UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course:	MATHEMATICAL INSTRUMENTS FOR ENGINEERING I	**Code:**	38300
Type:	BASIC	**ECTS credits:**	6
Degree:	345 - UNDERGRADUATE DEGREE PROGRAMME IN CIVIL ENGINEERING	**Academic year:**	2023-24
Center:	603 - E.T.S. CIVIL ENGINEERS OF CR	**Group(s):**	20
Year:	1	**Duration:**	First semester
Main language:	Spanish	**Second language:**	English
Use of additional languages:		**English Friendly:**	Y
Web site:		**Bilingual:**	N

Lecturer: **ROSA EVA PRUNEDA GONZALEZ** - Group(s): **20**

Building/Office	Department	Phone number	Email	Office hours
Politecnico 2-D33	MATEMÁTICAS	3292	rosa.pruneda@uclm.es	Tuesday and Thursday from 16:00 to 18:00. From Monday to Thursday from 11:30 to 12:00.

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	Tuesday 16.00-19.00 h and Thursday 16.00-19.00 h

2. Pre-Requisites

To achieve the learning objectives of the subject, knowledge and skills that are supposed to be guaranteed in the pre-university education are required. In particular, knowledge of basic geometry and trigonometry, elementary mathematical operations (powers, logarithms, fractions), polynomials, matrices, derivation, integration and fundamentals of graphical representation of functions are necessary.

With regard to basic skills in the handling of instruments is the elementary management of computers: access, file and directories management, etc.

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

In this subject, mathematical and computer concepts are studied, which constitute an essential part of the training of a future engineer.

Concepts related to vector spaces, matrix calculation, systems of linear equations, real functions of real variable (continuity, derivability, integration), sequences, expansion of a function into power series, which are basic for various subjects throughout the career, are studied. : Mathematical Instruments for Engineering II, Fundamentals of Physics, Mechanics of Rigid Solid, Differential Equations, Resistance of Materials, Hydraulic Engineering, Calculation of Structures, etc.

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 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 familiar with computer use: operative systems, databases, programming languages, and software applied to civil engineering.

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.

Students can handle and perform elementary operations with real and complex numbers.

Students know the fundamentals and applications of Linear Algebra: matrix theory, systems of equations and linear applications.

6. Units / Contents

Unit 1: Linear Algebra

Unit 1.1 Linear Equation Systems. Compatibility. Solution. Applications. Spaces with Interior Connectivity.

Unit 1.2 Matrices. Rank. Determinant. Operations.

Unit 1.3 Cones: Convex sets. Types of linear combinations. Concept of cone.

Unit 1.4 Polytopes and Polyhedra: Concept of polytope. Concept of polyhedra.

Unit 1.5 Linear Inequality Systems.

Unit 1.6 Vector Spaces. Vector Subspaces. Bases and Dimension of a Vector Space. Coordinates of a Vector.

Unit 1.7 Linear Applications: Matrix representation of a linear application. Change of basis. Eigenvectors and eigenvalues. Diagonalization.

Unit 1.8 Bilinear and Quadratic Forms: Bilinear forms. Matrix representation of a bilinear form.

Unit 2: Calculus

Unit 2.1 Real numbers. Introduction. The set of natural numbers N. Operations with natural numbers. The set of integer numbers Z. Operations with integer numbers. The set of rational numbers Q. Operations with rational numbers. The set of real numbers R. Operations with real numbers.

Unit 2.2 Complex numbers. Introduction. Complex numbers. Operations with complex numbers: addition and product of complex numbers, root of a complex number, natural logarithm and power of a complex number. Application of complex numbers to geometric transformations: translation, rotation, homotecy, product of homotecy by rotation, product of inversion by axial symmetry.

Unit 2.3 Sequences and Series of real numbers. Introduction. Sequences of real numbers, definition. Limit of a sequence of real numbers. Theorems about sequence limits. Practical calculation of limits. Equivalent infinitesimals and infinites. Series of real numbers, definition. Convergence of a serie. Remainder of a serie. Properties of series. Geometrical series. Divergence criteria. Positive terms series: comparison tests, integral test, p-series, ratio and root test. Alternating series. Leibniz criterion. Series of any terms. Conditional and absolute convergence.

Unit 2.4 Real functions of real variable. Concept of function. Limit of functions. Function continuity. Differentiability of a function. Differentiation techniques. Differentials and approximation by the tangent. Local behaviour of differentiable functions. Increase and decrease. Concave and convex functions. Study of the variation of a function. Local and global maxima and minima. Applications.Graphic representation of functions.

Unit 2.5 Power series, Taylor and MacLaurin. Sequences and functional series.Concept of power series. Convergence of a power series. Expansion of a function into power series. Taylor and MacLaurin series.

Unit 2.6 Definite integrals and their properties. Concept of definite integral. Geometric representation. Definite integrals properties. Indefinite integrals, definition. The fundamental theorem of calculus. Special integration methods: by parts, rational functions, substitution, irrational, transcendent. Improper integrals, generalization of the integral concept. Parametric and Eulerian integrals. Applications to the calculation of plane areas, curve length, area and volume of a surface of revolution.

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 CE02 CE04 CG01	1.12	28	N	-	
Class Attendance (practical) [ON-SITE]	Problem solving and exercises	CE01 CE02 CE04 CG01	0.78	19.5	N	-	
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CE01 CE04 CE06 CG01	0.08	2	Y	N	
Progress test [ON-SITE]	Assessment tests	CE01 CE02 CE04 CG01	0.16	4	Y	N	
Final test [ON-SITE]	Assessment tests	CE01 CE02 CE04	0.18	4.5	Y	Y	
Study and Exam Preparation [OFF-SITE]	Combination of methods	CE01 CE02 CE04 CE06 CG01	3.6	90	N	-	
Group tutoring sessions [ON-SITE]	Problem solving and exercises	CE01 CE02 CE04 CE06	0.04	1	N	-	
Individual tutoring sessions [ON-SITE]	Problem solving and exercises	CE01 CE02 CE04 CE06	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
Final test	60.00%	100.00%	The test includes the partial examinations and the ordinary / extraordinary examinations
Other methods of assessment	40.00%	0.00%	Includes resolution of problems or cases. Includes progress tests.
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 partial exams, each one evaluated by means of 60%- exam grade and 40% -problem solving and/or progress tests grade (average grades). 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, mark which is obtained as the mean of the 2 partials. The partial exams with a minimum mark of 4 are kept for the ordinary and extraordinary sessions. The note in resolution of problems or cases is saved for the ordinary and extraordinary calls.

All the assessable activities that have been carried out during the course are recovered.
Grades are not saved from previous courses.

Non-continuous evaluation:

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.
Unless stated otherwise, continuous evaluation criteria will be applied to all students.
Grades are not saved from previous courses.

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.
Grades are not saved from previous courses.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

Unit 1 (de 2): Linear Algebra

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	12
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	45
Group tutoring sessions [PRESENCIAL][Problem solving and exercises]	.5
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	.5

Unit 2 (de 2): Calculus

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	13
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	7.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Final test [PRESENCIAL][Assessment tests]	1.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	45
Group tutoring sessions [PRESENCIAL][Problem solving and exercises]	.5
Individual tutoring sessions [PRESENCIAL][Problem solving and exercises]	.5

Global activity

Activities	**hours**
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	2
Final test [PRESENCIAL][Assessment tests]	4.5
Progress test [PRESENCIAL][Assessment tests]	4
Class Attendance (theory) [PRESENCIAL][Lectures]	28
Class Attendance (practical) [PRESENCIAL][Problem solving and exercises]	19.5
Study and Exam Preparation [AUTÓNOMA][Combination of methods]	90
Group tutoring sessions [PRESENCIAL][Problem solving and exercises]	1
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
Larson, R; Edwards, B.H.; Falvo, D.C.	Algebra Lineal	Pirámide			2004	
Larson, R.E., Hostetler, R.P.	Cálculo y geometría analítica	McGraw-Hill de España		84-7615-240-X	1989	
Larson, Ron y Edwards, Bruce H.	Cálculo 1 de Una Variable	McGraw-Hill/Interamericana Editores		978-607-15-0273-5	2010	
Larson, Ron1941-	Cálculo I	Pirámide		84-368-1707-9 (v. 1)	2003	

Lipschutz, Seymour	Algebra lineal	McGraw-Hill	84-7615-758-4	2003
Losada Rodríguez, Ramón	Análisis matemático	Pirámide	84-368-0096-6	1981
Maron, I.A.	Problemas sobre calculo de una variable : (elementos y teori	Paraninfo	84-283-0706-7	1975
Pérez, CésarPérez López	Matlab y sus aplicaciones en las ciencias y la ingeniería	Pearson Educación	84-205-3537-0	2007
Spiegel, Murray R.	Cálculo superior	McGraw-Hill	970-10-0065-X	1993
Stewart, James (1941-)	Cálculo de una variable : Trascendentes tempranas	International Thomson	970-686-069-X	2001
Suárez Rodríguez, María del Carmen	Cálculo integral y aplicaciones con Matlab	Pearson	84-205-4215-6	2004
Thomas, George B	Cálculo de Una Variable	Addison-Wesley	978-607-32-0164-3	2010
de Burgos Román, Juan	Test y Problemas de Cálculo de Una Variable	García-Maroto Editores	978-84-15214-47-2	2011
Coquillat, F. (Fernando Coquillat Durán)	Cálculo integral : metodología y problemas	Tébar Flores	84-7360-168-8	1997
Castillo, Enrique; Conejo, Antonio; Pedregal, Pablo; García, R; Alguacil, N;	Building and Solving Mathematical Programming Models in Engineering and Science	Pure and Applied Mathematics: A Wiley-Interscience Series of Texts, Monographs and Tracts	0-471-15043-6	2001
Conejo, Antonio; Castillo, Enrique; Mínguez, Roberto; García-Bertrand, Raquel	Decomposition Techniques in Mathematical Programming, Engineering and Science Applications	Springer	978-3-540-27685-2	2006
Franco Brañas, José Ramón	Cálculo I	Dirección General de Universidades e Investigac	84-699-4088-0	2001
García López, A.; García Mazarío, F.; López de la Rica,A.; Rodríguez Sánchez, G.; de la Villa Cuenca, A.	Cálculo I : Teoría y Problemas de Análisis Matemático en una Variable	CLAGSA	978-84-921847-2-9	2011
Granero Rodríguez, Francisco	Cálculo infinitesimal : una y varias variables	McGraw-Hill	84-481-1740-9	1995
Granero Rodríguez, Francisco	Cálculo integral y aplicaciones	Prentice Hall	84-205-3223-1	2001
Granero Rodríguez, Francisco	Ejercicios y problemas de calculo	Tebar Flores	84-7360-109-2	1991
Herrero, Henar	Informática aplicada a las ciencias y a la ingeniería con Ma	E. T. S. Ingenieros IndustrialesLibrería-Papelería	84-699-3109-1	2009
Hill, Richard	Álgebra Lineal Elemental	Prentice Hall	978-968-880962-4	1997
Abaurrea, R. B.	Cálculo Infinitesimal e Integral	Litoprint		1997
Apostol, Tom M.	Calculus volúmen I : cálculo con funciones de una variable,	Reverté	84-291-5002-1	2006
Aranda E., Ureña F.	Problemas de cálculo de una variable.	Bubok Publishing	978-84-92580-05-7	2008
Ayres, Frank, Jr.	Calculo diferencial e integral	McGraw-Hill	84-7615-560-3	1992
Bradley, Gerald L.	Cálculo de una variable	Prentice Hall	84-8322-041-5 (Obra	2001
Burgos Román, Juan de	Algebra lineal	McGraw-Hill	84-481-0134-0	1993
Burgos Román, Juan de	Cálculo diferencial : (una y varias variables) : 126 problem	García-Maroto	978-84-937509-0-9	2010
Castillo E, Cobo A., Jubete F. Pruneda RE	Orthogonal Sets and Polar Methods in Linear Algebra: Applications to Matrix Calculations, Systems of Equations and Inequalities, and Linear Programming	John Wiley and Sons	0-471-32889-8	1999
Castillo E, Cobo A., Jubete F., Pruneda RE., Castillo C.	An Orthogonally Based Pivoting Transformation of Matrices and Some Applications			2000
Castillo E., Conejo A., Pedregal P., García R., Alguacil N.	Building and Solving Mathematical Programming Models in Engineering and Science.	Pure and Applied Mathematics: A Wiley-Interscience Series of Texts, Monographs and Tracts	0-471-15043-6	2001
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