Course guide
330129 - DM - Machine Design

Last modified: 25/04/2024

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

Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2016). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

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

LECTURER

Coordinating lecturer: ESTEBAN PEÑA PITARCH

Others: JOSE ORTUÑO MARTIN - JOAN VALLEJO SERRANO - FERRAN MARTINEZ CANO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge and skills for the calculation, design and testing of machines.

Transversal:
2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
4. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

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 for a better understanding, doubts will be discussed and resolved type problems and questions that guarantee understanding of the subject. Problem solving 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 anticipation to 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 class.
- Carrying out laboratory practices in small groups. Preparation and delivery of internship reports.
- Resolution and delivery of proposed problems.
- Tutoring, study and individual and team work.
- Exams and evaluation tests.

LEARNING OBJECTIVES OF THE SUBJECT

Upon completion of this course, the student should be able to:
- Acquire basic theoretical knowledge about mechanical design.
- Apply the main tools and methodology that facilitate, in each of the phases of the product design and development process, the fulfillment of objectives in order to achieve the satisfaction of customer needs.
- Model mechanical systems.
- Plan and analyze machine behavior tests.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Content Title 1: Introduction to Machine Design

Description:
Design in mechanical engineering, interaction between design elements, codes and standards, safety and legal responsibility, evaluation of suitability, effort and resistance.

Related activities:
A1, A8, A10.

Full-or-part-time: 12h
Theory classes: 2h
Laboratory classes: 3h
Self study : 7h

Content title 2: Curved beams. Calculation for the most used sections.

Description:
Calculation of the stresses that any curved machine element can be subjected to, such as hooks, etc.

Related activities:
A2, A8, A10.

Full-or-part-time: 21h
Theory classes: 2h
Laboratory classes: 6h
Self study : 13h

Content title 3: Buckling of machine elements. Euler and Rankine formulas. Method W.

Description:
Calculation of the stresses that any slender machine element can be subjected to.

Related activities:
A3, A8, A10.

Full-or-part-time: 21h
Theory classes: 2h
Laboratory classes: 6h
Self study : 13h

Title of content 4: Calculation and dimensioning of axes

Description:
Shaft vibrations, critical shaft speed, shaft calculation and power transmission through shafts.

Related activities:
A4, A8, A10.

Full-or-part-time: 33h
Theory classes: 6h
Laboratory classes: 6h
Self study : 21h

Content title 5: Union of elements. Threads Screws. Welded joints.

Description:
The union of machine elements will be calculated, sizing the diameters of the screws, their distribution and the type of welding.

Related activities:
A5, A9, A10.

Full-or-part-time: 21h
Theory classes: 6h
Laboratory classes: 3h
Self study : 12h

Content Title 6: Clutches and Brakes

Description:
Drum, band, disc and bevel brakes and clutches. Energy, temperature rise, and friction material considerations.

Related activities:
A6, A9, A10.

Full-or-part-time: 21h
Theory classes: 6h
Laboratory classes: 3h
Self study : 12h

Content Title 7: Mechanical Springs

Description:
Helical springs, bending and bending effect. Extension and compression springs. Belleville Springs. Spring fatigue load.

Related activities:
A7, A9, A10.

Full-or-part-time: 21h
Theory classes: 6h
Laboratory classes: 3h
Self study : 12h

ACTIVITIES

TITLE OF ACTIVITY 1: LABORATORY PRACTICE. STUDY OF A MACHINE.

Description:
The project of a machine will be analyzed to know the degree of application of the acquired knowledge.

Specific objectives:
Once the activity is finished, the student must know how to interpret the design in mechanical engineering, interaction between design elements, codes and standards, safety and legal responsibility, evaluation of suitability.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the indicated instructions and deliver it to the teacher within the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 2: PROBLEM SOLVING OF CURVED BEAMS

Description:
Curved beams will be dimensioned, based on the demonstrated equations.

Specific objectives:
Once the activity is finished, the student should be able to dimension curved beams.

Material:
Collection of problems (available on the digital Campus) and teacher's notes.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 3: RESOLUTION OF BUCKLING PROBLEMS OF MACHINE ELEMENTS

Description:
Elements subject to buckling will be dimensioned and calculated.

Specific objectives:
Once the activity is finished, the student should be able to dimension machine elements subjected to buckling.

Material:
Collection of problems (available on the digital Campus) and teacher's notes.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 4: PROBLEM SOLVING. CALCULATION AND DIMENSIONING OF AXES.

Description:
A shaft subjected to loads will be dimensioned, calculating the critical speed, the arrow and its diameters.

Specific objectives:
Once the activity is finished, the student should be able to dimension axes.

Material:
Collection of problems (available on the digital Campus) and teacher's notes.

Delivery:
Delivery of solved problems.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 16h
Laboratory classes: 6h
Self study: 10h

TITLE OF ACTIVITY 5: LABORATORY PRACTICE. UNION OF ELEMENTS. THREADS. SCREWS. WELDED JOINTS.

Description:
Calculation and dimensioning of the union of various machine elements.

Specific objectives:
Once the activity is finished, the student should be able to dimension any type of union of machine elements.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the indicated instructions and deliver it to the teacher within the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 6: LABORATORY PRACTICE. CLUTCHES AND BRAKES

Description:
Clutches and brakes will be dimensioned and studied.

Specific objectives:
Once the activity is finished, the student should be able to size and identify brakes and clutches.

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the indicated instructions and deliver it to the teacher within the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 7: LABORATORY PRACTICE. MECHANICAL SPRINGS

Description:
Springs used in machines will be dimensioned.

Specific objectives:
Once the activity is finished, the student should be able to size springs

Material:
Practice guide (available on the digital Campus) and teacher's notes.

Delivery:
Students must prepare a report of the practice carried out, according to the indicated instructions and deliver it to the teacher within the set time.
The evaluation of this activity together with the other activities will form part of the evaluation as specified in the corresponding section of the qualification system.

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

TITLE OF ACTIVITY 8: FIRST PARTIAL CONTINUOUS ASSESSMENT TEST

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Resolution of 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 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

TITLE OF ACTIVITY 9: SECOND PARTIAL TEST OF CONTINUOUS ASSESSMENT

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Resolution of 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 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

TITLE OF ACTIVITY 10: FINAL TEST.

Description:
Individual test in the classroom with a part of the theoretical concepts studied, and Resolution of 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 all the concepts studied in the theoretical sessions.

Material:
Statement and Calculator.

Delivery:
Resolution of the Test.
The evaluation of this activity together with that of 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

- Delivery of the Proposed Problems: 10% of the grade for the course.
- First Partial Continuous Assessment Test: 35% of the grade for the subject.
- Second Partial Continuous Assessment Test: 35% of the grade for the subject.
- Attendance to the practices (5%) and the preparation of reports (15%) related to the results obtained in said practices: 20% of the grade for the subject.

Therefore, the Note for Partial Tests (NPP) = 35% * (First Written Test Note) + 35% * (Second Written Test Note) + 20% * (Practice Note) + 10% * (Delivery Note of the Proposed Problems).

It is important to point out that the partial written tests are liberating, in such a way that, if the student obtains an NPP> 4.95, he will be exempt 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 with a new final test.

The Final Test Score (NPF) = 100% * (Final Written Test Score).

Thus, the Final Grade of the Subject = MAX (NPP: NPF).

EXAMINATION RULES.

- In order to pass the course, it is mandatory to attend and carry out all the activities, delivering all the reports of the laboratory practices, and the resolution of all the proposed problems within the indicated deadlines. Activities not carried out score 0.
- In solving the proposed problems, the students will use the contents studied in the expository part of the face-to-face session and will be able to clarify the doubts and difficulties they may encounter with the teacher. The deadline for delivery of the resolution of the proposed problems and the reports of the laboratory practices will be specified, and no delivery will be accepted after the deadline.
- The reports of the practices will be original, so that the copy of the practices (total or partial) will be sanctioned with the suspension of the activity. It will be taken into account that the responsibility of the laboratory practice is shared by all the members of the group, therefore, in the case of detecting a copy, the rule will be applied to all the members of all the groups involved in the copy.
- In the delivery of the resolution of the proposed problems, any total or partial copy of the solutions will suppose the suspension of the activity. The student must ensure the privacy and security of their data.
- In no case will it be possible to have any type of form or notes both in the partial tests and in the final.

BIBLIOGRAPHY

Basic:

- Budynas, Richard G; Nisbett, J. Keith. Diseño en ingeniería mecánica de Shigley [on line]. 10a ed. México: McGraw-Hill, 2019 [Consultation: 27/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?docID=5485813. ISBN 9781456267568.
- Mott, Robert L. Machine elements in mechanical design [on line]. 3ª ed. Upper Saddle River: Prentice Hall, 1999 [Consultation: 17/01/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5510299. ISBN 0138414467.
- Norton, Robert L. Diseño de maquinaria: síntesis y análisis de máquinas y mecanismos [on line]. 6ª ed. México: McGraw Hill, 2020 [Consultation: 07/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=5701. ISBN 9788448620998.

Complementary:

- Spotts, M. F. ; Shoup, T. E. Elementos de máquinas [on line]. México: Pearson Educación, 1999 [Consultation: 18/06/2024]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=12527. ISBN 9701702522.
- Hamrock, B. J. ; Jacobson, B. ; Schmid, S. R. Elementos de máquinas. México: McGraw Hill, 2000. ISBN 970102799X.