Teaching Guide				
Identifying Data				2022/23
Subject (*)	CÁLCULO		Code	730G04001
Study programme	Grao en Enxeñaría en Tecnoloxías Industriais			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	Basic training	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Campo Cabana, Marco Antonio	E-mail	marco.campo@udc.es	
Lecturers	Campo Cabana, Marco Antonio López Salas, José Germán	E-mail	marco.campo@udc.es jose.lsalas@udc.es	
Web	campusvirtual.udc.es/moodle			
General description	This introductory calculus course covers differentiation and integration of functions of one and several variables. Topics include: the study of functions of one and several variables, their continuity and differenciability; Taylor polynomials and its application in optimization, finding local extrema and constrained optimization; the integration of functions in one variable, both by using Riemann sums and numerical integration and also using Barrow's rule, together with its applications to computing arc lengths, volumes of revolution and surface areas of revolution; and finally the integration of functions of several variables, together with its application to computing volume and mass of a solid body and its center of mass.			

Study programme competences / results	
Code	Study programme competences / results
A1	FB1 Capacidade para a resolución dos problemas matemáticos que poidan formularse na enxeñaría. Aptitude para aplicar os coñecementos sobre: álxebra lineal; xeometría; xeometría diferencial; cálculo diferencial e integral; ecuacións diferenciais e en derivadas parciais; métodos numéricos; algorítmica numérica; estatística e optimización.
B1	CB1 Que os estudantes demostren posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral e adoita encontrarse a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo
B2	CB2 Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
B3	CB3 Que os estudantes teñan a capacidade de reunir e interpretar datos relevantes (normalmente dentro da súa área de estudo) para emitiren xuízos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
B5	CB5 Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprenderen estudos posteriores cun alto grao de autonomía
B7	B5 Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas
C1	C3 Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	C6 Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C5	C7 Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.

Learning outcomes	
Learning outcomes	Study programme competences / results

Abilities in differential and integral calculus.	A1	B1 B2 B3 B5 B7	C1 C4 C5
Being able to solve mathematical problems with applications in engineering. Abilities in geometry and differential geometry	A1	B1 B2 B3 B5 B7	C1 C4 C5

Contents	
Topic	**Sub-topic**
The space R^n	The vector space R^n. Scalar product: norms and distances. Classification of points and sets. Topology of R^n: bounded set, extrema. Coordinates systems: polar, cylindrical and spherical coordinates.
Functions of several variables	Scalar and vector functions. Level sets. Continuity. Continuity in compact sets.
Differenciation of funcions of several variables and applications	Directional derivative. Partial derivatives: properties and practical computing. Differential map of a function. Gradient, relation with partial derivatives. Relation between the differential map and partial derivatives: jacobian matrix. Higher order partial derivatives. Introduction to vector calculus. Taylor theorem for scalar functions. Critical points. Classification. Hessian matrix. Conditioned extremes: dimension reduction, Lagrange multipliers method. Implicit function theorem and inverse function theorem.
Integration of funcions of one and several variables	Riemann sums. Integrable functions. Integral Calculus Theorems: Mean Value Theorem, Fundamental Theorem and Barrow's rule. Primitive Calculus. Polinomial interpolation. Numerical integration. Compound Simpson's Rule. Application of integral calculus to computing arc lengths, volumes of revolution and surface areas of revolution. Double integrals. Triple integrals. Variable change in double and triple integrals. Application of integrals: calculation of areas and volumes.

Complex numbers	The field of complex numbers. Operations: sum, produt. Module and argument. Polar form. Operating in polar form.

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 B1 B2 B3 B5 B7 C1 C4 C5	30	45	75
Problem solving	A1 B1 B2 B3 B5 B7 C1 C4 C5	26	39	65
Mixed objective/subjective test	A1 B1 B2 B3 B5 B7 C1 C4 C5	6	0	6
Personalized attention		4	0	4
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	The course will be developed during the regular classes where the professor will explain the main concepts and results of the subject.
Problem solving	This classes are organiized in such a way that we practice how to solve the proposed problems.
Mixed objective/subjective test	Three exams will be carried out during the course. The first one will be a partial exam where only some of the chapters will be considered. A final exam will be done at the end of the semester. Furthermore a computer exam will be carried out.

Personalized attention	
Methodologies	Description
Problem solving	The contents of the course as well as the methodologies require that students work partly in an autonomous way. This may generate some questions that they can solve by using office hours as scheduled. In addition, homework will be guided by the lecturers of the course. Students with recognition of part-time dedication and academic exemption from attendance may use office hours as a reference in order to follow the course and be advised on autonomous work.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Problem solving	A1 B1 B2 B3 B5 B7 C1 C4 C5	After the completion of a thematic block, small collections of representative exercises will be proposed for evaluation.	20

Mixed objective/subjective test	A1 B1 B2 B3 B5 B7 C1 C4 C5	These consist on written exams to assess the knowledge of the course by the students. The exames will be divided into 2 parts and the final qualification will be the addition of the qualification obtained in each of them. 1) The first one will be done during the teaching period by means of a partial exam. It will likely involve contents of chapters 1, 2, 3 and 4. Students passing this exam, will not need to repeat the corresponding questions in the final exams. Otherwise, this part will be recoverable in the final exams. 2) The final exam will be carried out in the period of final exams. It will be include contents of the second part of the subject and a second chance to pass the first part. In case of passing any of these two parts, either in the partial or in the final exam of january, the qualification is retained for the present course until the exam of the second oportunity.	80

Assessment comments
Students with recognition of part-time dedication and academic exemption from attendance will be graded under the same conditions than other students, as explained above.

Sources of information	
Basic	- Salas, L., Hille, E., Etgen, G. (2003). Calculus. vol I-II. Madrid. Reverté - García, A. et al. (2007). Cálculo II. Teoría y Problemas de Análisis Matemático en Varias Variables. Madrid. Clagsa - García Castro, F., Gutiérrez Gómez, A. (1990-1992). Cálculo Infinitesimal. I-1,2. Pirámide. Madrid - Marsden, J., Tromba, A. (2010). Cálculo vectorial. ADDISON WESLEY - Spiegel, M. R. (1991). Cálculo Superior. Madrid. McGraw-Hill - Varios (1990). Problemas de Cálculo Infinitesimal. Madrid. R.A.E.C. - De Diego, B. (1991). Ejercicios de Análisis: Cálculo diferencial e intergral (primer curso de escuelas técnicas superiores y facultades de ciencias). Madrid. Deimos - Tébar Flores, E. (1977). Cálculo Infinitesimal. I-II. Madrid. Tébar Flores - García, A. et al. (2007). Cálculo I. Teoría y Problemas de Análisis Matemático en Una Variable. Madrid. Clagsa - Larson, R., Hostetler, R., Edwards, B. (2013). Calculus. . Brooks Cole - Coquillat, F (1997). Cálculo Integral. Madrid. Tebar Flores - Soler, M., Bronte, R., Marchante, L. (1992). Cálculo infinitesimal e integral. Madrid - Burgos Román, Juan de (2007). Cálculo infinitesimal de una variable. Madrid. McGraw-Hill
Complementary	As seguintes páxinas web poden resultar de interese para o estudio da materia: www.intmath.com www.ies.co.jp/math/java/ http://demonstrations.wolfram.com/http://dm.udc.es/elearning/ www.intmath.com www.ies.co.jp/math/java/ http://193.146.36.49/mat1

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

Linear Algebra/730G03006

Statistics/730G03008

Diferential Equations/730G03011

Reliability Statistics and Numerical Methods/730G03046

Other comments

In order to get a sustainable neighbourhood and attain the aim of action number 5: ?Docencia e investigación saudábel e sustentábel ambiental e social? of the "Plan de Acción Green Campus Ferrol", the homework of this course will attend to the following: ? Preferably, virtual homework will be used, when printing is not required.   ? In the case that paper is needed, then: -   No plastic materials will be used.   -   Printing will be done both sides.   -   Recycled paper will be used as possible.   In general, a sustainable use of natural resources will be done. Moreover, ethic principles related to sustainability will be followed.