Universidad Zaragoza

Year : 2020/21

27014 - Complex Analysis

Syllabus Information

Academic Year: 2020/21
Subject: 27014 - Complex Analysis
Faculty / School: 100 - Facultad de Ciencias
Degree: 453 - Degree in Mathematics
ECTS: 9.0
Year: 3
Semester: Annual
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

The aims and the approach to the course reply to its compulsory character in the degree. The subject covered in the course is present in any branch of mathematics as well as in natural and social sciences, which makes it of great theoretical and applied importance. The aims can be summarized, because of their importance in the study of mathematical analysis, in understanding the similarities and the differences between complex analysis and real analysis in one and several variables, as well as understanding which aspects in real analysis are embedded in complex analysis, which allows them to be better understood.

1.2.Context and importance of this course in the degree

The course is embedded in the module *Introduction to Mathematical Analysis,* and is the unique course covering the topic *Complex variable functions.* To follow the course properly it is essential to have taken the courses *Mathematical analysis I* and *Mathematical Analysis II* in advance.

On the other hand, it is an important course in order to get a proper academic achievement in other courses of the degree like: Topology, Probability theory, Fourier Analysis, Functional Analysis, Fundaments of mathematical Analysis, Riemannian geometry, Surfaces topology, Differentiable manifolds....

1.3.Recommendations to take this course

- Attend continuously, and paying attention, to the theoretical and practical lectures.
- Work with the materila delivered by the instructors in a continuous way.
- Make a good use of the office hours, whose exact schedule will be delivered at the beginning of the course.
- It is specially urged to have passed the courses *Mathematical analysis I* and *Mathematical analysis II*.
- The students who cannot attend the lectures should comunicate their situation to the instructors.

2.Learning goals

2.1.Competences

After passing this course the student will be more competent in the aims described in the paragraph *Learning goals.*

Among the competences that the graduate in mathematics should acquire, we pint out the following ones:

- CE1. Comprehend and use the language and mathematical methods. Know rigurous proofs of the basic theorems in the course.
- CT3. Recognise, when facing a problem, what is substantial and what is accesory, make conjectures and reason in order to prove or disprove them, identify mistakes in incorrect reasonings, and so on.
- CE3. Solve mathematical problems by means of basic calculus and other techniques.
- CE2. Propose, analyse, validate and interpret models of real simple situations, using the most suitable mathematical tools depending on the ends that are pursued.

2.2.Learning goals

In order to pass this course the student must show the following skills:

- Knowing, understanding and learning the definition , first properties and basic theory of of holomorphic or analytic functions, meromorphic functions, as well as the bascis in complex integration and local Cauchy's theory.
- Comprehension and easy handling of power series and Laurent series, and their convergence conditions.
- Master the computation of residues and some of its applications.
- Knowing the geometric and analytic aspects of conformal representation and possible applications.

2.3.Importance of learning goals

They give a basic formation in the degree (see the paragraph *Context and importance of this course in the degree*). Moreover, the concepts and techniques included in this course are basic to model numerous problems that are present in other sciences.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The assessment of the course is divided in two terms. In order to pass the course each of both terms must be passed. With this requisite, the final mark will be the mean of the marks in both terms.

In each term, several continuous evaluation examinations will take place during some lecture hours, and a long exam in the official assesment calls.

The number of continuous evaluation examinations will be two or three in each term, although this number could vary if the circumstances so require. The total weight of the marks in these continuous evaluation examinations will be 20 per cent.

In the first term there will also be a long exam in the exams period in January and February, giving the student the possibility to pass the first term in this exams period.

Those students who have not passed some of the terms will take a long exam on the corresponding term in the official assesment calls. The mark of a passed term will be kept through the whole academic year.

According to the University regulations, the students can refuse the aforementioned system and take only the exams in June or September as a global test.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, tutorials and individual work and study.

4.2.Learning tasks

This course is organized as follows:

- **Lectures**. Three weekly hours on theoretical results and key problems.
- **Problem-solving sessions**. With the purpose of understanding and applying the theoretical results.
- **Individual work and study**. Including problem assignments for individual work.
- **Tutorials**. Individual tutoring.
- **Assessment tasks**. Several midterm continuous evaluation exams will be done during the period of classes as well as a bigger midterm exam a the end of the first semester.
- More information and material is available at http://anamat.unizar.es/docencia.html and https://moodle.unizar.es/add/ .

The teaching activities and assessment tasks will take place in a face-to-face mode, except in the case that, due to the health situation, the dispositions emitted by the competent authorities and by the University of Zaragoza compel to take them in a telematic form.

4.3.Syllabus

This course will address the following topics:

Section I. First term.

- **Topic 1**. Holomorphic functions. Cauchy-Riemann conditions. Harmonic functions.
- **Topic 2**. Analytic functions. Power series. Elementary functions.
- **Topic 3**. Complex integration. Cauchy local theory.

Section II. Second term.

- **Topic 4**. Cauchy global theory. Cycles and homology. Simple connection.
- **Topic 5**. Zeroes and singularities. Meromorphic functions. Laurent expansions.
- **Topic 6**. Residue theorem and applications.
- **Topic 7**. Conformal mappings.

4.4.Course planning and calendar

- Three weekly face-to-face lectures will be delivered during the whole course.
- Topics 1, 2 y 3 correspond to the first term. Topics 4, 5, 6 y 7 correspond to the second term.
- At the end of the first term there will be a written exam on the topics covered up to that time.
- There will be a written exam in each official assessment calls (June and September).
- The exam periods, the precise dates and the academic calendar can be seen in the Facuclty of Sciences website (https://ciencias.unizar.es/).
- During the class period several continuous evaluation exams will be taken, on some dates that will be announced in advance.
- The first day of the course additional information will be provided.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=27014&year=2020