



## Teaching Guide

Identifying Data					2019/20
Subject (*)	Ecuacións Diferenciais		Code	770G02011	
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	Face-to-face				
Prerequisites					
Department	Matemáticas				
Coordinador	Suarez Taboada, María	E-mail	maria.suarez3@udc.es		
Lecturers	Calvo Garrido, María Del Carmen Suarez Taboada, Maria	E-mail	carmen.calvo.garrido@udc.es maria.suarez3@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. Througout 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 / results

Code	Study programme competences / results
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.
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 afrontarse.

## Learning outcomes

Learning outcomes	Study programme competences / results		
To be able to write the mathematical models governing simple physical phenomena in terms of differential equations.	A6	B1 B2 B4	C1
To understand the basic characteristics of differential equations: classify them and their solving particularities.	A6	B1 B2 B4	C1
To know and be able to apply the several analytic methods for solving ordinary differential equations (either first order or higher order).	A6	B1 B2 B4	C1



To understand and be able to apply Laplace transform to solve systems of ordinary differential equations and initial value problems.	A6	B1 B4	C1
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 B2 B3 B4	C1
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	C3 C6

Contents	
Topic	Sub-topic
First Order ODE	<p>Tema 1: Motivación</p> <p>Terminoloxía básica: orde, tipo e linearidade</p> <p>Solución xeral e solución particular</p> <p>Existencia e unicidade de solución para un problema de valor inicial de primeira orde</p> <p>Algunhas EDOs que gobernan fenómenos físicos na Enxeñaría.</p> <p>Tema 2: Ecuacións en variables separadas</p> <p>Ecuacións exactas. Factor integrante</p> <p>Ecuacións lineais</p> <p>Aplicacións das EDOs de primeira orde</p> <p>Tema 3: Métodos numéricos de integración: problema de valor inicial. Motivación.</p> <p>Xeneralidades</p> <p>Resolución numérica dun problema de valor inicial de primeira orde</p> <p>Métodos de Euler e Runge-Kutta</p>
Higher order ODE	<p>Tema 4: Ecuacións lineais de segunda orde</p> <p>Ecuacións lineais homoxéneas con coeficientes constantes</p> <p>Solución xeral</p> <p>Ecuacións lineais non homoxéneas con coeficientes constantes</p> <p>Ecuacións lineais de orde superior. Aplicacións.</p>
Laplace Transform	<p>Tema 5: Definición da transformada de Laplace</p> <p>Cálculo e propiedades da transformada de Laplace</p> <p>Transformada inversa de Laplace</p> <p>Aplicación á resolución de sistemas lineais de ecuacións diferenciais Aplicacións na Enxeñaría Eléctrica</p>
ODE linear systems	<p>Tema 6: Sistemas de ecuacións diferenciais lineais de primeira orde</p> <p>Estructura dos conxuntos de solucións</p> <p>Wronskiano dun conxunto de funcións</p> <p>Resolución de sistemas homoxéneos con coeficientes constantes</p>
Series de Fourier	<p>Tema 7: Definición das series de Fourier</p> <p>Cálculo e propiedades das series de Fourier</p> <p>Aplicacións á resolución de EDOs de orde superior</p>



Fourier series and Z-transform	<p>Tema 8: Definición da transformada Z</p> <p>Cálculo e propiedades da transformada Z</p> <p>Transformada Z inversa</p> <p>Aplicacións á resolución de EDOs de orde superior</p>
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Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	B2 B3 B4 C1	21	31.5	52.5
Laboratory practice	A6 B1 B3 B4 B6 C3	9	9	18
Mixed objective/subjective test	A6 B1 B3 B4 B6 C3 C6	8	8	16
Problem solving	A6 B2 C3 C6	21	31.5	52.5
Personalized attention		11	0	11

(\*)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.
Problem solving	Técnica mediante a que se ten que resolver unha situación problemática concreta, a partir dos coñecementos que se traballaron, que pode ter máis dunha posible solución.

Personalized attention	
Methodologies	Description
Laboratory practice	<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 / Results	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	10
Mixed objective/subjective test	A6 B1 B3 B4 B6 C3 C6	Written test including the resolution of problems and short questions (related to theoretical and practical subjects)	70



Problem solving	A6 B2 C3 C6	Técnica mediante a que se ten que resolver unha situación problemática concreta, a partir dos coñecementos que se traballaron, que pode ter máis dunha posible solución.	20
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## Assessment comments

The final grade of this subject 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 Engineering problem: NS (between 0 and 2).

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



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

## Recommendations

### Subjects that it is recommended to have taken before

Calculus/770G01001  
 Physics I/770G01003  
 Linear Algebra/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 recomendada Resolución tanto dos exercicios propostos nas sesións presenciais como doutros atopados na bibliografía recomendada Revisar periodicamente as prácticas de ordenador, para o que se dispón das aulas de Informática de libre acceso no centro Uso 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.