UAB
Universitat Autònoma de Barcelona

Complex Fourier Analysis

Code: 104400
ECTS Credits: 6

2024/2025

Degree	Type	Year
2503740 Computational Mathematics and Data Analytics	OB	2

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Elementary Algebra and differential and integral Calculus.

Objectives and Contextualisation

- Understand and use the concepts and fundamental results of Complex Analysis.
- Understand and use the basic concepts of the Fourier series and the Fourier transform.
- Apply the results of this area in various situations: circuits, fluid theory, signal processing, resolution of differential equations, etc.

Learning Outcomes

1. CM20 (Competence) Calculate Fourier coefficients of periodic functions and their possible immediate applications to the calculation of sums of series.
2. CM21 (Competence) Select the suitable data compression in each case to preserve the desired properties.
3. KM16 (Knowledge) Identify the basic results and the fundamental properties of holomorphic functions, Cauchy's theorem, the Fourier and Laplace transforms of elementary functions, and their application to the solution of differential equations.
4. KM17 (Knowledge) Identify the relationship between uniform convergence and continuity, derivability or integrability of functions of one variable. (
5. KM17 (Knowledge) Identify the relationship between uniform convergence and continuity, derivability or integrability of functions of one variable. (

Content

1. Complex numbers. Analytic functions. Power series.
2. Cauchy local theory.
3. Residues.

4. Fourier series.
5. Harmonic functions and Fourier transform.
6. Applications.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	30	1.2	CM20, CM21, KM16, KM17, CM20
Problem session	12	0.48	CM20, CM21, KM16, KM17, CM20
Working seminars	11	0.44	CM20, CM21, KM16, KM17, CM20
Type: Autonomous			
Solving problems	58	2.32	CM20, CM21, KM16, KM17, CM20
Studying theoretical concepts	30	1.2	CM20, CM21, KM16, KM17, CM20

There will be four hours a week, two of which serve to introduce the basic concepts of the course. The other two will be used to solve problems and apply the theory in different situations.

It is important that the students work individually on the lists of exercises that will be provided: read, think and solve.

During the problem and exercise sessions computing tools will be used to visualize results and to make the necessary computations.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	40%	3.6	0.14	CM20, CM21, KM16, KM17
Midterm exam	40%	3.6	0.14	CM21, KM16, KM17
Submission of exercise sets	20%	1.8	0.07	CM20, CM21, KM16, KM17

At the beginning of the course, the dates of each test or evaluation will be announced. The arithmetic mean of the tests will be a mark E. At the end there is a resit exam.

There will be individual delivery of problems, and the student will get a mark S.

The final qualification will be

QC=0,8*E+0,2*S

During the course, certain assessment activities may be announced, which will never be mandatory. In any case, their contrin¡bution to the qualification will always be to improve stundents' marks. See the catalan description for more details.

Unique assessment

Those students pledging for unique assessment, will have to solve a final test versing about all the content of the subject.

The final mark will be obtained by a mean of the submission of exercise sets (20%) and the final test (80%).

In case the mark is below 5, the student will have a second chance in the recovery test. Its date will be fixed by the coordination of the degree. In this test the student may recover the 80% corresponding to the tests. The submission part will not be reevaluated.

Bibliography

- Ahlfors, L. *Complex Analysis* (Third Edit.). McGraw-Hill, 1979.
- Bruna, J., & Cufí, J. *Complex Analysis*. *EMS* (Vol. 6), 2010.
- Cohen, H. *Complex analysis with applications in science and engineering*. New York: Springer, 2007.
- Volkovyski, Lunts, Aramanovich. *Problemas sobre la teoría de funciones de variable compleja.* MIR, 1977
- Churchill, R. V, & Brown, J. W. *Complex Variables and Applications,* 2009.
- R. M. Gray and J. W. Goodman. *Fourier Transforms,* Kluwer, 1995
- R. N. Bracewell. *The Fourier Transform and its Applications*, McGraw Hill, 1986
- M. C. Pereyra and L. A. Ward. *Harmonic Analysis: From Fourier to Wavelets*, AMS, 2012

Software

- Sagemath: https://www.sagemath.org
- Maxima: https://maxima.sourceforge.io
- WxMaxima: https://wxmaxima-developers.github.io/wxmaxima/index.html

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed