27040 - Topology of Surfaces

Syllabus Information

Academic Year: 2020/21
Subject: 27040 - Topology of Surfaces
Faculty / School: 100 - Facultad de Ciencias
Degree: 453 - Degree in Mathematics
ECTS: 6.0
Year: 4
Semester: Second semester
Subject Type: Optional
Module: ---

1.General information

1.1.Aims of the course

This subject and its syllabus have the following goals:
Give the student a topological sense of the study and classification of surfaces. The notion of topological invariant, such as the fundamental group, is relevant to the study of mathematical objects. In this class, a particular topological invariant, having an algebraic structure (a group) will be able of determine the topological structure of compact surfaces, and even determine their orientability.

1.2.Context and importance of this course in the degree

This subject is part of the módulo Ampliación de Geometría y Topología (Higher Geometry and Topology)
As mentioned in section 1.1, it is recommended that the student is familiar with both algebraic and topological techniques, such as those provided in Algebra Lineal, Topología General, and Estructuras Algebraicas. This class will connect them considering certain topological invariants of an algebraic nature and applying them to solve concrete problems.

1.3.Recommendations to take this course

Students are recommended to have aquired the competences associated with the Fundamentos de Geometría y Topología (Fundamentals in Geometry and Topology), in particular Algebra Lineal, Topología General and Estructuras Algebraicas.

2.Learning goals

2.1.Competences

Upon succesfully completion of this subject the student will improve the following abilities...

Carry out the goals described in section 2.1

CG3. To have the ability to gather and interpret the relevant data, particularly in the field of Mathematics, in order to make statements using analytical methods as well as abstraction, containing insights on relevant topics, be it of a social, scientific, or ethical nature.

CG5: To develop learning skills that will be necessary to continue studies in Mathematics with a high degree of autonomy.

CT1. Be able to clearly state, both orally and in writing, the student's reasoning, problem solving techniques, reports, etc.

CE1. Understand and apply both mathematical language and methods. Learn rigorous proofs of the basic theorems in the different areas of Mathematics.

2.2.Learning goals

In order to pass this class, the student should be able to show the following skills...

Understand the notion of fundamental group and be able to compute it in some concrete situations.

Topologically recognize compact surfaces and classify them.

2.3.Importance of learning goals

The learning objectives provide basic skills within the Degree. (See Context and reasons behind the subject area in the

Degree)

3.Assessment (1st and 2nd call)

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

The student must demonstrate that they have achived the learning objectives by means of the following evaluation activities:

Along the course, students are asked to solve different activities (mostly exercises and problems). These activities are the part of continuous evaluation.

Besides, the students are asked to give an oral presentation about a basic subject of the course.

The final grade will be obtained averaging the degrees in the continuous evaluation and the oral presentation.

If that grade is not enough, the student can take a written exam after the end of the classes. In that case, the result of the exam will give the final grade.

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 autonomous work and study.

4.2.Learning tasks

This course is organized as follows:
- **Lectures**. Three weekly sessions.
- **Problem-solving sessions** in small groups. One weekly session. Oral presentations of problems.
- **Tutorials**.
- **Autonomous work and study**. In addition to the general teaching methodology activities students are afforded the opportunity to submit individual homework assignments. These assignments are checked by the teacher and returned on a regular basis. This process allows students to pinpoint strengths/weaknesses and helps in their learning process.

These tasks will take place in-person at the classroom, unless the University of Zaragoza stablishes that, because of the public health situation, they should be done online.

4.3.Syllabus

This course will address the following topics:
- **Topic 1. Fundamental Group.**
    - Definition and Preliminaries.
    - Calculations of Fundamental Groups.
    - The Fundamental Group of the Circumference.
    - Seifert-Van Kampen Theorem.
- **Topic 2. Classification of Surfaces.**
    - Connected Sum. Surgery.
    - Triangulation. Euler Characteristic.
    - Classification Theorem.
- **Topic 3. Covering Spaces.**
    - G-spaces and group actions.
    - Definition and Motivation of covering space.
    - Covering Spaces of Surfaces.
- **Topic 4. Introduction to knot theory.**

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 and Moodle.

4.5.Bibliography and recommended resources

Basic Bibliography:

- Massey, William S.. Introducción a la topología algebraica / William S. Massey . Barcelona[etc.] : Reverté, cop.1982
- Armstrong, M.A.. Topología básica / M.A. Armstrong . Barcelona [etc.] : Reverté, D.L. 1987

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