Teaching Guide				
Identifying Data				2016/17
Subject (*)	Ecuacións Diferenciais		Code	770G02011
Study programme	Grao en Enxeñaría Eléctrica			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Second	FB	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Cao Rial, María Teresa	E-mail	teresa.cao@udc.es	
Lecturers	Cao Rial, María Teresa Suarez Taboada, Maria	E-mail	teresa.cao@udc.es maria.suarez3@udc.es	
Web	moodle.udc.es			
General description	Diferential Equations and their resolution methods are basic tools for the description and study of simpler mathematical models governing many physical phenomenons: fluid mechanics, electromagnetism, thermodynamics. Throguhout this subject an introduction to the study of differential equations will be performed (first and high order) and different analytical and numerical methods will be studied. Furthermore, basic notions of partial derivative equations and calculus in complex variable will be described.			

Study programme competences	
Code	Study programme competences
A6	Capacidade para a resolución dos problemas matemáticos que se poidan suscitar 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	Capacidade de resolver problemas con iniciativa, toma de decisións, creatividade e razoamento crítico.
B2	Capacidade de comunicar e transmitir coñecementos, habilidades e destrezas no campo da enxeñaría industrial.
B3	Capacidade de traballar nun contorno multilingüe e multidisciplinar.
B4	Capacidade de traballar e aprender de forma autónoma e con iniciativa.
B6	Capacidade de usar adecuadamente os recursos de información e aplicar as tecnoloxías da información e as comunicacións na enxeñaría.
C1	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
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.
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.

Learning outcomes			
Learning outcomes	Study programme competences		
To be able to write the mathematical models goberning simple physical phenomena in terms of differential equations.	A6	B1 B2 B4	C1
To undestand the basic characteristics of differential equations: clasify them and their solving particularities.	A6	B1 B2 B4	C1
To know and be able to aply the several analitic methods for solving ordinary differential equations (either first order or higher order).	A6	B1 B2 B4	C1

To understand and be able to aply Laplace transform to solve systems of ordinary differential equations and initial value problems.	A6	B1 B4	C1
To understand and be able to aply Fourier and Z-tranform to solve linear ordinary differential equations.	A6	B1 B2 B4	C1
To understand and be able to aply simple numerical methods to approximate the solution of differential equations.	A6	B1 B2 B3 B4	C1
To understand basic notions of partial differential equations and complex analysis and its relation with the mathematical models goberning physical phenomena in two and three dimensional spaces.	A6	B1 B2 B3 B4	C1
To be able to use the course literature and the IT tools available to find the information required to solve a particular problem.		B3 B4 B6	C3 C6

Contents	
Topic	**Sub-topic**
Introduction to ordinary differential equations (ODE)	Motivación Terminoloxía básica: orde, tipo e linearidade Solución xeral e solución particular Existencia e unicidade de solución para un problema de valor inicial de primeira orde Algunhas EDOs que gobernan fenómenos físicos na Enxeñaría
First Order ODE	Ecuacións en variables separadas Ecuacións exactas. Factor integrante Ecuacións lineais Aplicacións das EDOs de primeira orde
Introduction to the numerical resolution of ODE	Motivación. Xeneralidades Resolución numérica dun problema de valor inicial de primeira orde Métodos de Euler e Runge-Kutta
Higher order ODE	Ecuacións lineais de segunda orde Ecuacións lineais homoxéneas con coeficientes constantes Solución xeral Ecuacións lineais non homoxéneas con coeficientes constantes Ecuacións lineais de orde superior. Aplicacións.
Laplace Transform	Definición da transformada de Laplace Cálculo e propiedades da transformada de Laplace Transformada inversa de Laplace Aplicación á resolución de sistemas lineais de ecuacións diferenciais Aplicacións na Enxeñaría Eléctrica
ODE linear systems	Sistemas de ecuacións diferenciais lineais de primeira orde Estructura dos conxuntos de solucións Wronskiano dun conxunto de funcións Resolución de sistemas homoxéneos con coeficientes constantes
Fourier series and Z-transform	Definición das series de Fourier e transformada Z Cálculo e propiedades das series de Fourier e transformada Z Transformada Z inversa Aplicacións á resolución de EDOs de orde superior

Introduction to partial differential equations (PDE)	Definición de EDP: orde e solución dunha EDP EDPs de segunda orde lineais Introducción ás ecuacións clásicas: ecuacións do calor e de ondas Método de separación de variables

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	B2 B3 B4 C1	21	42	63
Laboratory practice	A6 B1 B3 B4 B6 C3	9	9	18
Mixed objective/subjective test	A6 B1 B3 B4 B6 C3	4	0	4
Seminar	A6 B1 B2 B3 C1 C6	21	42	63
Personalized attention		2	0	2
(*)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	Presentation of the subject contents. The aim of the sessions is to provide the student with the basic knowledge to allow him to explore the subject as autonomously as possible. Examples of applications are developed and related activities are proposed.
Laboratory practice	Interactive practice where computer programs are used to solve problems commented in the lectures.
Mixed objective/subjective test	Written test may consist of an explanation of any content of the course, the answer of test questions, the resolution of theoretical and practical issues and developing solutions to issues involving deep knowledge of the subject. They are useful to determine the degree of knowledge that students get at classes and with their personal study.
Seminar	Sessions where we move from theory to practice. Specific problems of the subject developed in the lectures are solved and student's questions will be answered.

Personalized attention	
Methodologies	Description
Laboratory practice Seminar	a) The diversity of students and their training makes advisable to provide personalized guidance, which could be carried out in the framework of a tutorial action b) In computer practice, teachers will help students in the development of the problems identified in the practical sessions, both in the management of the computer program Matlab / Octave and the understanding of the theoretical and practical aspects of differential equations c) During the seminars, teachers will make a more detailed monitoring of students in the learning process by solving theoretical questions, problem solving and applications to simple problems in the field of Electronic Engineering.

Assessment			
Methodologies	Competencies	Description	Qualification
Laboratory practice	A6 B1 B3 B4 B6 C3	Solving practical problems and illustration of theoretical aspects with the help of the computer program Matlab/Octave	5
Mixed objective/subjective test	A6 B1 B3 B4 B6 C3	Written test including the resolution of problems and short questions (related to theoretical and practical subjects)	75
Seminar	A6 B1 B2 B3 C1 C6	Active participation and work done in the problem solving sessions (individually or in very small groups)	20

Assessment comments

The final grade of this subjet consists of three parts: the grade obtained in laboratory practice, based on deliverables related to lab tasks: NP (between 0 and 0.5) the grade obtained in the assorted objective test: NE (between 0 and 7.5) from which 0.5 points come from the final lab test and 7 points from the January final test. the grade obtained in the problem solving classes: NS (between 0 and 2), from which 1 point comes from deliverables related to class tasks, and 1 point from the partial test.

The final grade will be the sum of NP+NE+NS as long as the following two conditions are met: unjustified absence to problem solving classes do not exceed 20% and the grade obtained in the assorted objective test NE is greater than 2.65.

Otherwise, the final grade will be the one obtained in the objective test NE (7.5 at most).

The grades NP and NS are retained for the present course until the second opportunity exam in July.

Should a student prefer to be graded just with the January final test, he/she needs to explicitly ask for it during the first weeks of the semester, and in any case before any continuous evaluation test or deliverable is handed. As soon as any part of NS is graded, it will no longer be possible to desist from continuous evaluation.

Part-time students with academic dispensation are graded through: the grade obtained with a lab practice report: NP (between 0 and 0.5) the grade obtained with the assorted objective test: (between 0 and 7.5) from which 0.5 points come from the final lab test and 7 points from the January final test. The grade of an essay applied to a real Engeneering problem: NS (between 0 and 2).

The final grade will be the sum of NP+NE+NS

Sources of information

Basic	- M. R. Spiegel (2001). Transformadas de Laplace. Mcgraw-Hill - S. L. Ross (1992). Ecuaciones Diferenciales. Reverté - W. E. Boyce, R. C. DiPrima (2005). Elementary Differential Equations and Boundary Value Problems. John Wiley & Sons - P. Quintela (2001). Ecuaciones Diferenciales. Tórculo - J. Gonzalez Montiel (1988). Problemas de ecuaciones diferenciales. Publ. Univ. Politécnica de Madrid - W. R. Derrick, S. I. Grossman (1984). Ecuaciones Diferenciales con aplicaciones. Fondo Educativo Interamericano - M. Braun (1990). Ecuaciones Diferenciales y sus Aplicaciones. Ed. Iberoaméricana - G. F. Simmons (1991). Ecuaciones Diferenciales. Mcgraw-Hill - D. G. Zill (2002). Ecuaciones diferenciales con aplicaciones de modelado. Thomson learning - R. K. Nagle, E. B. Saff (2005). Ecuaciones diferenciales y problemas con valores en la frontera. Pearson Education - C. H. Edwards, D. E. Penney (2008). Elementary Differential Equations. Prentice-Hall - R. K. Nagle, E. B. Saff (1992). Fundamentos de ecuaciones diferenciales. Addison-Wesley
Complementary	- T. B. A. Senior (1986). Mathematical Methods in Electrical Engineering. Cambridge University Press (Capítulos 2,4) - S. Rosloniec (2008). Fundamental Numerical Methods for Electrical Engineering. Springer (Capítulos 6-8)

Recommendations
Subjects that it is recommended to have taken before
Cálculo/770G01001 Física I/770G01003 Alxebra/770G01006
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
Estudo diario dos contidos tratados nas sesións expositivas, complementados co curso virtual e a bibliografía recomendadaResolución tanto dos exercicios propostos nas sesións presenciais como doutros atopados na bibliografía recomendadaRevisar periodicamente as prácticas de ordenador, para o que se dispón das aulas de Informática de libre acceso no centroUso das horas de titoría do profesorado para resolver todo tipo de dúbidas sobre os contidos da materia.

(*)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.