

Course guide

340060 - DSAO - Computer-Assisted Design and Simulation

Last modified: 28/05/2026

Unit in charge:	Vilanova i la Geltrú School of Engineering	
Teaching unit:	712 - EM - Department of Mechanical Engineering. 717 - DEGD - Department of Engineering Graphics and Design.	
Degree:	BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Optional subject). BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Optional subject). BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Compulsory subject).	
Academic year: 2026	ECTS Credits: 6.0	Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: ANTONIO SÁNCHEZ EGEA

Others:

PRIOR SKILLS

Basic knowledge of CAD software: NX, Solidworks y Matlab. Preferably NX.

REQUIREMENTS

Department 712-EM: knowledge of Theory of Machines (TEMA).
Department 717-DEGD: Knowledge of 3D modeling.
Department 712-EM: Knowledge of Elasticity and Strength of Materials.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

5. CE5. Visual spatial ability and knowledge of graphical techniques for traditional methods of descriptive geometry and metric geometry as well as for computer aided design applications.
6. CE19. Knowledge and ability to apply graphic engineering technique.
7. CE14. Knowledge and application of basics of material resistance.
8. CE25. Knowledge and ability of systems modeling and simulation.

Transversal:

1. 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.
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. 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.
4. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

TEACHING METHODOLOGY

The teaching methodology of this subject is divided into three modules:

Industrial Design Module:

Theoretical concepts focus on the 3D modelling process of both solids and surfaces. The characteristics of the different representation schemes of the 3D Model are presented and practical exercises of concepts are carried out. In the laboratory sessions, guided practices are carried out with the CAD software available in the computer laboratories (NX, Solidedge, Solidworks), preferably NX. The laboratory practices focus on: 1) Parameterization of a Solid Model of a part or product for its cataloging. 2) Rendering and Animation of the components for product presentation. 3) Definition of the 3D Model by Surfaces.

Mechanics Module:

In the theoretical sessions, the mechanism simulation method used by different computer software is shown. The generalized or natural coordinates method is analyzed in depth, its application to different mechanisms is shown and the most common mechanisms are simulated. During the laboratory practicals, students learn how to use the NX mechanism simulator with guided assembly tasks and expressions, kinematic simulation of a mechanism, dynamic simulation of a mechanism and simulation of a complex mechanism with several degrees of freedom controlled by various mechanical actuators.

Strength of Materials Module:

In the theoretical sessions, the finite element methodology is presented for the calculation of stresses and displacements of bars that make up mechanisms and articulated structures for their correct dimensioning. During the practical sessions, guided activities are carried out with Matlab and NX to implement the finite element method for the calculation of stresses and displacements of various 2D and 3D components. In addition, we work on the procedure of how to mesh a body and how to add the boundary conditions with the aim of correctly dimensioning the bars according to the yield stress of the selected material.

LEARNING OBJECTIVES OF THE SUBJECT

- Developing the ability to identify the tools related to computer-aided design.
- Effective communication of the added value of the designed product through modelling, renderings and animation.
- Enhance skills of ingenuity and the ability to develop kinematic and dynamic simulations of components and products.
- Enhance skills of ingenuity and ability to develop finite element simulations of components and products.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

1. ADVANCED 3D MODELING AND PARAMETRIZATION

Description:

- Solid modeling. Parameterization.
- Surface modeling.
- Assembly module, introduction to rendering and animation.

Specific objectives:

Application of modeling and rendering tools to achieve photo-realistic effects and animation.

Full-or-part-time: 10h

Theory classes: 10h

2. SIMULATION OF MECHANISMS

Description:

- Estructura dels mecanismes
- Anàlisi estàtic dels mecanismes
- Anàlisi cinemàtic dels mecanismes
- Anàlisi dinàmic dels mecanismes

Specific objectives:

Analyze a mechanism model and simulate its movements to solve kinematic and dynamic analysis and design problems.

Full-or-part-time: 10h

Theory classes: 10h

3. FINITE ELEMENTS. APPLICATION TO THE STRENGTH OF MATERIALS

Description:

- Matrix method and finite element method.
- Calculation of stress and displacement
- Tensile and compressive bar dimensioning check.
- Plane stress and stress concentration coefficient

Specific objectives:

To deepen in the analysis and testing of resistant elements.

To learn the basics of FEM

To work with different calculation and simulation software based on matrix analysis and the finite element method.

Full-or-part-time: 10h

Theory classes: 10h

4. Laboratory sessions

Description:

Exercises to apply the knowledge acquired.

Specific objectives:

Individual practices applying the tools and concepts related to the learning process of the course.

Full-or-part-time: 30h

Laboratory classes: 30h

GRADING SYSTEM

The assessment model is divided into three modules: design, mechanics and strength of materials. Within each module, there are two types of marks, the practical (40%) and the theory exam mark (60%).

Pdise: practical design marks.

Tdise: theory exam marks for design.

Pmeca: practical mechanics marks.

Tmeca: mechanical examination theory mark.

Prm: practical marks for resistance of materials.

Trm: theory marks for the resistance of materials examination.

$$\text{FINAL mark} = [(0,4 * \text{Pdise} + 0,6 * \text{Tdise}) + (0,4 * \text{Pmeca} + 0,6 * \text{Tmeca}) + (0,4 * \text{Prm} + 0,6 * \text{Trm})] / 3$$

NOTICE: The practical mark will be assessed in each module with an exam or an individual report according to the teacher's decision.

REVALUATION EXAM = only the theoretical parts of each module (Tdise, Tmeca and Trm) are re-evaluated. This grade of the theoretical re-evaluation is weighted with the marks of the practicals. The practicals cannot be re-evaluated.

EXAMINATION RULES.

- Attendance and active participation in the classroom are essential.
- CAD practices are sent through the ATENEA application.
- Other prior generic skills and qualities applicable to any activity within the university academic environment are also required, such as respect and the ability to synthesize.

BIBLIOGRAPHY

Basic:

- Chandrupatla, Tirupathi R.; Belegundu, Ashok D. Introduction to finite elements in engineering. 5th ed. Cambridge: Cambridge University Press, 2022. ISBN 9781108841412.
- Online Instructor. Solid Edge ST8 : basics and beyond. Leipzig: Createspace, 2015. ISBN 9781519192455.
- Garcia de Jalon, Javier; Bayo, Eduardo. Kinematic and Dynamic Simulation of Multibody Systems [electronic resource] : The Real-Time Challenge [on line]. New York, NY: Springer New York, 1994 [Consultation: 14/02/2024]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3076770>. ISBN 1-4612-2600-7.
- Olivares Benítez, Tania. Manual práctico NX7 CAD. Vizcaya: Servicios Informáticos DAT, 2009. ISBN 9788461367689.

Complementary:

- Wilson, John R. Virtual reality for industrial application : opportunities and limitations. Nottingham: Nottingham University Press, 1996. ISBN 1897676573.
- Unda, J. ; Garcia de Jalon, J.. "Análisis cinemático y dinámico de sistemas mecánicos formados por varios sólidos rígidos". Revista internacional de métodos numéricos para cálculo y diseño en ingeniería (1985), [on line]. Vol.1(4), 31-48 [Consultation: 24/04/2026]. Available on: <https://upcommons.upc.edu/entities/publication/36a32415-1543-438d-bf8c-8330a9cedfca>.

RESOURCES

Other resources:

Documentation for the monitoring of the course in ATENEA of the subject to be taught by each Department.