded in the section on other deliveries.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of the activities 3 and 4 and the grades of the activities 1 and 2 will be kept.

If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

EXAMINATION RULES.

Is essential to rate at N1 to be present the date and time of the realization of the activity at the enrolled class.
The realization of the exams is without class notes.

BIBLIOGRAPHY

Basic:
- Hibbeler, R. C. Mecánica vectorial para ingenieros : estática. 10a ed. México: Pearson Educación, 2004. ISBN 9702605016.
- Meriam, J. L. Mecánica para ingenieros, vol. 2, Dinámica [on line]. 3a ed. Barcelona: Reverté, 1998 [Consultation: 20/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635460. ISBN 8429142592.
- Beer, Ferdinand Pierre [et al.]. Mecánica vectorial para ingenieros, vol. 1, estática [on line]. 11ª ed. México: McGraw-Hill, 2017 [Consultation: 20/09/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8077. ISBN 9781456255275.

Complementary:
- Meriam, J. L. Mecánica para ingenieros, vol. 1, Estática [on line]. 3a ed. Barcelona: Reverté, 2004 [Consultation: 20/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5635461. ISBN 8429142576.
- Shigley, Joseph Edward. Teoría de máquinas y mecanismos. México: McGraw-Hill, 1982. ISBN 968451297X.

RESOURCES

Other resources:
Theory slides and problems collection puts on Atenea.