SUBJECT TEACHING GUIDE

G85 - Introduction to Partial Differential Equations

Double Degree in Physics and Mathematics
Degree in Mathematics

Academic year 2020-2021

1. IDENTIFYING DATA					
Degree	Double Degree in Physics and Mathematics Degree in Mathematics			Type and Year	Compulsory. Year 2 Compulsory. Year 2
Faculty	Faculty of Sciences				
Discipline	Subject Area: Mathematical Analysis and Differential Equations Module: Compulsory Subjects				
Course unit title and code	G85 - Introduction to Partial Differential Equations				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web	http://personales.unican.es/lafernandez/				
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION
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Other lecturers	

3.1 LEARNING OUTCOMES

- 1) Use analytical or approximate methods to solve partial differential equations (PDE), including Wave, Heat and Laplace equations.
  2) Apply the representation of simple functions in Fourier series for solving PDE.
  3) Know and manage the integral transformations of Fourier and Laplace, as well as its main properties for solving differential equations.
  4) Know and use the main properties of the most used special functions in Physics and its relation with solving PDE.
  5) Utilize the elementary theory of distributions in PDE solving.

4. OBJECTIVES

1) Know and distinguish the most important types of mathematical problems that arise in Physics and Engineering (ODE, PDE, linear, nonlinear, initial value problems, boundary value problems, ...).

2) Know and use the most common mathematical techniques in Physics and Engineering, depending on the type of problem to be solved.

3) Understand the equivalence between various mathematical problems, thanks to the use of appropriate transformations.

4) Understand the need to use sophisticated mathematical techniques when solving certain problems.

5) Develop mathematical intuition in solving some types of mathematical problems.

6. COURSE ORGANIZATION

CONTENTS	
1	Introduction to partial differential equations (PDE). First order linear PDE. Characteristic curves. Classification and reduction to the canonical form of second order PDE: Heat, Wave and Laplace equations. Elementary methods of resolution.
2	Fourier series. Separation of variables method. Representation of functions in Fourier series. Odd and even functions. Point convergence. Application to PDE solving: Heat conduction in a rod, vibrations of a string and Laplace equation in a rectangle.
3	Integral transformations of functions. Fourier transform. Laplace transform. Basic properties. Inverse transformations. Convolution of functions. Application to solving ODE and PDE.
4	Special Functions of Mathematical Physics. Gamma and Beta functions. Bessel functions. Legendre polynomials. Other orthogonal polynomials. Basic properties. Application to PDE in dimension three.
5	Elementary Theory of Distributions. Dirac Delta. Derivation of piecewise continuous functions. ODE and PDE solutions in the distribution sense.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Concerning chapters 1 and 2 of the subject.	Written exam	Yes	Yes	50,00
Concerning the chapters 3, 4 and 5 of the subject. Those students who have failed the first partial exam will can overcome it after the examination of the second part.	Written exam	Yes	Yes	50,00
TOTAL				100,00

Observations

During the exam, the statements of the main theorems and some useful formulas will be provided.
The final mark of the subject will be the average of the marks obtained in the two partial exams. To pass the subject it will be needed to obtain a final mark greater than or equal to 5.
In June, the exam will have a value of 100%.

Observations for part-time students

Evaluation of part-time students will be the same as that of the rest.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

1) Introducción a las Ecuaciones en Derivadas Parciales, L. A. Fernández, Univ. de Cantabria, 2018.

2) Matemáticas avanzadas para ingeniería, P. V. O'Neil, Ed. Thomson, 2004.

3) Ecuaciones diferenciales elementales con aplicaciones, C. H. Edwards y D. E. Penney, Ed. Prentice-Hall Hispanoamericana, 1986.

4) Partial differential equations for scientists and engineers , S. J. Farlow, Ed. Dover, 1993.