UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	MATHEMATICAL INSTRUMENTS FOR ENGINEERING II	**Code:**	38305
Type:	BASIC	**ECTS credits:**	6
Degree:	345 - UNDERGRADUATE DEGREE PROGRAMME IN CIVIL ENGINEERING	**Academic year:**	2022-23
Center:	603 - E.T.S. CIVIL ENGINEERS OF CR	**Group(s):**	20
Year:	1	**Duration:**	C2
Main language:	Spanish	**Second language:**	
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **CRISTINA SOLARES MARTINEZ** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Edificio Politécnico/2-D32	MATEMÁTICAS	3255	cristina.solares@uclm.es	It will be communicated at the beginning of the course.

2. Pre-Requisites

It is convenient that students have taken the subject “Mathematical Instruments for Engineering I” and “Mathematical and Computational Tools for Civil Engineering” .

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

This subject is essential for the formation of an engineer. Different concepts related to functions with several variables will be studied, which will allow the student to solve engineering problems involving differentiation, integration, differential geometry and optimization.

4. Degree competences achieved in this course

Course competences

Code	Description
CE01	Students can apply their knowledge in the practical solution of civil engineering problems, with capacity for the analysis and definition of the problem, the proposal of alternatives and their critical evaluation, choosing the optimal solution with technical arguments and with capacity of defense against third parties.
CE02	Students have the ability to broaden their knowledge and solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study. Self-study ability, to undertake further studies with a high degree of autonomy
CE04	Students have the ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial derivative equations; numerical methods; numerical algorithms; statistics and optimization.
CE06	Students have a basic knowledge of the use and programming of computers, operating systems, databases and software with engineering application.
CG01	Students achieve general knowledge of Information and Communication Technologies (ICT).

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Students know the fundamentals and applications of Optimization in the field of civil engineering.

Students know how functions and data are approximated by means of power and Fourier series expansions and their applications.

Students can handle functions of one and several variables including their derivation, integration and graphic representation. They know the fundamentals and applications of Differential and Integral Calculus.

Students are able to express correctly both orally and in writing and, in particular, they can use the language of mathematics as a way of expressing accurately the quantities and operations in civil engineering. Students get used to teamwork and behave respectfully.

Students use mathematical and computer tools to pose and solve civil engineering problems.

The students are able to handle and know the concepts of differential geometry.

Additional outcomes

Apply the concepts of continuity, limit and derivation of functions of several variables to solve engineering problems.

Understand multiple integrals and curvilinear integrals, as well as their applications in engineering.

6. Units / Contents

Unit 1: Functions of several variables

Unit 1.1 Real functions with several variables, definition. Limits of real functions with several variables. Geometric interpretation. Limits in one direction and consecutive limits. Continuity of real functions of several variables. Partial derivatives. Geometric interpretation. Partial derivatives of further order. Directional derivatives. Differential and gradient. Jacobian. Taylor series.

Unit 2: Extremes of Several Variables Functions

Unit 2.1 Maxima and minima of real functions of several real variables. Calculation of conditioned extrema: method of Lagrange multipliers. Applications.

Unit 3: Plane curves

Unit 3.1 Introduction and definition. Analytic expression. Tangent and normal to a curve. Length. Curvature. Evolutes.Locus. Applications.

Unit 4: Space curves

Unit 4.1 Introduction and definition. Analytic expression.Length. Versor and tangent straight line. Normal plane. Osculating plane. Curvature vector. Versor and principal normal line. Curvature, curvature centre and curvature radius. Versor and binormal straight line. Rectifying plane. Torsion. Torsion radius. Frenet frame. Applications.

Unit 5: Surfaces

Unit 5.1 Analytic expression. Tangent plane. Versor and normal straight line. Space curves that lie on a Surface. Cone and cylinder circumscribed. Curvature. Surface generation: Conical, cylindrical and revolution surfaces.

Unit 6: Line integrals. Potential function

Unit 6.1 Vector Analysis. Concept of line integral and properties. Calculation of a line integral. Concept of potential function. Calculation of the potential function. Existence condition. Independence of path. Applications: work calculation, mass calculation, area calculation, fluids study, etc.

Unit 7: Double integrals

Unit 7.1 Concept of double integral. Geometric interpretation. Properties of double integrals. Calculation of double integrals. Change of variables in double integrals. Green's theorem. Applications.

Unit 8: Area of a surface. Surface integral.

Unit 8.1 Area of a surface. Expression of the area in parametric coordinates. Surface integral. Stokes's theorem. Applications.

Unit 9: Triple integrals

Unit 9.1 Concept of triple integral. Properties of the triple integral. Calculation of triple integrals. Change of variables in triple integrals. The Divergence theorem. Applications.

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	CE01 CE04 CE06 CG01	1.46	36.5	N	-	
Class Attendance (practical) [ON-SITE]	Problem solving and exercises	CE01 CE04 CE06 CG01	0.54	13.5	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CE01 CE02 CE04 CE06 CG01	0.24	6	Y	N	
Final test [ON-SITE]	Assessment tests	CE01 CE02 CE04	0.12	3	Y	Y	
Study and Exam Preparation [OFF-SITE]	Combination of methods	CE01 CE02 CE04 CE06 CG01	3.6	90	N	-	
Individual tutoring sessions [ON-SITE]	Problem solving and exercises	CE01 CE02 CE04 CE06 CG01	0.04	1	N	-	
		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
Assessment of problem solving and/or case studies	40.00%	0.00%	It includes exercises and problems that the students will solve individually or in groups. Includes practical exercises in the computer room.
Final test	60.00%	100.00%	It includes the partial examinations, the ordinary and extraordinary examinations
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 is made up of 2 partials, each one evaluated by means of 60%-exam grade and 40%-problem solving and/or case studies grade. The minimum mark required in the partial exams is 4 out of 10. The minimum mark to pass the ordinary call is 5 out of 10. The partial exams with a minimum mark of 4 are kept for the ordinary and extraordinary calls. The note in problem solving and/or case studies is saved for the ordinary and extraordinary calls. All the assessable activities that have been carried out during the course are recovered. All the assessable activities that have been carried out during the course are no kept for the next year.

Non-continuous evaluation:

The student will have to do a global exam (100%). The global exam will include all the course content. To pass the course, the student must obtain at least a 5 out of 10.

Unless stated otherwise, continuous evaluation criteria will be applied to all students.

Anyone choosing non-continuous assessment must notify it to the lecturer within the class period of the subject. The option is only available if the student¿s participation in evaluation activities (from the continuous assessment) has not reached 50% of the total evaluation for the subject.

For the retake exam, the assessment type used for the final exam will remain valid.

Specifications for the resit/retake exam:
Same that in final exam.
Specifications for the second resit / retake exam:
The student will have to do a global exam that will include all the course and competences content. To pass the course, the student must obtain at least a 5 out of 10, which will constitute 100% of his/her grade.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	**hours**
Final test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	25
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	1
Unit 1 (de 9): Functions of several variables	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	9
Unit 2 (de 9): Extremes of Several Variables Functions	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	9
Unit 3 (de 9): Plane curves	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	5
Unit 4 (de 9): Space curves	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	7
Unit 5 (de 9): Surfaces	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	7
Unit 6 (de 9): Line integrals. Potential function	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	7
Unit 7 (de 9): Double integrals	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	9
Unit 8 (de 9): Area of a surface. Surface integral.	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	1.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	7
Unit 9 (de 9): Triple integrals	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	2
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	.75
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	5
Global activity	
Activities	**hours**
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	6
Final test [PRESENCIAL][Assessment tests]	3

Class Attendance (theory) [PRESENCIAL][Lectures]	36.5
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	13.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	90
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	1
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Gilbert Strang	Calculus	Wellesley-Cambridge Press				
	https://math.mit.edu/~gs/calculus/					
Vladimir Rovenski	Modeling of curves and surfaces with Matlab	Springer			2010	
Jon Rogawski	Cálculo de varias variables	Reverté		9788429151749	2012	
Anton, Howard	Calculus : a new horizon	John Wiley & Sons		0-471-15306-0	1999	
Aranda, Ernesto	Problemas de cálculo vectorial	Lulu.com		978-1-4092-5048-7	2009	
Bradley, Gerald L.	Calculo	Prentice-Hall		84-8322-041-5	2001	
Burgos Román, Juan de	Análisis matemático II (de varias variables) : 90 problemas	García-Maroto Editores		978-84-935271-2-9	2007	
Burgos Román, Juan de	Curvas y superficies : [Definiciones, Teoremas y Resultados]	García-Maroto		978-84-936299-3-9	2008	
Burgos Román, Juan de	Integración sobre curvas y superficies: teoremas de integrac	García-Maroto Editores		978-84-936712-7-3	2009	
Castellano Alcántara, J.	Cálculo matemático aplicado a la técnica	Proyecto Sur		84-8254-995-2	2000	
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Estrada Castillo, Octavio	Cálculo vectorial y aplicaciones	Grupo Editorial Iberoamerica		970-625-189-8	1999	
Fong, Yuen	Calculus	Springer		981-3083-01-8	1999	
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Granero Rodríguez, Francisco	Cálculo infinitesimal : una y varias variables	McGraw-Hill		84-481-1740-9	1995	
Gray, Alfred	Modern differential geometry of curves and surfaces with Mat	Chapman and Hall		978-0-58488-448-4	2006	
Losada, Rodriguez, R.	Análisis Matemático	Ediciones Pirámide			1978	
Herrero, Henar	Informática aplicada a las ciencias y a la ingeniería con Matlab	E. T. S. Ingenieros IndustrialesLibrería-Papelería		84-699-3109-1	2009	
Jeffery Cooper	A Matlab Companion for Multivariable Calculus	Academic Press		0-12-187625-X	2001	
Jeffrey, Alan	Mathematics for engineers and scientists	Chapman & Hall		0412621509	1996	
Kevin M. O'Connor	CALCULUS Labs for MATLAB	Jones and Bartlett Publishers, Inc.		0-7637-3426-8	2005	
Krasnov, Mijail Leontevich	Análisis vectorial: breve exposición del material teórico y	URSS		5-354-01103-5	2005	
Larson, Ron	Cálculo II de varias variables	McGraw-Hill		970-10-5275-7	2006	
Marsden, Jerrold E.	Cálculo vectorial	Pearson Educación		84-7829-069-9	2004	
Mataix Plana, José Luis	Mil problemas de cálculo integral : [tercera parte] : deriv	Dossat 2000		978-84-89656-06-2	1996	
O'NEILL, Barrett	Elementos de Geometria diferencial	Limusa		968-18-0671-9	1982	
Oprea, John	Differential Geometry and its applications	The Mathematical Association of America		978-0-88385-748-9	2007	
Pita Ruiz, Claudio de J.	Cálculo vectorial	Prentice-Hall Hispanoamericana		968-880-592-7	1995	
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Stein, Sherman K.	Cálculo y geometría analítica	McGraw-Hill Interamericana		958-600-250-0 (o.c.)	1995	
Stewart, James (1941-)	Cálculo multivariable	Thomson Learning		970-686-123-8	2003	
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Vera López, A.	Curso de geometría Diferencial: curvas y superficies	UNED			1993	