Universidad Zaragoza

Year : 2019/20

27014 - Complex Analysis

Syllabus Information

Academic Year: 2019/20
Subject: 27014 - Complex Analysis
Faculty / School: 100 -

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 basis of 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 imortance 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 a theoretical part and a problems part, which carry a 20 and 80 per cent of the marks, respectively. The evaluation will have two parts: during the course and the exams.

- During the course some theoretical tests will be taken. The average of the marks will be the 20 per cent in the final mark of the course.
- The problems part in the first term will be assessed in an exam that will be taken during the exams period in January and February.
- The problems part in the second term will be assessed in an exam that will be taken in Junes exams period.
- The students who have not passed some of the parts will be able to take an exam of that part in the exams periods in June and September.

The students who prefer it can refuse the aforementioned system and take only the exams in June or September as a global test in which the theoretical questions will also count 20 per cent of the marks and the problems will count 80 per cent of the marks.

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 theory exams will be done during the period of classes as well as a bigger midterm exam a the end of the first semester.

4.3.Syllabus

This course will address the following topics:

Section I. First semester.

- **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 semester.

- **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

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website (http://ciencias.unizar.es/) and Moodle (https://moodle2.unizar.es/add/). You can also check http://www.unizar.es/analisis_matematico/docencia.html for more information and material.

4.5.Bibliography and recommended resources

- Cuartero, B.; Ruiz, F. J.: Teoría de funciones de variable compleja. Lecture notes available in Moodle.
- Palka, B. P.: An introduction to complex function theory. New York, Springer, 1991.
- Conway, J. B.: Functions of one complex variable. 2nd ed., New York, Springer, 1978.
- Volkovyski, L. I.; Lunts, G. L.; Aramanovich, I. G.: A collection of problems on complex analysis. Oxford, Pergamon Press, 1965.
- Bruna, J.; Cufí, J.: Complex analysis. Zürich, European Mathematical Society Publishing House, 2013.
- Ponnusamy, S.; Silverman, H.: Complex variables with applications. Boston, Birkhäuser, 2006.
- Rudin, W.: Real and complex analysis. London, McGraw-Hill, 1970.

See also http://www.unizar.es/analisis_matematico/docencia.html and https://moodle2.unizar.es/add/.

http://biblos.unizar.es/br/br_citas.php?codigo=27014&year=2019