Course guide
340078 - DIAO-D5O17 - Computer-Aided Design

Last modified: 17/06/2024

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: 2024 **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 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.
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

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 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
- Static analysis of mechanisms
- Kinematic 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 displacement
- Tensile and compressive member sizing check.
- Plane stress and stress concentration coefficient

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

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.

FINAL mark=[(0,4*Pdise+0,6*Tdise) + (0,4*Pmeca+0,6*Tmeca) + (0,4*Prm+0,6*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.
NOTE REVALUATION = 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.
- 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.
- 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.