SUBJECT TEACHING GUIDE

G321 - Further Calculus

Degree in Chemical Engineering

Academic year 2021-2022

1. IDENTIFYING DATA					
Degree	Degree in Chemical Engineering			Type and Year	Core. Year 1
Faculty	School of Industrial Engineering and Telecommunications				
Discipline	Subject Area: Mathematics Basic Training Module				
Course unit title and code	G321 - Further Calculus				
Number of ECTS credits allocated	6	Term		Semester based (2)	
Web	https://www.giematic.unican.es/				
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION
Name of lecturer	MARIA TERESA HERRERO MARTINEZ
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Other lecturers	ANGEL BARON CALDERA

3.1 LEARNING OUTCOMES
- The student will learn the main concepts of multiple integration and will apply these concepts for solving practical problems.
- The student will learn the main concepts of vector calculus and will apply these concepts for solving practical problems.
- The student will learn how to solve line integrals and will know the most significant physical and geometric applications.
- The student will learn how to solve surface integrals and will know the most significant physical and geometric applications.
- The student will learn the basic concepts and resolution methods of first order differential equations.
- The student will learn the basic concepts and resolution methods of linear second order differential equations.
- The student will be able to modeling and solve some simple technical problems that involve differential equations.
- The student will learn Euler´s methods for obtaining a numerical approximation of the solution to an initial value problem and will implement this methods using the computer.
- The student will learn the main concepts of Laplace Transforms and will used them to solve initial value problems for linear differential equations.
- the student will learn the main concepts of partial differential equations and will be able to solve some of them using numerical methods.

4. OBJECTIVES
To introduce the student to some important basic concepts of Vector Calculus and Multiple Integration.
To introduce the student to the role of ordinary differential equations in engineering, and their methods of solution.
To introduce the student to the numerical methods for ordinary differential equations.
To introduce the student to the classical theory of Laplace Transforms and some of its applications to the analysis and design of engineering systems.
To introduce the student to the basic concepts of partial differential equations.
To be able to use mathematical software as an aid for solving problems.

6. COURSE ORGANIZATION

CONTENTS	
1	Part One: Multivariate Calculus
1.1	Topic 1.- Multiple Integration: The concept of the double integral. Properties. Calculation of double integrals. Change of variable in double integrals: Jacobians. The concept of the triple integral. Properties. Calculation of triple integrals. Change of variable in triple integrals. Applications in physics and geometry.
1.2	Topic 2.- Vector Calculus and line integrals. 2.1 Basic concepts of vector calculus. Vector fields. Differential operators. Conservative fields and potential functions. 2.2 Line Integrals: Definition of line integral. Fundamental theorem of line integrals. Green´s theorem. Line integrals and work. Line integrals and flow.
1.3	Topic 3.- Surface Integrals: The concept of surface integral. Flux of a vector field. Gauss´ divergence theorem. Stokes´ theorem.
2	Part two.- Ordinary Differential Equations and Laplace Transforms
2.1	Topic 4.- First Order Differential Equations. Applications to mathematical modeling. First order equations, basic concepts, general solution and particular solution. Analytical solution. Euler´s methods. Higher-order numerical methods.Mathematical modeling involving first order differential equations.
2.2	Topic 5.- Linear Second-Order Equations. Introduction to Linear Systems. General solution of the homogeneous equation, homogeneous equations of constant coefficients, non-homogeneous equations of constant coefficients. General solution of first order linear systems with constant coefficients. Numerical solution to an initial value problem. Numerical solution to a boundary value problem. Introduction to modeling problems using systems of linear differential equations.
2.3	Topic 6.- Laplace Transforms: Definition of the Laplace Transform. Properties. Inverse Laplace Transform. Impulses and the Dirac Delta Function. Solving initial value problems with Laplace Transforms.
2.4	Topic 7.- An introduction to partial differential equations and boundary problems. Introduction to numerical solving techniques: Method of Lines.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Theory and problems exam: 60% of the total mark.	Written exam	No	Yes	60,00
Test laboratory practices: 30% of the total mark.	Laboratory evaluation	No	Yes	30,00
Questions assignment for virtual evaluation: 10% of the total mark.	Activity evaluation with Virtual Media	No	Yes	10,00
Final exam with theory and problems	Written exam	No	Yes	0,00
TOTAL				100,00

Observations

The evaluation method will be a continuous assessment along the semester. The final mark is obtained as follows:
-- 45% evaluation tests for part one, done throughout the semester
-- 55% evaluation tests for part one, done throughout the semester
If students fail some of the evaluation tests taken during the semester, they can take the final exam in order to retrieve the part they failed during the semester.

Observations for part-time students

Part-time students will have a single final exam that will consist of theory and practice. The final grade will only be based on this final exam.

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
Álvarez, E., Herrero, Mª T. y Ruiz, R. Colección Fundamentos Matemáticos. Tomos III, IV y V.
Gerald L. Bradley y Karl J. Smith. "Cálculo de varias variables". Volumen II. Editorial Prentice-Hall.
Nagle, R.K. y Staff, E. B. "Fundamentos de ecuaciones diferenciales". Editorial Addison -Wesley.
Kaplan, Wilfred. Advanced Calculus. Editorial Addison-Wesley. Pdf online version.