Advanced Mathematics

Academic Year: (2024 / 2025) **Review date: 21-01-2025**

Department assigned to the subject: Mathematics Department

Coordinating teacher: PIJEIRA CABRERA, HECTOR ESTEBAN

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.

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.
CG3: Knowledge of basic and technological subject areas which enable acquisition of new methods and technologies, as well as endowing the technical engineer with the versatility necessary to adapt to any new situation.
CG10: Ability to solve mathematical problems arising in engineering. Aptitude for applied knowledge in: linear algebra, geometry; differential geometry; differential and integral calculus; differential equations and partial derivatives; numerical methods; numerical algorithms; statistics and optimization.
RA1: To acquire the knowledge and understanding of the general basic fundamentals of engineering, as well as, in particular, of multimedia communications networks and services, audio and video signal processing, room acoustic control, distributed multimedia systems and interactive multimedia applications specific to Sound and Image Engineering within the telecommunications family.

OBJECTIVES

The student should be familiar with the most important techniques in complex variable functions. Specifically, he/she should understand and manage the following basic concepts:

1. Elementary functions of one complex variable.
2. Integration in the complex plane.
3. Power series developments.
4. Aplications of the residue theorem.

The course is complemented with some basic topics in ordinary differential equations:

1. Solution of first order differential equations.
2. Solution of higher order linear differential equations.
3. Use of Laplace transform to solve linear equations and systems with constant coefficients.

DESCRIPTION OF CONTENTS: PROGRAMME

1. ORDINARY DIFFERENTIAL EQUATIONS
1.1. Initial and boundary value problems.
1.2. Existence and uniqueness.
1.3. Elementary solution methods.
1.3.1. Separable differential equations.
1.3.2. Homogeneous differential equations.
1.3.3. Exact differential equations.
1.3.4. Integrating factor.

1.3.5. Linear differential equations.
1.3.6. Bernoulli equations.
1.3.7. Reduction of order.
1.4. Linear equations and systems.
1.4.1. Characteristic polynomial.
1.4.2. Laplace Transform and applications.

2. FUNCTIONS OF ONE COMPLEX VARIABLE
2.1. Complex numbers.
2.1.1. Operations with complex numbers.
2.1.2. Absolute value and argument.
2.2. Holomorphic functions.
2.2.1. Limits and continuity.
2.2.2. Complex derivative.
2.2.3. Cauchy-Riemann equations.
2.2.4. Harmonic functions.
2.3. Analytic functions.
2.3.1. Power series.
2.3.2. Elementary functions.
2.4. Complex integration.
2.4.1. Cauchy's theorem and applications.
2.4.2. Laurent series.
2.4.3. Calculus of residues.
2.4.4. The residue theorem and applications.
2.4.5. Computation of real integrals.

LEARNING ACTIVITIES AND METHODOLOGY

The docent methodology will include:

1. MASTER CLASSES, where the knowledge that the students must acquire will be presented. To make easier the development of the class, the students will have written notes and also will have the basic texts of reference that will facilitate their subsequent work.

2. RESOLUTION OF EXERCISES by the student that will serve as self-evaluation and to acquire the necessary skills.

3. PROBLEM CLASSES, in which the proposed problems are discussed and developed.

4. PARTIAL CONTROLS.

5. FINAL EXAM.

6. TUTORIALS.

ASSESSMENT SYSTEM

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

Evaluation system, 40% continuous evaluation and 60% final exam.
The continuous evaluation will consist written controls.

BASIC BIBLIOGRAPHY

- D. G. ZILL Ecuaciones diferenciales con aplicaciones de modelado, Cengage Learning, 2015

- G. F. SIMMONS Differential equations with applications and historical notes, McGraw-Hill, 1991

- P. J. HERNANDO Clases de Ampliación de Matemáticas para Ingeniería, Versión 4.6, PDF, 2021

- PESTANA, D., RODRÍGUEZ, J. M. Y MARCELLÁN, F. Curso práctico de variable compleja y teoría de transformadas, Pearson Educación, S. A., 2014

ADDITIONAL BIBLIOGRAPHY

- EDWARDS, C. H. Jr., PENNEY, D. E. Elementary Differential Equations with Boundary Value Problems , Ed. Prentice Hall Inc. , 1993

- NAGLE, R.K. y SAFF, E.B. Fundamentals of Differential Equations, second edition , Ed. The Benjamin/Cummings Publishing Company Inc., Redwood City, California, U.S.A..

- VOLKOVYSKII, L.I., LUNTS, G.L. y ARAMANOVICH, I.G. A collection of problems in complex analysis , Ed. Dover, N.Y., U.S.A. , 1991

- WUNSCH, A. D. Complex Variables with Applications , Ed. Addisson-Wesley Publishing Company Inc. Reading, Massachusetts , 1994

- ZILL, D. G. Differential Equations with Modeling Applications , Ed. Brookes/Cole Publishing, 6th. ed. .

BASIC ELECTRONIC RESOURCES

- Herbert Gross . Complex Variables, Differential Equations and Linear Algebra: https://ocw.mit.edu/resources/res-18-008-calculus-revisited-complex-variables-differential-equations-and-linear-algebra-fall-2011/part-i/