Integral Calculus

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)

Fundamentals of Algebra (Course 1 - Semester 1)
Linear Algebra (Course 1 - Semester 1)
Differential Calculus (Course 1 - Semester 1)

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. Students are able to demonstrate knowledge and understanding of concepts in mathematics, statistics and computation and to apply them to solve problems in science and engineering with an ability for analysis and synthesis.
CG2. Students are able to formulate in mathematical language problems that arise in science, engineering, economy and other social sciences.
CG4. Students are able to show that they can analyze and interpret, with help of computer science, the solutions obtained from problems associated to real world mathematical models, discriminating the most relevant behaviours for each application.
CG5. Students can synthesize conclusions obtained from analysis of mathematical models coming from real world applications and they can communicate in verbal and written form in English language, in an clear and convincing way and with a language that is accessible to the general public.
CG6. Students can search and use bibliographic resources, in physical or digital support, as they are needed to state and solve mathematically and computationally applied problems arising in new or unknown environments or with insufficient information.
CE1. Students have shown that they know and understand the mathematical language and abstract-rigorous reasoning as well as to apply them to state and prove precise results in several areas in mathematics.
CE2. Students have shown that they understand the fundamental results from real, complex and functional mathematical analysis.

RA1. Students must have acquired advanced cutting-edge knowledge and demonstrated indepth understanding of the theoretical and practical aspects of working methodology in the area of applied mathematics and computing"
RA3. Students must have the capacity to gather and interpret data and information on which they base their conclusions, including where relevant and necessary, reflections on matters of a social, scientific, and ethical nature in their field of study.

RA5. Students must know how to communication with all types of audiences (specialized or not) their knowledge, methodology, ideas, problems and solutions in the area of their field of study in a clear and precise way.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Antiderivatives and the indefinite integral
Linearity property. Basic integrals. Initial value problem.
Techniques of integrations: Substitution method and integration by parts, the method of partial fractions. Trigonometric integrals and irrational expressions.
Strategies for integration.

2. The Riemann-Stieltjes integral
Definition and existence of the integral.
Properties of the integral. Change of variable.
Fundamental theorem of Calculus. Remainder term of Taylor polynomial.
Applications: Area, volume, density, average value, center of mass, work and energy.
Uniform convergence and integration.
Numerical integration: The trapezoid rule and Simpson's rule.

3. Integration of vector value functions.
Area between two curves. Arc length and area of surface of revolution.
Improper integrals. Applications: Probability and integration.
Integrals depending on parameters. Differentiation of integrals. Some special functions.

4. Integration in several variables.
Fubini's theorem. Integration over non-rectangular regions.
Mean value theorem. Application of multiple integrals.
Improper integrals. Integrals depending on parameters.

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES AND METHDOLOGY

THEORETICAL-PRACTICAL CLASSES. [44 hours with 100% classroom instruction, 1.76 ECTS]
Knowledge and concepts students must acquire. Student receive course notes and will have basic reference texts to facilitate following the classes and carrying out follow up work. Students partake in exercises to resolve practical problems and participate in workshops and evaluation tests, all geared towards acquiring the necessary capabilities.

TUTORING SESSIONS. [4 hours of tutoring with 100% on-site attendance, 0.16 ECTS]
Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.

STUDENT INDIVIDUAL WORK OR GROUP WORK [98 hours with 0 % on-site, 3.92 ECTS]

FINAL EXAM. [4 hours with 100% on site, 0.16 ECTS]
Global assessment of knowledge, skills and capacities acquired throughout the course.

METHODOLOGIES

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.

PRACTICAL CLASS. Resolution of practical cases and problems, posed by the teacher, and carried out individually or in a group.

TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with a teacher as tutor.

ASSESSMENT SYSTEM

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

Final Exam: 60%. Global assessment of knowledge, skills and capacities acquired throughout the course. Continuous Evaluation: 40%. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.

BASIC BIBLIOGRAPHY

- A. Zorich Mathematical Analysis, Springer-Verlag (Volume I and II), 2004

- J. Rogawski and C. Adams Calculus: Early Transcendentals, W. H. Freeman and Company (Third Edition Volume I and II), 2015

- J.E.Marsden, J.Tromba Vector Calculus, W.H.Freeman and Company (Sixth Edition), 2012

- W. Rudin Principles of Mathematical Analysis, McGraw-Hill (Third Edition), 1976

ADDITIONAL BIBLIOGRAPHY

- D. Pestana, J.M. Rodríquez, E. Romera, E. Touris, V. Álvarez, and A. Portilla Curso Práctico de Cálculo y Precálculo, Ariel, 2007

- I.I Liashkó, A.K: Boiarchuk, Iá.G. Gai, G.P. Golovach Matemática Superior. Problemas Resueltos, URSS, 1999

- J. Steward Single and multivariable calculus, Cengage Learning (7th Edition), 2011

- M. Spivak Calculus, Publish or Perish, 2008

- S.L. Salas, G.J. Etgen, E. Hille Calculus: One and Several Variables, (10th Edition) John Wiley and Sons, 2007

- V.A. Ilyin, E.G. Poznyak Fundamentals of mathematical analysis, Mir, 1982