UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	ADVANCED MATHEMATICS	**Code:**	56311
Type:	BASIC	**ECTS credits:**	6
Degree:	415 - UNDERGRADUATE DEGREE PROGRAMME IN ELECTRICAL ENGINEERING	**Academic year:**	2023-24
Center:	303 - E.DE INGENIERÍA INDUSTRIAL Y AEROESPOACIAL DE TOLEDO	**Group(s):**	40
Year:	2	**Duration:**	First semester
Main language:	Spanish	**Second language:**	
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **MARIA FUENSANTA ANDRES ABELLAN** - Group(s): **40**

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Lecturer: **JESUS ROSADO LINARES** - Group(s): **40**

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Lecturer: **DAVID RUIZ GRACIA** - Group(s): **40**

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2. Pre-Requisites

In order to achieve the learning goals described in section 5, the student must posses all the knowledge and skills associated to the mathematics curricula in earlier stages. In particular, we assume:
- Basic geometry and trigonometry knowledge.
- The ability to perform with ease basic math operations, such as powers, logarithms and fractions.
- The ability to work with polynomials.
- Proficience with computers at a user level.
In addition to this, "Advanced Mathematics" builds on the knowledge and skills acquiered in "Algebra", "Calculus I" and "Calculus II". Even if it is not compulsory to have passed all these subjects to take this course, in that case the learning experiece would become much harder and therefore we strongly recommend not to do so.

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

The industrial engineer makes use of physics, mathematics and statistics, together with engineering skills, to develop their profession in aspects such as control, instrumentation and automatization of processes and equipment or the design, manufacturing and operation of industrial products. In these course, the student will further their formation in mathemtics and get a broader perspective and a better understanding of how the knowledge and skills acquiered through the mathematics secquence intertwines with the rest of the degree.

4. Degree competences achieved in this course

Course competences

Code	Description
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
CEB01	Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge of linear algebra; geometry, differential geometry, differential and partial differential equations, numerical methods, numerical algorithms, statistics 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.
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

Ability to approximate functions and data by means of power series and de Fourier developments and their applications.

Ability to describe processes related to industrial engineering subjects by means of ordinary differential equations and partial differential equations, solve them and interpret the results.

Ability to express oneself correctly orally and in writing and, in particular ability to use the language of mathematics as a way of accurately expressing the quantities and operations that appear in industrial engineering. Acquired habits of working in a team and behaving respectfully.

6. Units / Contents

Unit 1: Ordinary Differential Equations

Unit 2: Systems of Ordinary Differential Equations

Unit 3: Introduction to numerical methods for Ordinary Differential Equations

Unit 4: Integral transforms

Unit 5: Functional series and Fourier series.

Unit 6: Partial Differential Equations

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]	Combination of methods	CEB01 CG03 CT03	1.2	30	N	-	The lecturer will teach the theory relative to each unit, present examples and solve model exercieses, so that the student can later work on its own.
Problem solving and/or case studies [ON-SITE]	Combination of methods	CEB01 CG04 CT03	0.6	15	N	-	Some lectures will be dedicated to solving exercieses. Some will be solved completely, for some, the lecturer will provide hints so that the student can finish them in their own. This lectures will also serve to solve problems that the students may have encountered while studying and solving excercises on their own.
Class Attendance (practical) [ON-SITE]	Practical or hands-on activities	CEB01 CG03 CG04 CT02 CT03	0.4	10	N	-	Some lectures will be dedicated to solve excercises with the aid of the computer. These will be a mix between basic exercises, and more realistic excercises and applications. The software used will be MATLAB.
Formative Assessment [ON-SITE]	Assessment tests	CB02 CB03 CB04 CB05 CEB01 CG04 CT02 CT03	0.2	5	Y	Y	The skill solving problems, the understanding of the theory and the proficiency with MATLAB will be evaluated through different tasks, as specified in section 8, "Evaluation Criteria and Grading System".
Study and Exam Preparation [OFF-SITE]	Self-study	CB05 CEB01 CG03 CG04 CT03	3.6	90	N	-	The student must work on its own, studying and understanding the theory and solving excercises. In this process they can relay on MATLAB, and should do so in order to train in the use of the software
		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

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	70.00%	90.00%	There will be an exam consisting of both theoretical questions and exercises. For the studintes graded on the coniuous assesment system, the exam will consist only of excercises. The minimum grade in this activity, in order for it to be compensable, is 3.5 over 10.
Laboratory sessions	10.00%	10.00%	There will be an exam consisting of excercises that must be solved using MATLAB. The minimum grade in this activity, in order for it to be compensable, is 4 over 10.
			The student must hand in the proposed exercises and

Projects	20.00%	0.00%	questions in the dates specified at the begining of te course. The goal of this activity is to encourage the implication of the student with the subject throught the whole course.
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:

Let TR, PF and ML be the grade attained respectively in the Projects, Final Test and Laboratory sessions activities. Then the final grade of the course, NF, is computed as:
NF = 0.2 * TR + 0.7 * PF + 0.1 *ML,
with the following considerations:
- Depending on the average grade of TR an ML, the student may opt to switch from the continuious assessment grading system to the non-continuous evaluation.
- If PR < 3.5, NF can be at most 4, regardless of the outcome of the previous formula, and therefore the student cannot pass the course.
- If ML < 4, NF can be at most 4, regardless of the outcome of the previous formula, and therefore the student cannot pass the course.

Non-continuous evaluation:

Let PF and ML be the grade attained respectively in the Final Test and Laboratory sessions activities. Then the final grade of the course, NF, is computed as:
NF = 0.9 * PF + 0.1 *ML,
with the following considerations:
- If ML < 4, NF can be at most 4, regardless of the outcome of the previous formula, and therefore the student cannot pass the course.

Specifications for the resit/retake exam:

There will an exam consisting of two parts: a first one with theoretical questions and excercises and a second one consisting on exercises to be solved with MATLAB.
If a student achieved a grade in one of the evaluation activities that made it compensable, they may keep that grade for the retake exam.
If a student has more than one grade in any activity, the larger of the two will be used.
If the grade corresponding to the lab sessions is smaller than 4 over 10, the final grade will be at most 4, and therefore the student cannot pass the course.

Specifications for the second resit / retake exam:

There will an exam consisting of two parts: a first one with theoretical questions and excercises and a second one
consisting on exercises to be solved with MATLAB. The criteria will be the same as in the "Non-continuous evaluation" system.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
Hours	**hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	30
Problem solving and/or case studies [PRESENCIAL][Combination of methods]	15
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	10
Formative Assessment [PRESENCIAL][Assessment tests]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	90

Global activity	
Activities	**hours**
Formative Assessment [PRESENCIAL][Assessment tests]	5
Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities]	10
Problem solving and/or case studies [PRESENCIAL][Combination of methods]	15
Study and Exam Preparation [AUTÓNOMA][Self-study]	90
Class Attendance (theory) [PRESENCIAL][Combination of methods]	30
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Bellido, J.C; Donoso, A; Lajara, S.	Ecuaciones en derivadas parciales	Paraninfo		978-84-283-3016-9	2014	
San Martín, J; Tomeo, V; Uña, I.	Métodos matemáticos: ampliación de matemáticas para ciencias e ingeniería.	Paraninfo		978-8497329804	2015	
Straws, W. A.	Partial differential equations: an introduction, 2nd Ed	Wiley		978-0470-05456-7	2009	
Bellido, J.C; Donoso, A; Lajara, S.	Ecuaciones diferenciales ordinarias	Paraninfo		978-84-283-3015-2	2014	
Burden, R. L; Freires, J. D; Burden A. M.	Numerical Analysis	Cengage Learning		978-1305253667	2016	
Simmons, G. F.	Differential Equations with applications and historical notes, 3rd ED	Chapman & Hall		978-1-4987-0259-1	2017	
García, A; López, A; Rodríguez, G. S; De la Villa, A.	Ecuaciones diferenciales ordinarias	Clagsa	Madrid	84-921847-7-9	2006	
Pérez García, V. M; Torres, P. J.	Problemas de ecuaciones diferenciales	Ariel	Barcelona	84-344-8037-9	2001	
Redheffer, R.	Differential Equations: Theory and Applications.	Jones & Barlett		978-086722007	1991	
	Ecuaciones diferenciales con	Cengage				

Zill, D. G.	aplicaciones al modelado.	Learning		978-970-830-055-1	2010
Pedregal, P.	Iniciación a las ecuaciones en derivadas parciales y al análisis de Fourier	Septem Ediciones		84-95687-07-0	2001
Simmons, G. F.	Ecuaciones diferenciales con aplicaciones y notas históricas	McGraw- Hill	Madrid	84-481-0045-X	
Haberman, R.	Ecuaciones en derivadas parciales con series de Fourier y problemas de contorno	Prentice- Hall		978-84-205-3534-0	2008
Bender, C.M; Orszag, S. A.	Advanced Mathematical Methods for Scientists and Engineers, 1st ED	Springer-Verlag		978-1-4419-3187-0	1999