Teaching Guide				
Identifying Data				2018/19
Subject (*)	Calculus		Code	730G03001
Study programme	Grao en Enxeñaría Mecánica			
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	Brozos Vázquez, Miguel	E-mail	miguel.brozos.vazquez@udc.es	
Lecturers	Benitez Garcia, Marta Brozos Vázquez, Miguel Calvo Garrido, María Del Carmen Torres Miño, Araceli	E-mail	marta.benitez@udc.es miguel.brozos.vazquez@udc.es carmen.calvo.garrido@udc.es araceli.torres@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

To think in a logic, critic and creative way.		B1 B2 B3 B5 B7	C4 C5
Ability of thinking in an abstract way, understanding and simplifying complex problems.	A1	B1 B2 B3 B5 B7	C1 C4 C5
To understand the main characteristics of the formulation of a mathematical problem using the tools of the inifinitesimal calculus.	A1 A5	B2 B3 B5 B7	C4
Get familiar with calculus language	A1	B1 B5	
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		B3	C1 C4 C5
To be able to use the bibliography and the available IT tools to find the necessary information for solving a given problem	A1 A5	B5 B7	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	B1 B2	
To obtain a basic knowledge of functions of several variables: level sets, limits, continuity	A1 A5	B1 B2 B3	
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	B2 B5 B7	
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	B2 B5 B7	

Contents	
Topic	**Sub-topic**
The following topics develop the contents established in the verification report	-Mean value theorems. -Introduction to vector calculus. -Taylor theorem and higher order derivatives. -Maximum and minimum. -Implicit function and inverse function. -Definite and indefinite integral. -Primitive Calculus. -Double and triple integrals. Applications to computing areas and volumes.
Complex numbers	The field of complex numbers. Operations: sum, produt. Module and argument. Polar form. Operating in polar form.

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. Introduction to vector calculus.
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. Implicit function and inverse function theorems.
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.

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**
Problem solving Workshop	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**	**Description**	**Qualification**
Objective test	A1 A5 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.	100

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 - Varios (1990). Problemas de Cálculo Infinitesimal. Madrid. R.A.E.C. - Tébar Flores, E. (1977). Cálculo Infinitesimal. I-II. Madrid. Tébar Flores - Spiegel, M. R. (1991). Cálculo Superior. Madrid. McGraw-Hill - 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 - Coquillat, F (1997). Cálculo Integral. Madrid. Tebar Flores - Larson, R., Hostetler, R., Edwards, B. (2013). Calculus. . Brooks Cole - García, A. et al. (2007). Cálculo I. Teoría y Problemas de Análisis Matemático en Una Variable. Madrid. Clagsa - De Diego, B. (1991). Ejercicios de Análisis: Cálculo diferencial e intergral (primer curso de escuelas técnicas superiores y facultades de ciencias). Madrid. Deimos
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.

(*)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.