Calculus III

Academic Year: (2023 / 2024) **Review date: 28-03-2023**

Department assigned to the subject: Mathematics Department

Coordinating teacher: PABLO MARTINEZ, ARTURO DE

Type: Basic Core ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I, Calculus II and Linear Algebra.

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG11. Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge of: linear algebra; geometry; differential geometry; differential and integral calculus; differential and partial derivative equations; numerical methods; numerical algorithms; statistics and optimisation.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

OBJECTIVES

The student will learn the basic topics of ordinary and partial differential equations:

1. Resolution of first-order differential equations
2. Resolution of higher-order, linear differential equations
3. Use of the Laplace transform to solve linear differential equations and systems
4. Separation of variables in partial differential equations
5. Solutions as Fourier series and generalized Fourier series

DESCRIPTION OF CONTENTS: PROGRAMME

1. DIFFERENTIAL EQUATIONS OF FIRST ORDER
   1.1. Definitions and examples
   1.2. Elementary methods of resolution
   1.3. Applications

2. HIGHER-ORDER DIFFERENTIAL EQUATIONS
   2.1. Linear differential equations of order n with constant coefficients
   2.2. Equations with variable coefficients: order reduction and equidimensional equations
   2.3. Relation between systems and linear equations

3. LAPLACE TRANSFORM
   3.1. Definition and properties

3.2. Transforming and back-transforming
3.3. Application to the resolution of linear equations and systems

4. METHOD OF SEPARATION OF VARIABLES
4.1. Initial and boundary problems. Examples of partial differential equations from Mathematical Physics
4.2. Different kinds of equations and data
4.3. Odd, even and periodic extensions of a function. Trigonometric Fourier series
4.4. Resolution of equations by separation of variables and Fourier series
4.5. Complex form of Fourier series

5. STURM LIOUVILLE PROBLEMS
5.1. Sturm-Liouville problems and theorem
5.2. Rayleigh's quotient. Minimization theorem
5.3. Resolution of equations by separation of variables and generalized Fourier series
5.4. Sturm-Liouville problems in several variables

6. NUMERICAL METHODS
6.1. Numerical methods for ODEs: Runge-Kutta
6.2. Numerical methods for PDEs: finite differences

LEARNING ACTIVITIES AND METHODOLOGY

1, MASTERCLASSES: Development of the theoretical part of the subject

2. PROBLEMS CLASSES: Resolution of problems and exercises in participative classes

3. TUTORIALS: Personal or group assessment for the students

4. SELF-EVALUATIONS: Control of the evolution of the student

ASSESSMENT SYSTEM

- Two partial exams (40%)
- Final exam (60%)

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- HABERMAN, R. Elementary Applied Partial Differential Equations, 3rd. ed., Prentice Hall., 1998

- SIMMONS, G. F. ; KRANTZ, S. G. Differential Equations. Theory, Technique, and Practice., McGraw-Hill Companies, Inc., 2007

ADDITIONAL BIBLIOGRAPHY

- D.G. ZILL. Ecuaciones Diferenciales con Aplicaciones de Modelado, sexta edición., Thomson. , 1997

- BRANNAN, J.R. ; BOYCE, W.E.. Differential Equations with Boundary Value Problems: An Introduction to Modern Methods & Applications., Wiley., 2010
- EDWARDS, C.H., PENNEY, D. E.. Elementary differential equations with boundary value problems , Pearson Education, 2014.
- NAGLE, R. KENT; SAFF, E.B.; SNIDER A. D.. Fundamentals of differential equations, 7th ed., Pearson Addison-Wesley., 2008
- SIMMONS, G. F.. Differential equations with applications and historical notes , 3rd edition, CRC Press Textbooks in mathematics., 2017