Course guide
820430 - DIMA - Machine Design

Last modified: 04/06/2026

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

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

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: PEDRO ORTIZ MORÓN

Others:

Primer quadrimestre:
PEDRO ORTIZ MORÓN - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: T11, Grup: T12, Grup: T13
DOMINGO SANTOS ESPADA - Grup: T11, Grup: T12, Grup: T13

Segon quadrimestre:
KEVIN IVAN BARRERA LLANGA - Grup: M15, Grup: T13, Grup: T14
PEDRO ORTIZ MORÓN - Grup: M11, Grup: M12, Grup: M13, Grup: M14, Grup: M15, Grup: T11, Grup: T12, Grup: T13, Grup: T14
DOMINGO SANTOS ESPADA - Grup: T11, Grup: T12

REQUIREMENTS

CINEMÀTICA I DINÀMICA DE MÀQUINES - Precorequisit
RESISTÈNCIA DE MATERIALS - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMEC-20. Calculate the characteristics of, design and test machines.

Transversal:
04 COE N3. 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.

TEACHING METHODOLOGY

The subject uses the expository methodology and study by case, with a presentation of each theoretical topic accompanied by comments that encourage adequate and comprehensive understanding of the concepts. On the other hand, problems representative of the contents in the classroom will be solved and students will be made available the problems, solved problems and diverse material for autonomous study.

LEARNING OBJECTIVES OF THE SUBJECT

1, Learn the basics of machine design. 2. To enable the student to develop design algorithms that allow the calculation and design of machine components. 3. Develop skills in experimental techniques and results analysis. 4. Develop an awareness of design safety and the importance of the use of standards and codes. 5. Familiarity with the use of advanced computational techniques in solving computational problems of mechanical elements. 6. Develop modeling capabilities. 7. Promote independent learning through observation by the student of mechanical systems that surround it, and his mental abstraction useful models for the mechanical calculation. 8. Promote critical thinking and intuitive interpretation of the results obtained through calculations. 9.Purchase orders of magnitude of common physical properties.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

1 - INTRODUCTION TO THE DESIGN OF MACHINES

Description:
1.1 Design in mechanical engineering.
1.2 Relation of the subjects of the degree in relation to Machine Design.
1.3 Design considerations.
1.4 Materials in the mechanical design.

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

2 - CONSTANT LOAD. STATIC

Description:
2.1 Analysis of solicitations. Free-Body diagrams. Reactions
2.2 Simple efforts in machine elements: shear stress, tensile / compressive stress, bending and torsion moments.
2.3 Resistant design. Static safety factor.
2.4 Main tensions. Mohr's Circle for plane stress.
2.5 Static failure theories. Equivalent Von Mises - Hencky Stress.

Full-or-part-time: 15h
Theory classes: 6h
Laboratory classes: 3h
Self study : 6h

3 – BRITTLE / DUCTILE

Description:
3.1 Brittle material - ductile material.
3.2 Brittle fracture - ductile fracture.

Full-or-part-time: 2h
Theory classes: 1h
Self study : 1h

4 - STRESS CONCENTRATION

Description:
4.1 Description of the stress concentration phenomenon.
4.2 Tables of stress concentration factors.
4.3 Effect on resistant elements depending on the static or variable character of the load and the brittle / ductile behaviour of the material.

Full-or-part-time: 2h
Theory classes: 1h
Self study : 1h

5 - VARIABLE LOADS. FATIGUE

Description:
5.1 Fatigue of the materials. Introduction to the phenomenon and mechanism of fatigue failure.
5.2 Recent accidents caused by fatigue.
5.3 Expression of a variable load cycle in medium component and amplitude component.
5.4 Rotating bending test. Wöhler diagram for the specimen.
5.5 Materials with endurance limit and materials with fatigue strenght.
5.6 Correction of the Wöhler diagram: endurance limit modifying factors.
5.7 Influence of the mean stresses in uniaxial fatigue.
5.8 Söderberg diagram. Description, equations and use in the resolution of cases of uniaxial fatigue with medium tensions.
5.9 Security factor to infinite life. Safety factor to life N cycles.

Full-or-part-time: 24h
Theory classes: 7h
Laboratory classes: 3h
Self study : 14h

6 - DESIGN OF ELEMENTS OF MACHINES SUBMITTED TO VARIABLE LOADS

Description:
Application of the tools exposed in the previous topics in different cases of resistant elements submitted to variable loads. These cases have been selected seeking to show different typologies, both in the type of machine element solved, and in the variability of the loads applied.

Full-or-part-time: 29h
Theory classes: 6h
Self study : 23h

7 - MECHANICAL TRANSMISSIONS

Description:
7.1 Definition.
7.2 Principles of operation.
7.3 Comparative characteristics according to the operating principle.
7.4 Functions of mechanical transmissions.
7.5 Some useful classifications in transmissions.
7.6 Descriptive exposition of mechanical transmission elements.
7.7 Transmission ratio.

Full-or-part-time: 11h
Theory classes: 3h
Laboratory classes: 3h
Self study : 5h

8 - FORCES IN MECHANICAL TRANSMISSIONS THROUGH GEARS

Description:
8.1 Spur Gears.
8.1.1 General.
8.1.2 Geometric parameters in spur gears.
8.1.3 Forces in transmissions with spur gears.
8.2 Helical gears.
8.2.1 General.
8.2.2 Geometrical parameters in helical gear.
8.2.3 Forces in transmissions with helical gears.
8.2.4 Compensation of the axial component.
8.2.5 Effect of the axial component on the diagram of bending moments.

Full-or-part-time: 16h
Theory classes: 5h
Laboratory classes: 3h
Self study : 8h

9 - FORCES IN MECHANICAL TRANSMISSIONS THROUGH BELTS AND CHAINS

Description:
9.1 Flat and trapezoidal belts.
9.2 General.
9.3 Geometric parameters in belt and chain transmissions.
9.4 Forces in transmissions with flat and trapezoidal belts.
9.4 Expression of Eytelwein, stress ratio, pretension.
9.5 Forces in transmissions with toothed belts and chains.

Full-or-part-time: 11h
Theory classes: 3h
Laboratory classes: 3h
Self study : 5h

10 - DESIGN OF SHAFTS

Description:
10.1 Introduction. Definition of axel, shaft and spindle. Most used types, shapes and materials.
10.2 Resistant shaft design.
10.3 Deformations in axels and shafts.
10.4 Critical speed.
10.5 Design recommendations.
10.6 Hub - shaft bushing.
10.7 Joints for tree coupling.

Full-or-part-time: 34h
Theory classes: 10h
Self study : 24h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

The qualification consists of the marks obtained in four evaluation acts: partial exam (EP), practice test (PR), questions of continuous evaluation (EC) and final exam (EF), with an initial weighting of 33%, 17% , 17% and 33% respectively.
In application of the concept of continuous evaluation, and taking into account the fact that the concepts demanded in the partial exam continue to be asked in the final exam, a second weighting is proposed that favors the students who have obtained a worse result in the first test, being this second weighting 20%, 17% , 17% and 46% respectively.
The evaluation of people who do not participate in the continuous evaluation will be in a fixed weighting proportion of 40%, 0%, 17% and 43% respectively.
Thus, the final grade of the subject is determined by the expression:
DIMA = MAX [(0.33NEP+0,17NEC+0,17NPR+0,33NEF) ; (0.20NEP+0,17NEC+0,17NPR+0,46NEF) ; (0,40NEP+0,00NEC+0,17NPR+0,43NEF)]
The questions of continuous evaluation consist of the realization of a question at the appropriate time of a class session that must be answered in writing.
Between 10 and 15 of these questions will be asked throughout the term.
Each of them will be evaluated with a numerical grade between 0 and 10 and the continuous evaluation grade that will be part of the calculation of the final grade of DIMA will be the average of the sum of marks obtained by each person divided of the number of continuous evaluation issues that have been proposed in the semester. Obviously the non-answer of an issue is equivalent to a numeric note of 0.
To provide the system with adequate flexibility, the average will be calculated by discarding the three lowest results for each person.
A continuous evaluation question can only be answered if it is present in the classroom at the time it is proposed. In some classes the question will be asked at the beginning of the session, in others at any intermediate time and in others just before the end.
Arriving in class at a later time than the question or having to leave class in advance of the realization of a question of continuous evaluation prevents the realization of the test.
This subject does not have the re-evaluation test planned.

EXAMINATION RULES.

Practice Test:
24 questions with four answers.
Only one of the answers is correct. Questions answered incorrectly subtract 1/3 and those not answered do not subtract.
You must answer in the box at the top of the first page and preferably using capital letters.
You cannot have any documentation or calculator.

Partial and Final Exams.
General instructions:
You cannot use graphing calculators or those that can store or transmit information, view pdf files or any other type.
Mobile phones and smart watches must be disconnected and stored out of the student's reach during the exam.
No questions will be answered: understanding the statement is part of the test.
You cannot take the exam in pencil or use a red pen.
Answer sheets should be used on both sides and in the natural order.
It is essential that all the calculations made appear in detail in the solution to the exam.
The proposed equations must be solved by hand, the use of the SOLVER of the calculator is not accepted as a solution.
The documentation that must be taken for examination is the printout of the document Tablas imprimir examen DIMA available at Atenea.
You may bring a double-sided A4 form containing only formulas. Drawings, graphics, and text are fobidden. This form will be handed in with the exam.

Content of the exam:
The resolution must generally include at least:
The justification of all decisions taken, which may be brief but must be sufficient
Units in all magnitudes
The necessary sketches in axonometric with sufficient quality to be understood including the reference axes and the forces clearly represented.
Request Diagrams: DECs, DEN, DMFs and DMT
The diagrams used: Söderberg, Wöhler, the representation of the CCC, the tension states of mediums and amplitudes, etc
The correct expression and verification of the hypotheses that are made
Clearly point out the direction of engine rotation
All formulas used will have replaced the numeric values with which they are solved
All expressions used to solve free solid diagrams
The equations that give rise to the value of flector moments in DMF's
Mention of what the CCC is and why it is this
Discussion of SC with relevant data that allow discarding sections or choosing the SC
Justification of the selection of each of the modifying factors of life to fatigue, including identifying the table from which kt is read
Highlight expression of the result obtained, by square or underline and conclusion

The list is not intended to be exhaustive but only minimal. The person who completes the exam will add to the aforementioned any explanation or additional content that they consider should be taken into account positively in their evaluation.

BIBLIOGRAPHY

Basic:
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- Calero Pérez, Roque; Carta Gonzalez, José Antonio. Fundamentos de mecanismos y máquinas para ingenieros. Madrid [etc.]: McGraw-Hill, 1999. ISBN 844812099X.

- Chevalier, A. Dibujo industrial. México [etc.]: Limusa, 1992. ISBN 968183948x.
- Juvinall, Robert C; Marshek, Kurt M. Diseño de elementos de máquinas. 2a edición en español. México, D.F.: Limusa, cop. 2013. ISBN 9786070504365.
- Faires, Virgil Moring. Diseño de elementos de máquinas. México, D.F.: Limusa, cop. 1994. ISBN 9681842073.
- Spotts, M. F; Shoup, T. E; León Cárdenas, Javier; Cera Alonso, José María de la. Elementos de máquinas. México [etc.]: Pearson Educación, cop. 1999. ISBN 9701702522.