Differential Equations

Academic Year: (2020 / 2021) **Review date: 17-07-2020**

Department assigned to the subject: Mathematics Department

Coordinating teacher: MOSCOSO CASTRO, MIGUEL ANGEL

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I and II, Algebra

OBJECTIVES

CB1. Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
CB2. Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
CB5. Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CE1. Solve mathematical problems that may arise in engineering and apply knowledge of linear algebra, differential and integral calculus, numerical methods, numerical algorithms, statistics, differential equations and in partial derivatives, complex and transformed variables.
CE22. Design, plan and estimate the costs of an engineering project.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.
RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them;
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking;
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study;
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1. First Order Differential Equations.
a. Definitions and examples.
b. Elementary resolution methods.

c. Applications.
2. Higher Order Differential Equations.
a. Linear equations of order n with constant coefficients.
b. Equations with variable coefficientes: order reduction and equidimensional equations.
c. Relation between systems and linear equations.
d. Applications.
3. Introduction to Partial Differential Equations.
a. Initial and boundary problems.
b. Examples of PDEs of Mathematical Physics.
c. Different kind of equations and data.
d. Classification of second order, linear PDEs.
4. Method of separation of variables.
a. Even, odd, and periodic extensiones of a function. Trigonometric Fourier series.
b. Solving homogeneous and non-homogeneous PDEs using separation of variables and Fourier series.
c. Complex form of Fourier series.
5. Sturm-Liouville Problems.
a. Self-adjoint Sturm-Liouville problems.
b. Rayleigh's quotient. Minimization theorem.
c. Solving PDEs using separation of variables and generalized Fourier series.
d. Sturm-Liouville problems in several variables.

LEARNING ACTIVITIES AND METHODOLOGY

AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students mustacquire. Receive course notes and will have basic reference texts.Students partake in exercises to resolve practical problems
AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.Subjects with 6 credits have 4 hours of tutoring/ 100% on- site attendance.
AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK.Subjects with 6 credits have 98 hours/0% on-site.
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject`s main concepts are developed, while providing material and bibliography to complement student learning
MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

The final mark will be based on the following criteria:

- Midterms and homework (50%).
- Final exam (50%).

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- J. C. Robinson An Introduction to Ordinary Differential Equations, Cambridge University Press, 2004
- Ll.N. Trefethen, A. Birkisson, and T. A. Driscoll Exploring ODEs, Society for Industrial and Applied Mathematics, 2018
- R. Haberman Elementary applied partial differential equations, Prentice Hall, 1998

ADDITIONAL BIBLIOGRAPHY

- B. M. Budak, A. A. Samarskii AND A. N. Tikhonov A Collection of Problems on Mathematical Physics, Pergamon Press, 1964
- G.B. Whitham Linear and Nonlinear Waves, John Wiley & Sons, 1999

- James C. Robinson Ordinary Differential Equations, Cambridge, 2013
- S. G. Krantz Differential Equations: Theory, Technique and Practice, Chapman and Hall/CRC Press, 2015