



Teaching Guide				
Identifying Data				2023/24
Subject (*)	Differential Equations	Code	770G01011	
Study programme	Grao en Enxeñaría Eléctrica			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Second	Basic training	6
Language	SpanishGalician			
Teaching method	Hybrid			
Prerequisites				
Department	Matemáticas			
Coordinador	Campo Cabana, Marco Antonio	E-mail	marco.campo@udc.es	
Lecturers	Brozos Vázquez, Miguel Campo Cabana, Marco Antonio	E-mail	miguel.brozos.vazquez@udc.es marco.campo@udc.es	
Web	moodle.udc.es			
General description	Differential 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: álgebra 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.
B4	Capacidade de traballar e aprender de forma autónoma e con iniciativa.
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben afrontarse.

Learning outcomes			
Learning outcomes	Study programme competences		
To be able to write the mathematical models governing simple physical phenomena in terms of differential equations.	A6	B4	
To understand the basic characteristics of differential equations: classify them and their solving particularities.	A6		
To know and be able to apply the several analytic methods for solving ordinary differential equations (either first order or higher order).	A6		
To understand and be able to apply Laplace transform to solve systems of ordinary differential equations and initial value problems.	A6	B1 B4	C5
To understand and be able to apply Fourier and Z-transform to solve linear ordinary differential equations.	A6	B1 B2 B4	C1
To understand and be able to apply simple numerical methods to approximate the solution of differential equations.	A6	B1	C6
To understand basic notions of partial differential equations and complex analysis and its relation with the mathematical models governing 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	C2 C5



Contents	
Topic	Sub-topic
First Order ODE	Tema 1: O corpo dos números complexos. Operacións: suma, produto. Módulo e argumento. Forma exponencial. Operacións en forma exponencial. Tema 2: 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 Tema 3: Ecuacións en variables separadas. Ecuacións exactas. Factor integrante. Ecuacións lineais. Aplicacións das EDOs de primeira orde.
Higher order ODE	Tema 4: 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	Tema 5: 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.
ODE linear systems	Tema 6: 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.
Series de Fourier	Tema 7: Definición das series de Fourier. Cálculo e propiedades das series de Fourier. Aplicacións á resolución de EDOs de orde superior.
Fourier series and Z-transform	Tema 8: Definición da transformada Z. Cálculo e propiedades da transformada Z. Transformada Z inversa. Aplicacións á resolución de ecuacións en diferenzas.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A6 B1 B4 B2 B3 B4 C1	30	30	60
Mixed objective/subjective test	A6 B1 B2 C6 C1 C5	15	15	30
Laboratory practice	A6 B3	8	4	12
Problem solving	A6 B2 B6 C2	20	20	40
Personalized attention		8	0	8

(\*)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.
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.
Laboratory practice	Uso dun programa informático adecuado á materia.
Problem solving	Técnica mediante a que se ten que resolver unha situación concreta, a partir dos coñecementos que se traballaron, que pode ter máis dunha posible solución.

Personalized attention
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Methodologies	Description
Problem solving	<p>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</p> <p>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</p> <p>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.</p>

Assessment			
Methodologies	Competencies	Description	Qualification
Mixed objective/subjective test	A6 B1 B2 C6 C1 C5	Written test including the resolution of problems and short questions (related to theoretical and practical subjects)	70
Problem solving	A6 B2 B6 C2	Formularanse cuestións prácticas nas que o alumnado buscará a solución a un determinado problema.	20
Laboratory practice	A6 B3	Resolución de problemas con la ayuda de un programa	10

Assessment comments

Sources of information	
<b>Basic</b>	<ul style="list-style-type: none"> <li>- D. G. Zill (2002). Ecuaciones diferenciales con aplicaciones de modelado. Thomson learning</li> <li>- C. H. Edwards, D. E. Penney (2008). Elementary Differential Equations. Prentice-Hall</li> <li>- R. K. Nagle, E. B. Saff (2005). Ecuaciones diferenciales y problemas con valores en la frontera. Pearson Education</li> <li>- R. K. Nagle, E. B. Saff (1992). Fundamentos de ecuaciones diferenciales. Addison-Wesley</li> <li>- G. F. Simmons (1991). Ecuaciones Diferenciales. Mcgraw-Hill</li> <li>- M. Braun (1990). Ecuaciones Diferenciales y sus Aplicaciones. Ed. Iberoamericana</li> <li>- W. R. Derrick, S. I. Grossman (1984). Ecuaciones Diferenciales con aplicaciones. Fondo Educativo Interamericano</li> <li>- J. Gonzalez Montiel (1988). Problemas de ecuaciones diferenciales. Publ. Univ. Politécnica de Madrid</li> <li>- W. E. Boyce, R. C. DiPrima (2005). Elementary Differential Equations and Boundary Value Problems. John Wiley &amp; Sons</li> <li>- S. L. Ross (1992). Ecuaciones Diferenciales. Reverté</li> <li>- M. R. Spiegel (2001). Transformadas de Laplace. Mcgraw-Hill</li> </ul>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- S. Rosloniec (2008). Fundamental Numerical Methods for Electrical Engineering. Springer (Capítulos 6-8)</li> <li>- T. B. A. Senior (1986). Mathematical Methods in Electrical Engineering. Cambridge University Press (Capítulos 2,4)</li> </ul>

Recommendations
<b>Subjects that it is recommended to have taken before</b>
Calculus/770G01001 Physics I/770G01003 Linear Algebra/770G01006
<b>Subjects that are recommended to be taken simultaneously</b>
<b>Subjects that continue the syllabus</b>

