UAB
Universitat Autònoma de Barcelona

Complex Fourier Analysis

2026/2027

Code: 104400
Credits: 6

Degree programme	Type	Course
Computational Mathematics and Data Analytics	OB	2

Contact lecturer

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Teaching staff

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Group languages

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

Prerequisites

Elementary Algebra and differential and integral Calculus.

Objectives

- 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

- CM20 (Calculate Fourier coefficients of periodic functions and their possible immediate applications to the calculation of sums of series.) Calculate Fourier coefficients of periodic functions and their possible immediate applications to the calculation of sums of series.
- CM21 (Select the suitable data compression in each case to preserve the desired properties.) Select the suitable data compression in each case to preserve the desired properties.
- KM16 (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.) 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.
- KM17 (Identify the relationship between uniform convergence and continuity, derivability or integrability of functions of one variable. () Identify the relationship between uniform convergence and continuity, derivability or integrability of functions of one variable. (

Contents

2. Complex numbers. Analytic functions. Power series.
4. Cauchy local theory.
6. Residues.
8. Fourier series.
10. Harmonic functions and Fourier transform.
12. Applications.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Studying theoretical concepts	30	1.2	
Solving problems	58	2.32	
Lectures	30	1.2	
Working seminars	12	0.48	
Problem session	11	0.44	

There will be four hours of class per week, two of which will be used 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 students work individually on the exercise lists that will be provided: read, think, and solve. In this way, group classes can be used optimally.

During the practical classes, computer tools will be used to visualize results and perform the necessary calculations.

For this course, the use of Artificial Intelligence (AI) technologies is permitted exclusively in seminars and as a support tool for assistance with small programming fragments. Students must clearly identify which parts have been generated using this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final outcome of the activity. A lack of transparency in the use of AI in this assessable activity will be considered a breach of academic honesty and may result in a partial or total penalty in the activity grade, or more serious sanctions in severe cases.

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Submission of exercise sets	20%	1.8	0.072	CM20, CM21, KM16, KM17
Final exam	40%	3.6	0.144	CM20, CM21
Midterm exam	40%	3.6	0.144	KM16, KM17

The dates for tests and assignments will be announced at the start of the course. The exam mark will be the arithmetic mean of the partial exams (E). There will be a resit for each of the partial exams.

Two individual problem-solving submissions or tests with a grade of S will be held.

The continuous assessment grade will be calculated as:

$QP = 0.8 \cdot E + 0.2 \cdot S$

If $E < 3.75$, the module cannot be passed.

If $QP \geq 5$, the course is considered passed.

Otherwise, the student may take a resit exam, obtaining grades R1 and R2 corresponding to the recovery of each partial exam. Then, the resit grade will be:

$R = (\max(P1, R1) + \max(P2, R2)) / 2$,

and the final grade will be:

$QR = \min(0.8 \cdot R + 0.2 \cdot S, 5)$,

which means that the maximum grade attainable in the resit is a 5.

The final course grade will always be:

$QF = \max\{QP, QR\}$.

Possible distinctions (honours) will be awarded in accordance with current regulations, once the entire evaluation process is complete.

If a student has taken only one assessment test, the final mark will be recorded as "Not evaluable".

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

Bibliografia bàsica

- C. Cascante, N. Fagella, E. Gallego, J. Pau i M. Prats, *Apunts d'Anàlisi Complexa*. Versió preliminar disponible en línia.
- L. Ahlfors, *Complex Analysis*, McGraw-Hill, 3a edició, 1979.
  (Referència clàssica que, amb un format compacte, tracta molts temes amb gran rigor.)
- J. Conway, *Functions of One Complex Variable*, 2a edició, Springer-Verlag, 1978.
  (Abarca molt més que el curs i inclou nombrosos problemes.)
- J. P. D'Angelo, *An Introduction to Complex Analysis and Geometry*, AMS, 2010.
  (Introducció de nivell més elemental que les obres anteriors.)
- B. Davis, *Transforms and Their Applications*, 3a edició, Springer, 2001.
  (Serveix com a inici i aprofundimenten l'estudi de les transformacions integrals.)
- M. C. Pereyra i L. A. Ward, *Harmonic Analysis: From Fourier to Wavelets*, AMS, 2012.
  (Curs força complet d'anàlisi harmònica.)

Bibliografia complementària

- J. Bruna i J. Cufí, *Anàlisi Complexa*, Manuals UAB 49, 2008.
- L. Volkovyski, G. Lunts i I. Aramanovich, *Problemas sobre la teoría de funciones de variable compleja*, MIR, 1977.
- R. Burckel, *Introduction to Classical Complex Analysis*, vol. I, Academic Press, 1979.
- W. Rudin, *Análisis Real y Complejo*, Alhambra, 1979.
- S. Saks i A. Zygmund, *Fonctions Analytiques*, Masson et Cie, 1970.
- E. Stein i R. Shakarchi, *Complex Analysis*, Princeton University Press, 2003.
- R. N. Bracewell, *The Fourier Transform and Its Applications*, McGraw-Hill, 1986.
- R. M. Gray i J. W. Goodman, *Fourier Transforms*, Kluwer, 1995.
- R. V. Churchill i J. W. Brown, *Complex Variables and Applications*, 2009.

Software

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

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this link. To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan	second semester	morning-mixed