Universidad Zaragoza

25894 - Technical Analysis for Design Proposals

Información del Plan Docente

Academic Year	2018/19
Subject	25894 - Technical Analysis for Design Proposals
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	558 - Bachelor's Degree in Industrial Design and Product Development Engineering
ECTS	6.0
Year	4
Semester	First semester
Subject Type	Optional
Module	---

1.General information

1.1.Aims of the course

The design of products or equipment goods in any material is an activity that concerns almost all industrial sectors from the automotive industry to household appliances, containerization, furniture, etc.

The successful technical development of a product depends on the way to integrate materials, piece design, manufacturability and viability in terms of strength and rigidity according to a series of tests, sometimes imposed by a specific regulation for the product, other times imposed the customer. Also in the case of mechanisms, it is necessary to ensure the correct kinematic and dynamic behaviour.

For all these reasons, this subject focuses on the concepts and methodologies that allow, using modelling tools, a numerical calculation to reach the successful design of a product or mechanism, thinking not only about its aesthetics.

1.2.Context and importance of this course in the degree

This subject is an optional one corresponding to the specialty of "Product Development" imparted during fourth year of the degree.

Taking into account the objectives of the degree and in particular those of the intensification in which it is imparted, the meaning of this subject is to train the student to participate actively in the analysis, simulation and optimization phase of the product within the process of its development

1.3.Recommendations to take this course

Since this is a subject of the last course and part of the intensification of product development, it would be convenient for the student to have passed, or at least, studied subjects of the second course "Computer Assisted Design I" and "Design of mechanisms", and studied during third course "Computer-Assisted Design II" and "Resistance of materials". All these subjects are basic for a correct study of the subject object of this guide. It would also be advisable to have completed the subject "Materials" that is taught in the first year of the degree.

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The evaluation is developed during the course with the realization of the practices, the proposed problems and during the presentation of the final work. In this way, a continuous evaluation is proposed, in which it is necessary to reach a minimum in each section. In the case of going to the final evaluation, the presentation of the final work is replaced by an exam always if minimum score in practices and problems has reached.

Practice sessions (20% of the final score)

Attendance is not compulsory, but the presence in each of the five practices will be assessed with 50%. The other 50% it will be the result of the qualification of work delivered at the end of each session. Students who attend all the practice sessions and make the work correctly can obtain a maximum of 2 points.

* Students who cannot attend some practice session can recover it in the way indicated by the teacher, only if the no attendance is correctly justified.

* Those students who choose not to attend the practice sessions can make the practical work at home and deliver the corresponding script but they cannot obtain the punctuation of attendance to the practices.

It will be necessary to obtain a minimum of 0.5 points in the practices.

Problem sessions (20% of the final grade):

At the end of the each units, and based on the work of the subject proposed at the beginning of the semester, the student will pose several problems that will be solved by applying the knowledge acquired.

The results obtained in each problem will be presented in a file for later evaluation following a proposed calendar. ADD will be used for the presentation and management of the works.

The exercises consistently solved and with logical results will be scored with a maximum of 2 points, assuming 20% of the final grade.

It will be necessary to obtain a minimum of 0.5 points in problem solving.

Final work (60% of the final grade)

The work will consist of a design proposal proposed by the teacher, which is common to all working groups (of 3 people), but which admits variations, versions and the possibility of being creative and original. The work will be evaluated according to the following criteria, which will add a maximum of 6 points, and which will represent 60% of the final grade.

* Creativity and originality in the solution to the design proposal, evaluating geometries, aesthetics, modelling quality, mechanisms and assembly.

* Quality of the technical report, evaluating the presentation, order and clarity in the presentation of results.

* Quality of the oral presentation of the work evaluating clarity and order in the exposure of the entire design process based on the numerical results that have been obtained, communication and synthesis capacity for the listener.

* Time for questions from the teacher assessing the ability to answer questions correctly, both the product designed, and knowledge that students have been acquired.

* Ability of the students to ask, to debate and to evaluate the response received. In this case, the students' ability to ask their classmates about their work, both from the technical point of view, and curiosities that may arise throughout the exhibition will be assessed.

It will be necessary to obtain a minimum of 3 points in the final work.

Final exam (60% of the final grade in substitution of 60% of the final work)

The students who have not passed the subject based on the qualifications obtained in the three options presented above, or who wish to improve their qualification, will be able to take a final exam that will consist in the resolution of three problems related to the design proposed for the final work. These problems will have at least the level of final work. The student will have the necessary computer resources to solve them in an approximate time of three hours.

It will be necessary to obtain a minimum of 1 point between the practices and problem solving sections to mediate with the qualification obtained in the exam.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives:

- Proposed physical problems by analysing the interaction with reality to which the design proposals give rise.

- Be able to carry out structural, kinematic and dynamic analysis of elements and mechanical components through the use of computer tools, to solve from a technical point of view the physical problems that arise from a design proposal.

As will be seen in detail in section 4.3. of contents, the syllabus of the subject is divided into five themes (Modelling, Assemblies, Simulation, Optimization and Movement), which will be explained during ten theoretical sessions of two hours each one. Another ten sessions will be interspersed, also of two hours, to solve problems. During these practice sessions, students will follow the instructions of the teacher to become familiar with the software, and learn the methodology of work for posing physical problems derived from the design proposals (problems of mechanical resistance and problems of kinematics and dynamics of mechanisms).

To complete the learning in the classroom, five practical sessions of three hours each one are proposed, for autonomous works, but with the supervision of the teacher. During practical sessions, the student will receive a design proposal, to pose and solve problems in order to make functional the design. Each of the sessions will be related to each of the blocks in which the theory is divided.

* 1 session for Modelling

* 1 session for Assemblies

* 1 session for Simulation (FEM)

* 1 session for Optimization

* 1 session for Movement

During last week of the semester, five hours of seminar are proposed, so that the students can finalize details of their final work, and simultaneously they can solve doubts with the help of the teaching staff.

Regarding the autonomous work of the student outside the classroom, there are seventy hours of autonomous work and personal study, ten hours dedicated to the development of the final work and five hours of personalized tutorials, in addition to the five assessment hours.

4.2.Learning tasks

6 ECTS are assigned to this subject, corresponding to 150 hours of student work organized as follows:

1. In the computer classroom, in which all students have portable computers with a specific software at their disposal, or in which they can work with their own portable computers

* Theory sessions (20 hours, divided into 10 sessions of 2 hours). They will treat the necessary theoretical base of resistance of materials and kinematics and dynamics of mechanisms from the point of view of computer simulation so that later the student will be able to configure and solve the physical problems that derive from a design proposal.

* Practice sessions for resolution of problems and practical cases with all the students (20 hours, divided into 10 sessions of 2 hours). The teacher will conduct problems so that all the students develop the work and simultaneously they will solve the doubts. The objective of these sessions is to illustrate in a practical way the Theory sessions.

* Seminar consisting of a 2-hour session and a 3-hour session, mainly dedicated to the resolution with all students of doubts regarding the presentation and definition of the final work proposals (last week of the semester).

* Practical classes for carrying out practical exercises in small groups of students (15 hours, divided into 5 sessions of 3 hours), so that they work autonomously, but with the teacher's availability to solve doubts during the session.

2. Autonomous study and work (70 hours)

* In addition to the material resources available in the department, the student will have the SolidWork Campus license so that they can work independently (in their own home, having the license of the center). The student will have the possibility of receiving advice, follow-up and other questions related to the resolution of problems that may arise in the learning process during tutorials office hours.

3. Final work tutorials (5 hours)

* The students will have a specific tutorial schedule, established by the teachers of the subject, intended for advice and monitoring of the group final work, which they must develop and show it at the end of the semester.

4. Preparation of group final works and assessment

* The preparation of the final work will consist of the preparation of a technical report, a compendium of the various problems that have been raised throughout the course according to a design proposal common to all students at the beginning of the semester. This technical report should explain the evolution of the design based on the analyses carried out and also, the report must have clear final conclusions. The dedication of each student to the preparation of the final work will be 10 hours.

* For the assessment, each group will do a public presentation of the final work. Attendance to this presentation will be mandatory for all students, since in these presentations the ability to question, suggest, establish debate and assess the work of colleagues who are making the exhibition will be assessed. The dedication of each student to the evaluation will be 5 hours.

4.3.Syllabus

* 1: MODELLING. Introduction to SOLID as a calculation tool. Aspects about 3D modelling giving CAD notions of pieces, not only metallic, but also plastic parts in which a special order must be followed when are modelized: implementation of ribs, turrets and specific elements. Obtaining discretizable geometries to analyse and to prepare them for subsequent meshing. It's necessary to take into account the order of the draw functions in the model tree. This order in important for subsequent piece modifications as required by the resistant tests to be performed. Approximately 15% of the subject is dedicated to this topic (theory and practices).

* 2: ASSEMBLIES. Advanced relationship of positions and contacts between pieces, taking into account the relative movement between elements of a mechanism, or assembly for the kinematic simulations in case of movement, and for the FEM resistant tests. Approximately 10% of the subject is dedicated to this topic (theory and practices).

* 3: SIMULATION. Introduction to the methodology and simulation calculation tools based on the Finite Element Method (FEM) for static analysis:

a) Definition of the problem; b) Module of pre-processing of a case (types of studies, selection of materials, definition of constraints and loads, as well as connections in case of analysis of an assembly, mesh); c) execution of the case; d) Post process module for plotting results, interpreting them and generating reports. Approximately 40% of the subject is dedicated to this topic (theory and practices).

* 4: OPTIMIZATION. Definition of variables, constraints and objective functions in order to optimize on the basis of weight / volume of a piece meeting the requirements of strength and rigidity. Execution of case queues. Know differences between optimizing metallic pieces, in which generally the dimensions are easy to vary (a thickness, a width, a profile height), and work with non-metallic pieces, in which the variations are more ambiguous, and require more work by the

person responsible for the study. Approximately 10% of the subject is dedicated to this topic (theory and practices).

* 5: MOVEMENT. Kinematic and dynamic calculation of mechanisms. Application of loads, springs, linear motors and other drives, to generate movement cases that take into account the impenetrability of the parts and the option to consider or not the own weight of the parts, as well as the friction between them. Plotting and interpretation of results, which can be extrapolated to the FEM calculation module for the analysis of the parts of a mechanism in motion. Approximately 25% of the subject is dedicated to this topic (theory and practices).

4.4.Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or in ADD Moodle during the semester. You can find more information in the EINA website https://eina.unizar.es/

4.5.Bibliography and recommended resources

Basic references:

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- Mecánica vectorial para ingenieros. Ferdinand P. Beer, E. Russell Johnston, jr., David F. Mazurek; revisión técnica, Javier León Cárdenas, Miguel Ángel Ríos Sánchez, Enrique Zamora Gallardo. 10ª ed. México: McGraw-Hill Interamericana, 2013
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- SolidWorks Simulation. Sergio Gómez González. Paracuellos de Jarama (Madrid): Ra-Ma, D.L. 2010
- Elementos finitos: introducción para ingenieros, R.K. Livesley. 1ª ed. Mexico: Limusa, 1988
- The finite element method and applications in engineering using Ansys, Erdogan Madenci, Ibrahim Guven. New York: Springer, 2006
- Mecánica para ingenieros [Volumen I], Estática. L. Meriam, L. G. Kraige. 3ª ed. Barcelona: Reverté, 2007
- Cálculo de estructuras por el método de elementos finitos: análisis estático lineal. Eugenio Oñate Ibañez de Navarra. 2ª ed. Barcelona: Centro internacional de Métodos Numéricos en Ingeniería, 1995
- Ingeniería de diseño. P. Orlov; traducido del ruso por José Puig Torres. 2ª ed. Moscú: Mir, 1985
- SolidWorks 2006 tutorial: a step-by-step project based approach utilizing 3D solid modelling. David C. Planchard, Schroff Development Corporation, Marie P. Planchard Kansas: Schroff Development Corporation, 2006
- El método de los elementos finitos aplicado al ánalisis structural. Manuel Vázquez, Eloisa López. Madrid: Noela, D.L. 2001

Complementary references:

- Diseño de máquinas: teoría y práctica. Aaron D. Deutschman, Walter J. Michels, Charles E. Wilson. 3ª. reimp. México: Compañía Editorial Continental, 1985
- Engineering Analysis with SolidWorks Simulation 2009. Kurowski, P.M. SDC publications. 2009
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- Diseño en ingeniería mecánica. Joseph Edward Shigley, Charles R. Mischke; traducción, Javier León Cárdenas;

revisión técnica, James de Gomar Rodríguez, Gilberto D. Álvarez Miranda, Bernardo I. de la Merced Sánchez. - 6ª ed. en español México: McGraw-Hill, 2002

- Analysis of Machine Elements using SolidWorks Simulation 2009. Steffen, J.R. SDC publications. 2009
- El método de los elementos finitos. Las bases. Zienkiewicz, O.C., 2010