Complex variable and transforms

Academic Year: (2022 / 2023) **Review date: 20-06-2022**

Department assigned to the subject: Department of Mathematics

Coordinating teacher: RODRIGUEZ GARCIA, JOSE MANUEL

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus II
Differential Equations

DESCRIPTION OF CONTENTS: PROGRAMME

1. Complex functions
Complex numbers. Complex functions. Limits. Continuous functions. Derivatives and Cauchy-Riemann equations. Armonic functions.
2. Elementary functions
Polynomials. Exponential function. Trigonometric functions. Hyperbolic functions. Logarithm. Complex exponents. Inverses of trigonometric and hyperbolic functions.
3. Integrals in the complex domain.
Contour integrales. Cauchy-Goursat theorem. Cauchy formula. Morera theorem. Bounds for analytic functions. The fundamental theorem of algebra.
4. Series
Sequences and convergence criteria. Power series. radius of convergence. Taylor series. Laurent series. Analytic continuation. Power series and differential equations. Frobenius theory. Special functions of Mathematical Physics
5. Residues and poles
Zeros of a function. Singularities. Poles. Residue formula. Residue theorem. Real integrals of trigonometric functions. Real improper integrals. Integrals on branch cuts. Summations of series by using residue theorem.
6. Fourier series
Fourier series and their application to periodic signals. Square integrable functions. Pointwise convergence. Uniform convergence. Application to differential and partial differential equations.
7. Fourier transform.
Definition and properties. Inverse Fourier transform. Representation of aperiodic signals. Discrete time Fourier transform.
8. Laplace transform
Definition, properties and convergence. Inverse Laplace transform. Derivatives, integrals, and convolution. Applications to systems of linear differential equations. Transfer function.
9. z-Transform
Convergence region and other properties. Inverse z-transform. Transforms between continuous and discrete time signals. Applications to linear difference equations.Transfer function.
10. Linear invariant-time systems
Linear time-invariant (LTI) systems. Analysis of LTI systems with transforms.

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. It entails 44 hours with an 100% on-site.
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.
AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
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

SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course.The percentage of the evaluation will be 40% .
SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course.The percentage of the evaluation will be 60% of the final grade.
This methodology will me implemented if the lectures are either the synchronous and interactive online modality through Blackboard Collaborate or presential. It will depend on the decision of the university in the framework of the response to COVID pandemia.

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

BASIC BIBLIOGRAPHY

- A. Papoulis, Signal Analysis. , McGraw Hill International Editions,, 1984
- B. Fornberg, C. Piret Complex Variables and Analytic Functions: An Illustrated Introduction, SIAM, 2019
- D. Pestana, J. M. Rodríguez, F. Marcellán, Curso práctico de variable compleja y teoría de transformadas. , Pearson, , 2014
- J.W. Brown, R. V. Churchill, Complex Variables and Applications., McGrawHill,, 2009
- N. Levinson, R. M. Redheffer, Complex Variables., McGraw Hill,, 1989

ADDITIONAL BIBLIOGRAPHY

- A. V. Oppenheim, A. S. Willsky, I. T. Young, Signals and Systems. , Prentice Hall International Editions. , 1983
- I. Volkovyski, G. Lunts, I. Aramanovich Problemas sobre la teoría de funciones de variable compleja, Mir, 1972
- J. Bruna, J. Cufí, Complex Analysis, , EMS Textbooks in Mathematics. European Mathematical Society , 2013
- J. G. Proakis, D. G. Manolakis Introduction to Digital Signal Processing. , Macmillan Publishing Company, 1988
- P. Henrici, Applied and Computational Complex Analysis (3 volúmenes). , Wiley Classics Library. Wiley Interscience. , 1993