Universitat Autònoma de Barcelona

Complex Fourier Analysis

2020/2021

Code: 104400
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OB	2	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

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.

Competences

- Calculate and reproduce certain mathematical routines and processes with ease.
- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.
- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic resources to obtain information.
- Relate new mathematical objects with other known objects and deduce their properties.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. "Explain ideas and mathematical concepts pertinent to the course; additionally, communicate personal reasonings to third parties."

2. Calculate Fourier coefficients for periodic functions and their possible immediate application to calculating the sum of series.
3. Contrast, if possible, the use of calculation with the use of abstraction in solving a problem.
4. Develop autonomous strategies for solving problems such as identifying the ambit of problems within the course, discriminate routine from non-routine problems, design an a priori strategy to solve a problem, evaluate this strategy.
5. Evaluate the advantages and disadvantages of using calculation and abstraction.
6. Handle the calculation of waste and its applications.
7. Make effective use of bibliographical resources and electronic resources to obtain information.
8. Manage homographic transformations and consequent representation.
9. Read and understand a mathematical text at the current level of the course.
10. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
11. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
12. Understand Fourier and Laplace transformations in elementary functions and their application to the resolution of differential equations.
13. Understand the basic results and the fundamental properties of holomorphic functions and Cauchy's theory.
14. Understand the relationship between uniform convergence and the continuity, derivability or integrability of variable functions.
15. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

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.

Methodology

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 make the necessary calculations.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	30	1.2	2, 13, 12, 1, 9, 6, 8
Problem session	12	0.48	5, 2, 3, 13, 12, 4, 1, 6, 8, 11, 10, 7
Working seminars	11	0.44	5, 2, 3, 13, 12, 4, 1, 9, 6, 8, 11, 10, 15, 7

Type: Autonomous			
Solving problems	58	2.32	5, 2, 3, 13, 12, 4, 1, 9, 6, 8, 11, 10, 15, 7
Studying theoretical concepts	30	1.2	5, 2, 3, 13, 12, 4, 1, 9, 6, 8, 11, 10, 7

Assessment

At the beginning of the course, the dates of each test or evaluation will be announced. At the end there is a resit exam. There will be individual delivery of problems.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	40%	3	0.12	5, 2, 3, 12, 4, 1, 9, 7
Midterm exam	30%	2	0.08	5, 3, 13, 4, 1, 9, 6, 8, 7
Submission of exercise sets	30%	4	0.16	5, 2, 3, 13, 14, 12, 4, 1, 9, 6, 8, 11, 10, 15, 7

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