Universitat Autònoma de Barcelona

2023/2024

Complex Variable Analysis

Code: 106072
ECTS Credits: 5

Degree	Type	Year	Semester
2500097 Physics	OB	2	2

Contact

Name: Rafel Escribano Carrascosa

Email: rafel.escribano@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Francisco Javier García Garrido

Cosimo Nigro

Prerequisites

Prior knowledge of real variable functions is required, so it is advisable to have studied the Calculus I, Calculus II and Calculus of Several Variables.

Objectives and Contextualisation

The main goal of this course is to introduce the analysis of complex functions of a complex variable, its calculation and applications, beginning with the presentation of complex numbers and ending with advanced applications and topics.

Competences

- Develop the capacity for analysis and synthesis that allows the acquisition of knowledge and skills in different fields of physics, and apply to these fields the skills inherent within the degree of physics, contributing innovative and competitive proposals.
- Make changes to methods and processes in the area of knowledge in order to provide innovative responses to society's needs and demands.
- Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments

- Use mathematics to describe the physical world, selecting appropriate tools, building appropriate models, interpreting and comparing results critically with experimentation and observation
- Work independently, have personal initiative and self-organisational skills in achieving results, in planning and in executing a project

Learning Outcomes

1. Calculate real integrals using the method of residues.
2. Determine the Taylor or Laurent series for a complex variable function.
3. Handle simple distributions with ease.
4. Identify situations in which a change or improvement is needed.
5. Obtain Fourier's transform for a function.
6. Use complex numbers and multiform functions with ease.
7. Use critical reasoning, show analytical skills, correctly use technical language and develop logical arguments
8. Use the mathematical tools developed in this subject for the quantitative study of advanced problems in any branch of knowledge.
9. Work independently, take initiative itself, be able to organize to achieve results and to plan and execute a project.

Content

1) Complex numbers: representation, Euler's formula, powers and roots

2) Topology of complex numbers

3) Elementary and multiple-valued functions: exponential, trigonometric, hyperbolic, logarithm, power

4) Fourier series and transform

5) Complex differentiation: limits and continuity, Cauchy-Riemann equations, differentiation

6) Cauchy's theorem: integrals in the complex plane, primitives

7) Cauchy's integral formula: index of a closed path, nth derivative of a regular function

8) Series expansions: Taylor series, Laurent series, singularities of an analytic function

9) The residue theorem: calculation of residues, applications

Methodology

Theory Lectures and Exercises.

Classwork and Homework.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises	14	0.56	1, 2, 3, 5, 6, 8
Theory Lectures	27	1.08	1, 2, 3, 5, 6, 8
Type: Autonomous			
Discussion, Work Groups, Group Exercises	19	0.76	1, 2, 4, 3, 5, 7, 9, 6, 8
Study of Theoretical Foundations	36	1.44	1, 2, 4, 3, 5, 7, 9, 6, 8

Assessment

Exam and delivery of exercises for topics 1, 2, 3, 4 and 5;

Exam and delivery of exercises for topics 6, 7, 8, 9 and 10;

Make-up exam: all topics;

In order to participate in the make-up exam you have to be evaluated of the two partial exams without requiring a minimal mark;

The make-up exam covers the whole subject;

You can come to the make-up exam to improve your mark. If so, your final mark corresponding to the exam part will be that of this exam.

Single assessement: The students that opted for single assessement evaluation will have to perform a final evaluation that will first consist of a test of the whole syllabus. This test will take place on the same date, time and place as test of the continuous assessment modality. Besides, before the exam, the student will deliver 2 deliveries consisting in resolved exercises of a selected set of exercises proposed at an earlier date. For the mark, 80% of the final mark will come from the exam and each of the deliveries will count 10%. The students that opted for single assessement evaluation will have the chance of passing the module or improve their mark at the same re-evaluation test as the students that had opted for the continuous assessement option (both exams will be identical and will take place on the same day, time and in the same place), but it is mandatory to at least have taken the previous final test. At this test, it is only possible to improve the mark of the exam. The part of the deliveries can not be improved in the re-evaluation.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of Exercises: topics 1, 2, 3, 4 and 5	10%	10	0.4	4, 3, 5, 7, 9, 6, 8
Delivery of Exercises: topics 6, 7, 8, 9 and 10	10%	10	0.4	1, 2, 4, 7, 9, 8
Exam: topics 1, 2, 3, 4 and 5	40%	3	0.12	4, 3, 5, 7, 9, 6, 8
Exam: topics 6, 7, 8, 9 and 10	40%	3	0.12	1, 2, 4, 7, 9, 8
Make-up Exam: all topics	80%	3	0.12	1, 2, 4, 3, 5, 7, 9, 6, 8

Bibliography

Bibliography: Complex Variables

• "Complex Variables", M. R. Spiegel *et al.*, Schaum's Outline Series, McGraw-Hill

• "Complex Variable and Appications", J. W. Brown and R. V. Churchill, McGraw-Hill

Bibliografia: Fourier Series and Transform

• "Mathematical Methods for Physicists", G. B. Arfken and H. J. Weber, Elsevier Academic Press

Software

It is recommended to use Mathematica Student Edition.