Universidad Zaragoza

Academic Year/course: 2021/22

27006 - Calculus II

Syllabus Information

Academic Year: 2021/22
Subject: 27006 - Análisis matemático II
Faculty / School: 100 - Facultad de Ciencias
Degree: 453 - Degree in Mathematics
ECTS: 15.0
Year: 2
Semester: Annual
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

This is a mandatory course in the degree.

The topics covered during the course intersect any other area of mathematics as well as nature and social sciences. That's why they are so important from both the theorical and applied points of view.

1.2. Context and importance of this course in the degree

This course belongs to the module *Introduction to mathematical analysis*, and it is the only one in the subject *Functions of several real variables*. In order to understand the course, the knowledge of *Mathematical Analysis I* is essential. In addition, this course is of great importance for the following ones in the degree.

1.3. Recommendations to take this course

It is recommendable to have passed the course *Mathematical Analysis I*.

It is recommendable the attendance to the lectures to learn the concepts and basic results and their application to exercises, as well as the attendance to problem sessions in which the acquired knowledge will be applied to solve proposed problems. The students should come to office hours to ask whatever questions they have.

Finally, it is recommendable to attend the computer sessions to learn how to use the software in relation to the course.

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 point out the following ones:

CE1. Comprehend and use the language and mathematical methods. Know rigorous proofs of the basic theorems in the course.

CE2. Propose, analyze, validate and interpret models for simple real situations, by using the most appropriate math tools for the purposes pursued.

CG4. Be able to communicate, both orally and in writing, mathematical information, ideas, problems and solutions to a broad audience.

CT3. Recognise, when facing a problem, what is substantial and what is accessory, make conjectures and reason in order to prove or disprove them, identify mistakes in incorrect reasonings, and so on.

CE4. Use assorted software to experiment in Mathematics and solve problems.

2.2. Learning goals

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

- Understanding the algebra and the topology of $?^n$.
- Comprehension of the notion of differentiability, computation of partial derivatives using the chain rule, and use of the implicit function theorem.
- Computation and study of extreme values of functions in open subsets and manifolds in $?^n$.
- Statement and resolution of multiple integrals, line integrals and surface integrals.
- Knowing of the applications to other fields the notions of partial derivatives and multiple, line, and surface integrals.
- Handling of software to solve problems and give geometric interpretations to the notions involved in the course.

2.3. Importance of learning goals

They give a basic formation in the degree and work as a support for most of the other courses of 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)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

Lectures including theoretical concepts and fundamental exercises.

Problem-solving sessions to practice and consolidate theoretical conceptsand ideas.

Homework based on proposed problems.

There will also be problem-solving sessions in which computers will be used in order to solve different types of exercises proposed in the course.

4.2. Learning tasks

More additional information and material is available in the links http://anamat.unizar.es/docencia.html and https://moodle.unizar.es/.

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 to a greater or lesser extent in a telematic form.

4.3. Syllabus

This course will address the following topics:

- **Topic 1.** Algebraic and topological properties in $?^n$
- **Topic 2.** Functions of several real variables. Limits and continuity.
- **Topic 3.** Partial derivatives and differentiability of real-valued and vector-valued functions. Higher order partial derivatives. Functions of class C^p.
- **Topic 4.** Taylor's formula. Application to the study of extreme points.
- **Topic 5.** Implicit and inverse function theorems, change of variables.
- **Topic 6.** Extreme points on manifolds and the Lagrange multipliers rule.
- **Topic 7.** Integration in $?^n$. Differentiation under integral sign, change of variable and Fubini's theorem.
- **Topic 8.** Integration of functions and 1-differential forms on paths. Poincaré's lemma.
- **Topic 9.** Integration of functions and 2-differential forms on surfaces in $?^3$. Riemann-Green, Gauss-Ostrogradski and Stokes theorems.

4.4. Course planning and calendar

The course consists of six hours per week during the first term and four hours per week during the second one, following the official timetable given by the Faculty of Science in the University of Zaragoza. Two hours per week, from the previous six, in the first term, and one hour and a half, from the previous four, in the second term, are devoted to solve exercises in the classroom.

Computer lessons will take place in the first and second term in time and form to be fixed during the course.

There will be a written exam about the subject explained in the first term, at the end of it.

Besides this, a written final exam will take place according to the schedule.

Dates and locations for exams will be programmed by the center.

Further information concerning timetable, classroom, office hours, assessment dates and other details regarding this course will be provided in class. Alternatively, information is available in the Faculty of Sciences website and Moodle.

4.5. Bibliography and recommended resources

- Apostol, Tom M.. Análisis matemático / Tom M. Apostol . - 2a ed., [reimp.] Barcelona, [etc.] : Reverté, cop.1988
- Bombal Gordón, F.; Rodríguez Marín, L.; Vera Botí, G. Problemas de análisis matemático. 1ª ed. [s. l.]: Electolibris, 2017. ISBN 9788494615085.
- Browder, Andrew. Mathematical analysis : an introduction / Andrew Browder New York [etc.] : Springer, cop. 1996
- Demidovich, B.P.. 5000 problemas de análisis matemático / B. P. Demidóvich ; traducido del ruso por Emiliano Aparicio Bernardo . - 5ª ed. Madrid : Paraninfo, 1993
- Facenda Aguirre, J. A.; Freniche Ibáñez, F. J. Integración de funciones de varias variables. [s. l.]: Pirámide, 2002. ISBN 843681665x.
- Fleming, Wendell H.. Functions of several variables / Wendell Fleming . - 2nd. ed. New York, [etc] : Springer-Verlag, 1977
- Marsden, J. E.; Tromba, A. J. Cálculo vectorial. 6ª ed. [s. l.]: Pearson Educación, 2018. ISBN 9788490355787.

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27006