Teaching Guide				
Identifying Data				2015/16
Subject (*)	CÁLCULO		Code	730G04001
Study programme	Grao en enxeñaría en Tecnoloxías Industriais			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	First	FB	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Brozos Vázquez, Miguel	E-mail	miguel.brozos.vazquez@udc.es	
Lecturers	Benitez Garcia, Marta Brozos Vázquez, Miguel Cao Rial, María Teresa Suarez Peñaranda, Vicente Suarez Taboada, Maria	E-mail	marta.benitez@udc.es miguel.brozos.vazquez@udc.es teresa.cao@udc.es vicente.suarez.penaranda@udc.es maria.suarez3@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	
Code	Study programme competences
A1	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.
A5	Capacidade de visión espacial e coñecemento das técnicas de representación gráfica, tanto por métodos tradicionais de xeometría métrica e xeometría descritiva, coma mediante as aplicacións de deseño asistido por ordenador.
B1	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	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	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	Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprenderen estudos posteriores cun alto grao de autonomía
B7	Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas
C1	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	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C5	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.

Learning outcomes	
Learning outcomes	Study programme competences

Get familiar with calculus language	A1	B1 B5	
To understand the main characteristics of the formulation of a mathematical problem using the tools of the inifinitesimal calculus.	A1 A5	B1 B2 B3 B7	C5
To be able to evaluate the difficuylty of a problem and to choose the most suitable technique among the studied ones to carry on its solution. Have a good predisposition for problem solving	A1 A5	B2 B3 B5 B7	C4
To be able to use the bibliography and the available IT tools to find the necessary information for solving a given problem		B3	C1 C4 C5
To know the underlying geometrical meaning of the studied mathematical formalism. To be able to represent sets in the plane and in the three dimensional space using different coordinates systems	A1 A5		
To obtain a basic knowledge of functions of several variables: level sets, limits, continuity	A1 A5		
To understand the importance of partial derivatives and their relation to instantaneous variation of a magnitude (phisical, chemical, economical) and to asses their utility for the correct mathematical formulation of problems in engineering	A1		
To understand the meaning of integrals and their usage for the formulation of several problems in engineering. To know how to apply integral for the computation of areas of plane figures, areas of a surface of revolution and solid volumes.	A1		

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	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.
Applications of the differenciation of functions of several variables	Taylor polynomial for funcions of one and several variables. Critical points. Classification: Hessian matrix. Constrained optimization: dimensionality reduction, Lagrange multipliers method.

Integration of funcions of one variable	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.
Integration of functions of several variables	Double integrals. Triple integrals. Change of variable in double and triple integrals. Application of integral calculus to computing volume and mass of a solid body and its center of mass.
Appendix: The free software program, MAXIMA	Practical sessions with the free software program MAXIMA

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A5 B3 B5 B7 C4 C5	30	45	75
Problem solving	A1 A5 B1 B2 B3 B5 B7 C4 C5	20	25	45
Objective test	A1 A5 B1 B2 B3 B5 B7 C1 C4 C5	6	0	6
Workshop	A1 B1 B2 B3 C1 C4	10	10	20
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.
Objective 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.
Workshop	Problems are solved assisted by the computer programm Maxima.

Personalized attention	
Methodologies	Description
Workshop Problem solving	The contents of the subject as well as the homework require that student work by themselves. This will generate some questions that they can ask during the classes or during the office hours.

Assessment			
Methodologies	Competencies	Description	**Qualification**

Objective test	A1 A5 B1 B2 B3 B5 B7 C1 C4 C5	Written exams to assess the knowledge of the subject by the students. The subject will consists on three parts and the final qualification of the subject will be de addition of the quelification obtained at each of these parts Three exams will be performed 1) The first one in the reserved period for the partial exams (about the beginning of November), and will involve all the chapters studied until the celebration of the exam. If the student passes this exam, the qualification is retained until the end of the present course. This part will be recoverable in the final exam (second chance), to be held in July. 2) The second (and final) exam will be carried out in the period of final exams. It will envolve the second part of the subject and a second chance to pass the first part. The weight of both exams will be the 90% of the final qualification. In case of passing any of these two parts, either in the partial of november or in the final exam of january, the qualification is retained for the present course untuil the exam of second oportunity of july. 3) The third exam will consist of a computer exam with the program MAXIMA, where the students must show their capacity for problem solving using the MAXIMA program. The weight of this third part will be the 10% of the final qualification. This part WILL NOT be recoverable, but the obtanined qualification will be kept until July.	100

Assessment comments

Sources of information	
Basic	- De Diego, B. (1991). Ejercicios de Análisis: Cálculo diferencial e intergral (primer curso de escuelas técnicas superiores y facultades de ciencias). Madrid. Deimos - Coquillat, F (1997). Cálculo Integral. Madrid. Tebar Flores - Burgos Román, Juan de (2007). Cálculo infinitesimal de una variable. Madrid. McGraw-Hill - Soler, M., Bronte, R., Marchante, L. (1992). Cálculo infinitesimal e integral. Madrid - Spiegel, M. R. (1991). Cálculo Superior. Madrid. McGraw-Hill - Tébar Flores, E. (1977). Cálculo Infinitesimal. I-II. Madrid. Tébar Flores - Varios (1990). Problemas de Cálculo Infinitesimal. Madrid. R.A.E.C. - Marsden, J., Tromba, A. (2010). Cálculo vectorial. ADDISON WESLEY - García Castro, F., Gutiérrez Gómez, A. (1990-1992). Cálculo Infinitesimal. I-1,2. Pirámide. Madrid - García, A. et al. (2007). Cálculo II. Teoría y Problemas de Análisis Matemático en Varias Variables. Madrid. Clagsa - Salas, L., Hille, E., Etgen, G. (2003). Calculus. vol I-II. Madrid. Reverté - 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
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
MÉTODOS NUMÉRICOS/730G04054 ÁLXEBRA/730G04006 ESTATÍSTICA/730G04008 ECUACIÓNS DIFERENCIAIS/730G04011
Other comments

(*)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.