

## SUBJECT TEACHING GUIDE

### G1462 - Engineering Computation

#### Degree in Civil Engineering BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM

Academic year 2022-2023

1. IDENTIFYING DATA			
Degree	Degree in Civil Engineering BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM	Type and Year	Core. Year 2 Compulsorv. Year 1
Faculty	School of civil Engineering		
Discipline	Obligatory Subjects  BASIC MATHEMATICS FOR ENGINEERING		
Course unit title and code	G1462 - Engineering Computation		
Number of ECTS credits allocated	6	Term	Semester based (2)
Web	<a href="http://personales.unican.es/gila/EngComp22-23.pdf">http://personales.unican.es/gila/EngComp22-23.pdf</a>		
Language of instruction	English	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION		
Name of lecturer	AMPARO GIL GOMEZ		
E-mail	amparo.gil@unican.es		
Office	E.T.S. de Ingenieros de Caminos, Canales y Puertos. Planta: + 1. DESPACHO PROFESORES (1028)		
Other lecturers			

3.1 LEARNING OUTCOMES
- Be able to apply and analyze the performance of basic numerical techniques used for solving mathematical models in Engineering.
- Basic understanding and evaluation of numerical errors when using approximate numerical methods with a computer.
- Be able to apply basic numerical methods for solving differential equations.
- Be able to apply and analyze the performance of basic numerical methods to approximate data sets and functions, compute derivatives and evaluate integrals.
- Be able to apply and analyze the performance of basic numerical methods for solving non linear scalar equations and linear and non linear systems of equations.

#### 4. OBJECTIVES

Complete the training of a Civil Engineering student on mathematical topics such as Algebra , Geometry, Analysis, Introduction to Numerical Methods and Computer Science.

To further strengthen the abilities of the student in : a) the use of numerical methods needed for solving differential equations appearing in mathematical models in Engineering; b) the use of numerical methods for solving multiple integrals; c) the approximation of functions, 1-D integrals, scalar equations and linear and nonlinear systems of equations.

Be able to identify and understand the source of the errors appearing when using approximate methods. Be able to implement efficiently the numerical methods in a computer.

#### 6. COURSE ORGANIZATION

##### CONTENTS

1	Part 1: Introduction . Outline of the course contents. Engineering and numerical modeling approach. Errors. . Taylor series and numerical derivatives. Error formulas. Applications.
2	Part 2. Differential equations . Ordinary Differential Equations (ODEs). . ODEs. Initial value problems. Single step methods of integration. Errors. . ODEs. Boundary problems: Finite differences. . Partial Differential Equations (PDEs). Basic ideas. Finite differences. simple examples of stationary and time dependent problems (heat, fluid flow).
3	Part 3. Approximation and integration. Solving scalar equations and systems of equations. . Least squares approximation. . Interpolation of functions of one and several variables. . 1D numerical integration. Basic quadrature rules (trapezoidal, Gauss, ..). Errors. . Multiple integration: overview of analytical techniques. Domain transformations. Numerical methods. . Scalar nonlinear equations and systems of nonlinear equations. Methods and convergence. . Matrix factorization. Systems of linear equations. . Matrix norms and errors in linear systems of equations. . Iterative methods: basic ideas; convergence.

### 7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
A first prelim exam at week #6 of the course.	Written exam	No	Yes	25,00
A second prelim exam at week #11 of the course.	Written exam	No	Yes	25,00
A third exam at the end of the course.	Written exam	No	Yes	25,00
Computer lab exercises.	Others	No	No	15,00
Problem sets.	Others	No	No	10,00
<b>TOTAL</b>				<b>100,00</b>
<b>Observations</b>				
Only for duly justified reasons (eg health restrictions) remote online exams could be allowed, with prior authorization from the UC Civil Engineering School Council.				
<b>Observations for part-time students</b>				
Any student in this category can choose between following the continuous evaluation examinations or being evaluated of all the contents in the final exam with a weight of a 75% of the final score. The remaining 25% will be based on the student performance in computer assignments.				

### 8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC
<ul style="list-style-type: none"> <li>- Resúmenes de las lecturas de la asignatura (se proporcionarán a los alumnos).</li> <li>- "Numerical Methods for Engineers", 6th, 5th editions. Steven C. Chapra and Raymond P. Canale. ISBN: 978-0-07-340106-5. Ed: McGraw-Hill Book Company, New York. 2010, 2005</li> </ul>