UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	NUMERICAL METHODS IN ENGINEERING	**Code:**	56465
Type:	ELECTIVE	**ECTS credits:**	6
Degree:	418 - UNDERGRAD. IN INDUSTRIAL ELECTRONICS AND AUTOMAT. ENGINEERING	**Academic year:**	2023-24
Center:	303 - E.DE INGENIERÍA INDUSTRIAL Y AEROESPOACIAL DE TOLEDO	**Group(s):**	41
Year:	4	**Duration:**	C2
Main language:	Spanish	**Second language:**	
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **DAMIAN CASTAÑO TORRIJOS** - Group(s): **41**

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Lecturer: **JESUS ROSADO LINARES** - Group(s): **41**

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Lecturer: **DAVID RUIZ GRACIA** - Group(s): **41**

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2. Pre-Requisites

To enroll in this subject and make the most of it, students must possess the knowledge and skills acquired in the early years of their degree: competencies related to solving mathematical problems and the ability to apply knowledge in linear algebra, geometry, differential and integral calculus, differential equations (ordinary and partial), and numerical algorithms. It is also recommended to have a basic understanding of general laws in mechanics, thermodynamics, fields and waves, and electromagnetism.

3. Justification in the curriculum, relation to other subjects and to the profession

The Industrial Engineer is a professional who utilizes knowledge from physical sciences, mathematics, and statistics, along with engineering techniques, to carry out their professional activities in areas such as control, instrumentation, and automation of processes and equipment, as well as the design, construction, operation, and maintenance of industrial products. Through this subject, students will achieve a better understanding of a variety of engineering problems they are likely to encounter in their professional career. Emphasis will be placed on modeling, while introducing the most studied numerical methods for analysis, and promoting the student's familiarity with various software programs commonly used in industry.

4. Degree competences achieved in this course

Course competences

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
CB05	Have developed the necessary learning abilities to carry on studying autonomously
CEO31	Ability to mathematically model engineering problems, system simulation and its application to control and optimisation.
CG03	Knowledge of basic and technological subjects to facilitate learning of new methods and theories, and provide versatility to adapt to new situations.
CG04	Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of industrial engineering.
CG09	Organisational and planning skills in the field of companies and other institutions and organisations.
CG10	Capacity to work in a multilingual and multidisciplinary environment.
CT02	Knowledge and application of information and communication technology.
CT03	Ability to communicate correctly in both spoken and written form.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Knowledge of different modelling, simulation and optimisation techniques, which enable responses to a wide variety of engineering problems.

Ability to assess the quality of approximations and control the propagation of errors in simulations.

Knowledge of the main algorithms required for the numerical study of physical systems.

6. Units / Contents

Unit 1: Numerical error

Unit 2: Numerical methods for linear algebra

Unit 3: Linear and non-linear programming

Unit 4: Finite difference method

Unit 5: Finite elements

Unit 6: Applications to design and control in engineering problems

ADDITIONAL COMMENTS, REMARKS

Topic 6 will be taught in the laboratory sessions, parallel to topics 1 to 5.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CEO31 CG03 CT03	1	25	N	-	The professor will explain those aspects of the theoretical development of each topic that they consider necessary for the students to subsequently work independently. Additionally, practical examples will be presented.
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CEO31 CG03 CG04 CT02 CT03	0.6	15	N	-	In-class problem-solving sessions. After solving some typical problems, the professor will dedicate themselves to solving the problems from the proposed collection that the students ask them about.
Computer room practice [ON-SITE]	Practical or hands-on activities	CEO31 CG03 CG04 CG09 CG10 CT02 CT03	0.6	15	N	-	Problem-solving workshops will be conducted in the computer lab using various computer tools.
Self-study [OFF-SITE]	Self-study	CB02 CB03 CB05 CG03 CG04 CT02	3.6	90	N	-	The student must work autonomously in preparing for the assessment tests and the final exam. They should study all the theoretical concepts and apply them to solving the proposed problems for each topic, without neglecting the use of the computer tools employed for this purpose. Any doubts that may arise should be resolved either in the problem-solving sessions or by attending tutorials.
Final test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 CB05 CEO31 CG04 CT02 CT03	0.08	2	Y	Y	There will be a final exam for the subject, which will be of a theoretical/practical nature. The minimum grade for this part to be eligible for compensation will be 3 points.
Final test [ON-SITE]	Assessment tests	CB02 CB03 CB04 CB05 CEO31 CG04 CG09 CG10 CT02 CT03	0.08	2	Y	Y	A laboratory test will be conducted using various computer tools, with exercises similar to those seen in the computer lab practice classes. The minimum grade for this part to be eligible for compensation will be 3 points.
Final test [ON-SITE]	Individual presentation of projects and reports	CEO31 CG03 CG04 CT02 CT03	0.04	1	Y	Y	In each practice session, an exercise will be proposed for development. At the end of the course, a report comprising all the proposed exercises must be submitted, which will be defended in an oral presentation. The minimum grade for this part to be eligible for compensation will be 3 points.
		Total:	**6**	**150**			
Total credits of in-class work: 2.4							**Total class time hours: 60**
Total credits of out of class work: 3.6							**Total hours of out of class work: 90**

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

	Continuous	Non-	

Evaluation System	assessment	continuous evaluation*	Description
Projects	40.00%	40.00%	In each practice session, an exercise will be proposed for development. At the end of the course, a report encompassing all the proposed exercises must be submitted, which will be defended in an oral presentation. The minimum grade for this part to be eligible for compensation will be 3 points.
Laboratory sessions	30.00%	30.00%	A laboratory test will be conducted using various computer tools, with exercises similar to those seen in the computer lab practice classes. The minimum grade for this part to be eligible for compensation will be 3 points.
Final test	30.00%	30.00%	There will be a final exam for the subject, which will be of a theoretical/practical nature. The minimum grade for this part to be eligible for compensation will be 3 points.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The evaluation criteria for the regular assessment period are as follows:

- 40% for the development and defense of a practical assignment (TP).
- 30% for the written exam (PE).
- 30% for the computer-based exam (PO).

The final grade for the subject (NF) will be calculated using the following formula:

NF = 0.4TP + 0.3PE + 0.3*PO

With the following considerations:

-If TP is less than 3 out of 10, NF cannot exceed 4.
-If PE is less than 3 out of 10, NF cannot exceed 4.
-If PO is less than 3 out of 10, NF cannot exceed 4.

The subject is considered passed with NF greater than or equal to 5 out of 10.

Non-continuous evaluation:

The same criteria as the continuous assessment will be followed.

Specifications for the resit/retake exam:

The evaluation system of the regular assessment period will be maintained.

The grades obtained for the assessment milestones that have been successfully completed in the regular assessment period will be retained.

Specifications for the second resit / retake exam:

The evaluation system of the regular assessment period will be maintained, with the peculiarity that there will be no oral presentations. Instead, an additional exercise will be proposed, and its solution should be added to the practice report.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	hours
Class Attendance (theory) [PRESENCIAL][Lectures]	25
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Self-study [AUTÓNOMA][Self-study]	90
Final test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Individual presentation of projects and reports]	1

Global activity

Activities	hours
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Class Attendance (theory) [PRESENCIAL][Lectures]	25
Final test [PRESENCIAL][Individual presentation of projects and reports]	1
Final test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	2
Self-study [AUTÓNOMA][Self-study]	90
Total horas:	135

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
V. Chvatal	Linear Programming	Macmillan		9781429280518	1983	
I. Griva, S. G. Nash, A. Sofer	Linear and Nonlinear Optimization	SIAM		9780898716610	2009	
	Dynamic programming and optimal					

D. Bertsekas	control	Athena Scientific	1886529086	2001
C. Conde, G. Winter	Métodos y algoritmos básicos del álgebra numérica	Reverté	9788429150360	1990
J. Stoer, R. Bulirsch	Introduction to Numerical Analysis	Springer-Verlag	9780070941151	1980
M. Mocholi, R. Sala	Programación lineal : metodología y problemas	Tebar	9788473601344	1993
D. Grainer	Advances in evolutionary and deterministic methods for design, optimization and control in engineering and sciences	Springer	9783319115405	2015
J. W. Demmel	Applied Numerical Linear Algebra	SIAM	9780898713893	1997
N. Threfethen	Numerical Linear Algebra	SIAM	9780898713619	1997
S. Brenner, L. R. Scott	The Mathematical Theory of Finite Element Methods	Springer	9780387759340	2008
O. C. Zienkiewicz, R. L. Taylor, J. Z. Zhu	The Finite Element Method: Its Basis and Fundamentals 7th Edition	Elsevier	9781856176330	2013
R. J. LeVeque	Finite Difference Methods for Ordinary and Partial Differential Equations Paperback: Steady-State and Time-dependent Problems	SIAM	9780898716290	2007