UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2022/23
Subject (*)	Calculus and Numerical Analysis		Code	614G03002
Study programme	Grao en Intelixencia Artificial			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	Basic training	6
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Gonzalez Taboada, Maria	E-mail	maria.gonzalez.taboada@udc.es	
Lecturers	Cendan Verdes, Jose Jesus Gonzalez Taboada, Maria	E-mail	jesus.cendan.verdes@udc.es maria.gonzalez.taboada@udc.es	
Web				
General description	In this subject students will learn basic techniques from differential and integral calculus in one variable, and an introduction to the calculus in several variables. Moreover, we will present some basic numerical methods to solve nonlinear equations, approximate functions of one variable and their derivatives, and to solve linear systems of equations.			

Study programme competences / results	
Code	Study programme competences / results
A1	Capacidad para utilizar los conceptos y métodos matemáticos y estadísticos para modelizar y resolver problemas de inteligencia artificial.
B2	Que el alumnado sepa aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posea las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio.
B3	Que el alumnado tenga la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética.
B5	Que el alumnado haya desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía.
B7	Capacidad para resolver problemas con iniciativa, toma de decisiones, autonomía y creatividad.
B9	Capacidad para seleccionar y justificar los métodos y técnicas adecuadas para resolver un problema concreto, o para desarrollar y proponer nuevos métodos basados en inteligencia artificial.
C3	Capacidad para crear nuevos modelos y soluciones de forma autónoma y creativa, adaptándose a nuevas situaciones. Iniciativa y espíritu emprendedor.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Know the basics from mathematics that support the remaining subjects of this degree.	A1	B2 B3 B5 B7 B9	C3
Identify, model and solve problems from differential and integral calculus.	A1	B2 B3 B5 B7 B9	C3

Learn the conceptual basis of the mathematical techniques that make up the skeleton of the methods of analysis and modelisation from artificial intelligence.	A1	B2 B3 B5 B7 B9	C3
To handle the concepts of function of several real variables, gradient of a function and approximation of functions, as well as their application to real problems.	A1	B2 B3 B5 B7 B9	C3

Contents	
Topic	**Sub-topic**
Functions of one variable.	Real functions of one real variable. Elementary functions. Limits. Continuity. Bisection method to solve nonlinear equations.
Derivatives	Derivative of a function at one point. Physical and geometrical meaning. Derivability. Calculus of derivatives. Lagrange Mean Value Theorem. Extrema. Concavity and convexity. Newton-Raphson method to solve nonlinear equations. Lagrange interpolation. Numerical differentiation.
Integration	Indefinite integrals: primitives. Riemann's integral. Numérica quadrature. Calculus of areas of plane regions. Calculus of volumes.
Functions of several variables	Functions of several variables. Visualization. Limits and continuity. Diferenciability: gradient vector, approximation by the tangent plane, chain rule, directional derivative. Derivatives of higher order. Schwarz's Theorem. Extrema of real functions of several variables.
Resolución numérica de sistemas lineais	Condicionamiento dun sistema de ecuacións. Métodos directos. Métodos iterativos. Método dos mínimos cuadrados.

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
ICT practicals	A1 B2 B3 B5 B7 B9 C3	20	10	30
Problem solving	A1 B2 B3 B5 B7 B9 C3	10	25	35
Objective test	A1 B2 B3 B5 B7	3	7	10
Guest lecture / keynote speech	A1 B3 B5 B9 C3	30	45	75
Personalized attention		0		0
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
ICT practicals	In these lectures students will solve problems related with the subject contents using Python.
Problem solving	In these lectures students will solve problems related with the subject contents by hand, with the aim of easing concepts and methods comprehension.
Objective test	To evaluate learning outcomes, there will be a written test on the dates set by the Faculty Board. The test will be oriented essentially to problem solving.
Guest lecture / keynote speech	During these lectures, the teacher will present the subject contents making use of examples to help to the comprehension of the different concepts and methods.

Personalized attention	
Methodologies	**Description**
ICT practicals Problem solving	During ICT practicals with Python and Problem solving sessions, lecturers will solve students questions about theoretical concepts and their practical applications, reviewing and discussing with each student him/her progress in the assigned practice or problem. In addition, lecturers will solve the doubts raised by the students in their respective tutorial hours. With the aim of facilitating to follow the subject, teachers will make tutorial attention via Teams with part-time students and those with academic dispensation of attendance exemption.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
ICT practicals	A1 B2 B3 B5 B7 B9 C3	During ICT practicals lecturers will propose exercises that will qualify up to 40% of the final mark.	40
Objective test	A1 B2 B3 B5 B7	There will be a written test on the dates set by the Faculty Board. This test will qualify between 50% and 60% of the final mark, depending on the qualification obtained in the problem solving test.	50
Problem solving	A1 B2 B3 B5 B7 B9 C3	Along the four-month period of classes, there will be a test that will qualify up to 10% of the final mark. Those students that won't achieve the maximum qualification, will have the opportunity to recover the remaining part in the objective test.	10

Assessment comments
In order to pass the subject, it is mandatory to attain at least a qualification of 50%. Part-time students and those with academic dispensation of attendance exemption that have not been evaluated of ICT practicals can do a specific exam to recover 40% of the final mark; they can obtain the remaining 60% with the objective test. Fraudulent performance of the tests or evaluation activities, once verified, will directly imply a mark of "0" in the subject in the corresponding call, invalidating any grade obtained in all the evaluation activities for the extraordinary call.

Sources of information	
Basic	- R.L. Burden, D.J. Faires & A.M. Burden (2017). Análisis Numérico. CENCAGE Learning - C. Neuhauser (2004). Matemáticas para ciencias. Pearson - R. Johansson (2019). Numerical Python. Apress
Complementary	- J.W. Demmel (1997). Applied Numerical Linear Algebra. SIAM - J.E. Marsden & A. Tromba (2018). Cálculo vectorial. Pearson - G. Strang & E. Herman (2022). Cálculo (Volumen 1). http://openstax.org/books/cálculo-volumen-1/ - G. Strang & E. Herman (2022). Cálculo (Volumen 2). http://openstax.org/books/cálculo-volumen-2/ - G. Strang & E. Herman (2022). Cálculo (Volumen 3). http://openstax.org/books/cálculo-volumen-3/ - G.B Thomas Jr. (2015). Cálculo. Pearson Educación

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

Students are recommended to take the subject up to date and consult with the teachers any doubts that may arise.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.