

Course guide

340078 - DIAO-D5017 - Computer-Aided Design

Last modified: 17/05/2023

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 INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2009). (Compulsory subject).

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

LECTURER

Coordinating lecturer: Sánchez Egea, Antonio José
Torras Sendra, Maria Alba.

Others: Departament 712-EM: Sánchez Egea, Antonio José y González Rojas, Hernán Alberto;
Departament 717-DEGD: Torras Sendra, Maria Alba.

PRIOR SKILLS

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

REQUIREMENTS

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

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

5. D7. Ability to simulate and design mechanisms as a solution for specific mechanical problems.
6. D.27 Advanced MODELAJE in 3D knowledge.
7. D28. Knowledge of ANIMACION and basic 3D simulation.

Transversal:

1. 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.
2. 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.
3. 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.
4. 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.

TEACHING METHODOLOGY

Specific methodology of each Department:

Department 712-EM (mechanics):

In the content of this subject, different simulation methods and variables are described in detail. The transmission angle is defined as a design criterion applied in this course. In theoretical sessions, the mechanism simulation method used by the ordinates is shown. The generalised or natural coordinates method is analysed in depth, its application to different mechanisms is shown and mechanisms with few components are simulated. In laboratory sessions, the use of a specific CAD software (NX) is taught for simulating several mechanisms. It is developed 2 o 4 guided tasks: assembly and expressions, kinematic simulation of a mechanism, dynamic simulation of a mechanism and simulation of a complex mechanism.

Department 717-DEGD:

Sessions of theoretical concepts based on the 3D modelling process to define the final 3D model. Solid model and surface model. Characteristics of the different representation schemes of the 3D Model. Practical exercises of concepts.

In laboratory sessions, 2 or 3 practical exercises with the CAD software are performed with several software (NX and Solidworks) available in the computer laboratories, preferably NX. Several practical assignments are required to evaluate the acquired knowledge in the practical sessions.

Laboratory session will cover:

- the Solid Model in the parameterization of a part or product for its cataloguing.
- Rendering and Animation of the components for product presentation.
- Definition of the 3D Model by Surfaces.

Department 712-EM (materials strength):

Theoretical sessions present methodologies for the analytical calculation of stresses in structural members for their dimensioning, calculation of stresses and deformations and the calculation bases of the finite element method. In laboratory sessions, several assignments are required by using NX to showcase the knowledge acquired of the modules of material description, material resistance characteristics, introduction of stresses and boundary conditions and interpretation of the results of stresses and deformations in the post-processing module are worked on. Students are accompanied in their subject project from the point of view of the resistance of materials.

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

Specific objectives:

Use of CAD software to simulate real scenarios, whether rendering, movement of mechanisms and strength of materials.

Full-or-part-time: 10h

Theory classes: 10h

2. SIMULATION OF MECHANISMS

Description:

- Mechanisms structure
- Kinematic analysis of mechanisms
- Static analysis of mechanisms
- Dynamic analysis of mechanisms

Specific objectives:

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

Full-or-part-time: 10h

Theory classes: 10h

3. FINITE ELEMENTS APPLIED TO THE STRENGTH OF MATERIALS

Description:

- Matrix method and finite element method
- Calculation of stress and deformation
- Tensile and compressive member sizing check.
- Plane stress. Stress concentration coefficient. Geometric discontinuities.

Specific objectives:

To deepen in the analysis and verification of resistant elements.

To know the basics of FEM

To work with 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

5. GROUP WORK REPORT

Description:

In groups of a maximum of three students, a work will be carried out throughout the course where students will have to develop the knowledge acquired from the different parts of the course.

Specific objectives:

Practical work, where the student will have to apply the tools and concepts related to the learning process of the course.

Full-or-part-time: 90h

Self study : 90h

GRADING SYSTEM

The evaluation takes into account the different modules taught by each department involved in the subject. The Final Grade (NF) of the subject is the average of the three modules, $NF = (Nem + Neg + Nrm)/3$;

Nem: Final mark of the department ME (mechanics)

Neg: Final grade of the department DEGD

Nrm: Final grade of the department ME (materials strength)

Same evaluation system is applied by each department:

T: Theory Test. Each department has dates indicated by the school (Dates of the partial or final test, exams).

TG: Group Work. Partial deliveries (NOT evaluable) and Final Delivery Complete TG at the end of the course (date indicated in Atenea).

P: Laboratory session. The score is the average of the different practices assignments delivered in the three modules.

$$\text{FINAL mark by content} = 0.45 T + 0.25 TG + 0.35 P$$

In the evaluation of the acquisition of knowledge, competences and skills, the following bullets will be taken into account:

- The individual test: the exam.
- Individual work: monitoring in the performance of the laboratory sessions.
- Group work TG. Team of a maximum of 3 students. Partial deliveries of the group work are done following Atenea's script defined by "activity sheet of the group participants". 3 deliveries are required, 2 partials and one final (date indicated to Atenea). In the case of NOT MAKING SOME PARTIAL DELIVERY of the final work, the MAXIMUM EVALUATION of the final work will be a 7 (out of 10).

In accordance with article 4.1.3 of the current Academic Regulations for Undergraduate and Master's studies of the EPSEVG, this subject contemplates a reassessment exam that corresponds to a reassessment exam per didactic unit (mechanics, design, resistance). This exam re-evaluates the theoretical part corresponding to 45% of the total mark. Only students who have obtained a failing rating and not less than 2, may take these reassessment tests.

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, teamwork and the ability to synthesize.



BIBLIOGRAPHY

Basic:

- Javier Garcia de Jalon; Eduardo Bayo. Kinematic and Dynamic Simulation of Multibody Systems [electronic resource] : The Real-Time Challenge [on line]. New York, NY: Springer New York, 1993 [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.
- Online Instructor. Solid Edge ST8 : basics and beyond. Leipzig: Createspace, 2015. ISBN 9781519192455.
- Chandrupatla, Tirupathi R., Belegundu, Ashok D.. Introduction to Finite Elements in Engineering. 3. EEUU: Prentice Hall PTR, 2002. ISBN 9780130615916.
- Leu, Ming C.; Ghazanfari, Amir; Kolan, Krishna. NX 10 for engineering desing [on line]. Missouri: Missouri University of Science and Technology, 2015 [Consultation: 22/02/2024]. Available on: <https://core.ac.uk/download/pdf/229319563.pdf>.

Complementary:

- Wilson, John R. Virtual reality for industrial application : opportunities and limitations. Nottingham: Nottingham University Press, 1996. ISBN 1897676573.
- J. Unda, J. Garcia de Jalon,. "Análisis cinemático y dinámico de sistemas mecánicos formados por varios sólidos rígidos". Revista internacional de métodos numéricos para cálculo y diseño en ingeniería (1985),. Vol. 1(4),31-48..

RESOURCES

Other resources:

Documentation for monitoring the course is enclosed in ATENEA.