Course guide
340060 - DSAO-M6O17 - Computer-Assisted Design and Simulation

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

LECTURER

Coordinating lecturer:	Sánchez Egea, Antonio J. (EM)
	Torras Sendra, Maria Alba. (DEGD)
Others:	Departament 712-EM: Gonzalez Rojas, Hernan A.; Sánchez Egea, Antonio J.;
	Departament 717-DEGD: Torras Sendra, Maria Alba.

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 geometryas 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 INFORMATI0N 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

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 or 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 (material 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 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 cinemàtic dels mecanismes
- Anàlisi estàtic 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

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

3. FINITE ELEMENTS. APPLICATION TO THE STRENGTH OF MATERIALS

Description:
- Matrix method and finite element method.
- Stress and strain calculation.
-Tensile and compressive bar dimensioning check.
- Plane stress. Stress concentration coefficient. Geometric discontinuities

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

5. GROUP WORK REPORT

Description:
Groups with a maximum of 3 students will carry out a work 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 considers 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 (material 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 practical assignments delivered in the three modules.

FINAL mark by content = 0.45 T + 0.25 TG + 0.3 P

In the evaluation of the acquisition of knowledge, competences and skills, the following bullets will be considered:
- 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 that corresponds 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:

- Olivares Benítez, Tania. Manual práctico NX7 CAD. Vizcaya: Servicios Informáticos DAT, 2009. ISBN 9788461367689.
- 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.
- 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.

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