Integral Calculus

Academic Year: (2019 / 2020) **Review date: 22/05/2020 12:22:03**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ARVESU CARBALLO, JORGE

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
Linear Algebra
Differential Calculus

OBJECTIVES

SPECIFIC LEARNING OBJECTIVES (PO a):
- To understand the notion of antiderivatives and indefinite integral.
- To understand the concept of Riemann integrability.
- To know the properties and techniques of integrations.
- To understand how to calculate double, triple, and multivariable integrals.
- To be able to apply the integral to calculate areas, volumes, and to solve some basic problems of Mathematical-Physics.
- To relate the notion of integrability with continuity and differentiability.

SPECIFIC ABILITIES (PO a, k):
- To be able to work with functions of one and several variables given in terms of a graphical, numerical or analytical description.
- To understand the concept of integrability and ability to solve problems involving this concept.
- To understand the concept of multiple integral and its practical applications.
- To determine the best strategies both numerically and analytically for solving practical problems involving integration.
- To know what is an integro-differential equation and the available strategies for solving these equations in different contexts.

GENERAL ABILITIES (PO a, g, k):
- To understand the necessity of abstract thinking and formal mathematical proofs.
- To acquire communicative skills in mathematics.
- To acquire the ability to model real-world situations mathematically, with the aim of solving practical problems.
- To improve problem-solving skills.
- To be able to use mathematical software in specific situations.

OTHER GENERAL ABILITIES:
- Students must be able to demonstrate knowledge and understanding of concepts in Integral Calculus and to apply them to solve problems in science and engineering with an ability for analysis and synthesis.
- Students must be able to formulate in mathematical language problems that arise in computer science and in different branches of mathematics.
- Students should show a notable knowledge and understanding of mathematical language and abstract-rigorous reasoning as well as to apply them to state and prove precise results in several areas in mathematics.
- Students should show that they understand the fundamental results from differential and integration calculus as whole mathematical analysis.

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

There will be two weakly sessions:
- Theory sessions. The professor will explain the fundamental concepts and results of the theory.
- Exercise/Lab sessions. The students will work in solving exercises or practices to solve questions proposed by the professor.
-Office hours: Assistance to students, individualized or in groups, by the instructor/professor.

ASSESSMENT SYSTEM

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

Final Exam: 60%. The knowledge, skills and abilities acquired throughout the course will be assessed globally.
Midterm Exams: 40%. The knowledge, skills and abilities acquired during the weeks prior to the evaluation will be graded.

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

- 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

- 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

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

- 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