COURSE DETAILS

"METODI MATEMATICI PER L'INGEGNERIA"

SSD MAT/05

DEGREE PROGRAMME: BACHELOR DEGREE IN COMPUTER ENGINEERING

ACADEMIC YEAR: 2023-2024

GENERAL INFORMATION – TEACHER REFERENCES

TEACHER: MULTIPLE STUDY COURSE
PHONE:
EMAIL:

SEE THE STUDY COURSE WEBSITE

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): N.A.
MODULE (IF APPLICABLE): N.A.
CHANNEL (IF APPLICABLE): N.A.
YEAR OF THE DEGREE PROGRAMME (I, II, III): II
SEMESTER (I, II): I
CFU: 8

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

Analisi matematica II, Geometria e Algebra.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

To provide the fundamental concepts and results, in view of the applications, related to the theory of analytic functions, of distributions of Fourier series, Fourier and Laplace transforms and their applications.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding
The student will have to demonstrate knowledge of the notions (definitions, statements, demonstrations if foreseen by the program) related to the theory of holomorphic functions and integration in a complex field, distributions, Fourier series, Fourier and Laplace transforms and the developed calculation tools, and be able to understand related topics by elaborating the acquired notions.

Applying knowledge and understanding
Finally, he must demonstrate to be able to apply what he has learned in the resolution of verification exercises developed by the teacher, in principle related to topics such as: calculation of integrals in real field and in complex field with residue theory, linear difference equations, series and Fourier transforms of periodic signals, Laplace transforms of functions and applications to linear differential problems, distributional calculation.

COURSE CONTENT/SYLLABUS

(0,5 cfu) Complex numbers. Algebraic, trigonometric, exponential form. Form and argument properties. De Moivre formulas and n-th roots. Elementary functions in the field of complex numbers: exponential, sine and cosine, hyperbolic sine and cosine, logarithm, power. Sequences and series in the field of complex numbers. Power series: radius of convergence and properties, term-to-term derivation.

(1 cfu) Analytical functions. Holomorphy and Cauchy-Riemann conditions. Line integrals of functions of complex variable. Cauchy's theorem and formulas. Taylor series development. Serial development by Laurent. Zeros of analytic functions and identity principles. Classification of isolated singularities. Liouville's theorem.

(0,5 cfu) Integration. Notes on the measure and the Lebesgue integral. Summable functions. Limit passage theorems under the integral sign. Integrals in the sense of the main value according to Cauchy. Summable function spaces.

(1 cfu) Residues. Residue theorem. Calculation of residues at the poles. Calculation of integrals by the residue method. Lemmas of Jordan. Decomposition into simple fractions.

(0,5 cfu) Difference equations. Z-transformed: definition and properties. Z-antitransformed. Sequences defined by recurrence.

(1 cfu) Laplace transformation. Signals. General information about signals. Periodic signals. Convolution. Definition and domain of the bilateral Laplace transform. Analyticity and behavior ad infinitum. Notable examples of a Laplace transform. Formal properties of the Laplace transform. Unilateral transformation of Laplace and property. Initial and final value theorems. Antitransform (s.d.). Use of the Laplace transform in linear differential models.

(0.5 cfu) Fourier series. Notes on Banach and Hilbert spaces. Energy of a periodic signal. Trigonometric polynomials. Exponential and trigonometric Fourier series. Convergence in the punctual sense and in the sense of energy.

(0.5 cfu) Fourier transform. Definition of a Fourier transform. Formal properties of the Fourier transform. Anti-transformed. The Fourier transform and the heat equation.

(1.5 cfu) Distributions. Linear functionals. Limits in the sense of distributions. Derived in the sense of distributions. Derivation rules. Notable examples: Dirac δ, v.p. 1/t. Convolution of distributions. Space of fast-decreasing functions and their topology. Temperate distributions and slow-growing functions. Fourier transform of temperate distributions. Laplace transform of distributions. Fourier transform of the Dirac δ, of the pulse train. Fourier transform of periodic signals.

(0.5 cfu) Boundary problems Self-added equations. Green's function, the alternative theorem. The Sturm-Liouville problem, orthogonality eigenfunctions.

(0.5 cfu) Partial differential equations Generalities. Laplace and Poisson equations, harmonic functions, Dirichlet and Neumann problems. Solving the Dirichlet problem for the Laplace equation in a circle. Heat equation, Cauchy problem in the half-plane. Wave equation, Cauchy problem in the half-plane, mixed problem in the half-strip.

READINGS/BIBLIOGRAPHY

SEE THE TEACHER'S WEBSITE

TEACHING METHODS

The lessons will be frontal, and about a third of the lessons will be exercised.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	X
only written	
only oral	
project discussion	
other	

In case of a written exam, questions refer to:	**Multiple choice answers**	X
	Open answers	X
	Numerical exercises	X

b) Evaluation pattern: