UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Course guide
330063 - SM - Mechanical Systems

Last modified: 14/05/2024

Unit in charge:	Manresa School of Engineering
Teaching unit:	712 - EM - Department of Mechanical Engineering.

Degree:
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN ICT SYSTEMS ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2021). (Compulsory subject).

Academic year: 2024   **ECTS Credits:** 6.0   **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer:	ANAS AL OMAR MESNAOUI
Others:	Alcelay Larrión, José Ignacio
	Català Calderón, Pau
	Ortuño Martin, Jose
	Peña Pitarch, Esteban

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Ability to know, understand and use the fundamental principles that govern the mechanical balance of rigid bodies, as well as the different calculation methods. Understand the problems of analysis and design of mechanical systems.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
3. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

TEACHING METHODOLOGY

- Expository class of theory and problems: in this class it is not intended to make an exhaustive demonstration of the subject, but the student will be given a global vision of it insisting on the key concepts. Doubts will be discussed and standard problems and questions will be solved to ensure understanding of the subjects. The resolution of the problems in face-to-face class aims for the student to learn to analyze them and identify the key elements for their approach and resolution. For each face-to-face session, the student will be provided with enough notice in the virtual classroom, the notes on the topic covered in the session, and a series of problems. The reading of the theoretical content before the face-to-face session is mandatory and will be controlled by formulating questions during the class.
- Carrying out laboratory practices in small groups. Preparation of reports.
- Tutoring, study and personal and team work.
- Exams and evaluation tests.

LEARNING OBJECTIVES OF THE SUBJECT

Once this course is finished, the student must be able to:

- Carry out the composition of a force system and analyze the equilibrium conditions of a rigid body subject to such a system.
- Solve the kinematic and dynamic problem of a mechanical system from the perspective of both analysis and synthesis.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Force Systems

Description:
Forces and Vectors. Moments of Forces. Torque. Centers of Gravity. Reduction of a System of Forces.

Related activities:
A 1, A 6 and A 8

Full-or-part-time: 25h
Theory classes: 8h
Laboratory classes: 2h
Self study : 15h

2. Balance of Rigid Bodies

Description:
Free Body Diagram. Joints and Supports. Equations of Equilibrium 2D and 3D. Frames and Machines.

Related activities:
A 2, A 3, A 6 and A 8

Full-or-part-time: 23h
Theory classes: 7h
Laboratory classes: 2h
Self study : 14h

3. Friction

Description:
Types of friction. Static and Kinetic Friction. Applications.

Related activities:
A 4, A 7 and A 8

Full-or-part-time: 15h
Theory classes: 4h
Laboratory classes: 2h
Self study : 9h

4. Kinematics of Rigid Bodies

Description:
Reference Systems. Plane Kinematics of Rigid Bodies. Instant Center of Rotation. Movement Relative to Axes in Rotation.

Related activities:
A 5, A 7 and A 8

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

5. Dynamics of Rigid Bodies

Description:
Moments of Inertia. Kinetic moment. General Equations of the Plane Motion of the Rigid Body.

Related activities:
A 5, A 7 and A 8

Full-or-part-time: 30h
Theory classes: 9h
Laboratory classes: 3h
Self study : 18h

6. Mechanisms as Rigid Body Systems

Description:
Degrees of freedom. Kinematic pairs: basic types. Kinematic Chains and Links. Kinematics of Plane Mechanisms. Dynamics of Plane Mechanisms. Applications

Related activities:
A 5, A 7 and A 8

Full-or-part-time: 27h
Theory classes: 8h
Laboratory classes: 3h
Self study : 16h

ACTIVITIES

1. LABORATORY PRACTICE. Forces Systems.

Description:
Forces systems analysis.

Specific objectives:
At the end of this activity the student should be able to:
Identify the most important aspects to carry out a forces systems analysis of any mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus) and Teacher's Notes.

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

2. LABORATORY PRACTICE. Centers of Gravity

Description:
Mechanical systems determination of centers of gravity.

Specific objectives:
At the end of this activity the student should be able to:
Determine centers of gravity of any mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus) and Teacher's Notes.

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

3. LABORATORY PRACTICE. Balance of Rigid Bodies.

Description:
Equilibrium analyis of mechanical systems.

Specific objectives:
At the end of this activity the student should be able to:
Identify the most important aspects to carry out an equilibrium analysis of any mechanical system, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus) and Teacher's Notes.

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

4. LABORATORY PRACTICE. Friction.

Description:
Mechanical systems analysis under frictions effects.

Specific objectives:
At the end of this activity the student should be able to:
Identify the types of friction and analyze the behavior of various mechanical systems in which friction plays a central role, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus) and Teacher's Notes.

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

5. LABORATORY PRACTICE. Kinematic and Dynamic of Mechanisms

Description:
Kinematic and dynamic study of mechanisms.

Specific objectives:
At the end of this activity the student should be able to:
Interpret the theoretical concepts studied and apply them to the kinematic and dynamic analysis of some appropriately selected mechanisms, to work autonomously and as a team and to communicate effectively and clearly the results obtained.

Material:
Practice Script (available on the Digital Campus) and Teacher's Notes.

Delivery:
The students have to prepare, in groups of 5 people, a report of the practice, according to the instructions indicated and deliver it to the teacher within the deadline set for each practice.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 5h
Laboratory classes: 2h
Self study: 3h

6. FIRST INDIVIDUAL TEST OF CONTINUOUS EVALUATION

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

7. SECOND INDIVIDUAL TEST OF CONTINUOUS EVALUATION

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in the theoretical sessions taught so far.

Material:
Statement and Calculator

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 12h
Theory classes: 2h
Self study: 10h

8. FINAL TEST

Description:
Final test in the classroom that includes all the material, and Solving exercises and problems related to the learning objectives.

Specific objectives:
At the end of this activity the student should be able to:
Know, understand and apply the concepts studied in all the theoretical sessions.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of the other activities will form part of the evaluation as specified in the corresponding section of the teaching guide.

Full-or-part-time: 18h
Theory classes: 3h
Self study: 15h

GRADING SYSTEM

- First Individual Continuous Assessment Test (Activity 7): 35% of the grade for the subject.
- Second Individual Continuous Assessment Test (Activity 8): 45% of the grade for the subject.
- Preparation of reports on the results obtained in these practices (Activities 4, 5 and 6): 20% of the grade for the subject.

Therefore, the Note for Written Tests (NPE) = 35% * (First Written Test Note) + 45% * (Second Written Test Note) + 20% * (Practice Note).

It is important to point out that the partial written tests are liberatory, so that, if the student obtains an NPE> = 4.95, he will be exempted from passing the final test. Students who fail to pass the course by partial exams or those who want to improve their grade will have a second chance in a new final test.
Thus, the Final Test Note (NPF) = 80% * (Final Written Test Note) + 20% * (Practice Note).

EXAMINATION RULES.

- In order to pass the course, it is mandatory to attend and carry out all the laboratory practice reports.
- The reports of the practices will be original, so that the copy of practices (total or partial) will be sanctioned with the global failure of the activity and the subject. It will be taken into account that the responsibility of the laboratory practice is shared by all the members of the group, so in case of detecting a copy the rule will be applied to all the members of all the groups involved in the copy (both those who They copy like those who let themselves be copied).
- If it is detected that a student has copied in a written test, it will be evaluated as a failure of the course.
- It not allowed to use any type of notes or forms in the partial and final tests..

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