Calculus II

Academic Year: (2024 / 2025) **Review date: 21-08-2024**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ROMERA COLMENAREJO, ELENA

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I
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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG1. Analyze, formulate and solve problems with initiative, decision-making, creativity,critical reasoning skills and ability to efficiently communicate and transmit knowledge, skills and abilities in the Energy Engineering field
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE1 Módulo FB. Ability to solve the mathematic problems arising in engineering. Aptitude for applying knowledge on: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives in differential equations; numerical methods; numerical algorithms; statistics and optimization.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:
RA1.1 knowledge and understanding of the mathematical principles underlying their branch of engineering;
RA2.1 the ability to apply their knowledge and understanding to identify, formulate and solve mathematical problems using established methods;
RA5.1 the ability to select and use appropriate tools and methods to solve mathematical problems;
RA5.2 the ability to combine theory and practice to solve mathematical problems.

OBJECTIVES

The student must be able to state, solve and understand, from a mathematical point of view, problems related to Engineering and of Energy Engineering. First of all, a comprehensive approach to Euclidean spaces with a special emphasis in the two-dimensional and three-dimensional cases as well as their most relevant subsets will be done. He must handle the main properties of functions in several variables related to continuity, differentiability and integrability both in the scalar and vector cases. The study of problems related to optimisation, with and without constraints, constitutes a nice application of Taylor formula and local extrema.
Iterated integrals on domains as well as the integration on lines and surfaces will provide the basic background for the analysis of areas and volumes as well as the computation of some characteristics of rigid solids. The computation of such integrals will be used as applications of the most important theorems of integral Calculus.

By the end of this subject, students will be able to have:
1.- Knowledge and understanding of the mathematical principles underlying the branch of energy engineering;
2.- The ability to a ly their knowledge and understanding to identify, formulate and solve mathematical problems using established methods;
3.- The ability to choose and apply relevant analytical and modelling methods;
4.- The ability to select and use appropriate tools and methods to solve mathematical problems;
5.- The ability to combine theory and practice to solve mathematical problems;
6.- Understanding of the applicable methods and techniques and their limitations.

DESCRIPTION OF CONTENTS: PROGRAMME

Chapter 1. n-dimensional Euclidean Space.
Chapter 2. Functions of several variables. Limits and continuity.
Chapter 3. Partial and directional derivatives. Differentiability. Gradient vector.Jacobian matrix.
Chapter 4. Chain rule. Higher order derivatives. Polar, spherical and cylindrical coordinates. Applications to PDE's, separation of variables.
Chapter 5. Taylor formula. Local extrema. Extremum problems with constraints. Lagrange multipliers. Open, closed, compact and connected subsets.
Chapter 6. Integration in R^n.Iterated integrals. Fubini,s Theorem. Applications.
Chapter 7. Line integrals. Conservative fields.
Chapter 8. Green's Theorem
Chapter 9. Surfaces in R^3.
Chapter 10. Surface integrals.
Chapter 11. Green, Stokes and Gauss Theorems.

LEARNING ACTIVITIES AND METHODOLOGY

The learning activities will be focused on
- Magistral sessions devoted to the presentation of the basic concepts and results of every chapter as well as some exercises. The theoretical background will be supported by the basic monographs listed in the bibliography.
- Problem sessions. Here we will solve questions and problems proposed in the magistral classes as well as individual homeworks in order to allow the self asessment of the students.
- Continuous Evaluation:
  · Two partial tests concerning Differential Calculos (Chapters 1-5) and Integral Calculus (Chapters 6-11).
  · Individual assignments to be solved at Home.
- Final exam.

ASSESSMENT SYSTEM

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

The assessment system will be focused on the following:

Two partial examinations. One mid-term, the other at the end of the course. The weight of this option in the final mark will be 40%

The mark of the final exam will have a weight of 60% in the final mark of the subject.

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BASIC BIBLIOGRAPHY

- B.P. DEMIDOVICH Problemas de Análisis Matemático,, Editorial Paraninfo , 1991

- D.M. Bressoud A radical approach to real analysis., Mathematical Association of American Textbooks, 2007

- J. E . MARSDEN A. J. TROMBA, Vector Calculus, Freemann, 2012

- R.C. Vrede, M. Spiegel Outline of Advanced Calculus, McGraw-Hill, 2002, 2002

- S. L. SALAS, E. HILLE, Calculus:One and several variables, Wiley, 1999

ADDITIONAL BIBLIOGRAPHY

- R. G. BARTLE The Elements of Real Analysis,, Editorial Wiley International, 1976

- T. APOSTOL Calculus, Volume 2, John Wiley& Sons, 1969