Universidad Zaragoza

**Academic Year/course: 2023/24**

# 27040 - Topology of Surfaces

## Syllabus Information

**Academic year:** 2023/24
**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

Topology studies the properties of spaces that are preserved by deformations without "cutting and pasting". In this context, a surface is a space that is locally like two-dimensional Euclidean space, such as a sphere. Surfaces occur naturally in many areas of mathematics, and their (topological) classification is a natural problem.

One of the main objectives of the course is to prove the classification theorem for surfaces. To this end, some rudiments of algebraic topology will be introduced, an area of topology that associates algebraic objects to topological spaces. In this context the notions of homotopy and fundamental group of a topological space appear.

The approaches and objectives of this module are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda; the learning activities could contribute to some extent to the achievement of the goals 4 (quality education), 5 (gender equality), 8 (decent work and economic growth), and 10 (reducing inequality).

## 2. Learning results

- Understand the notion of fundamental group and be able to compute it in some concrete situations.
- Topologically recognize compact surfaces and classify them.

## 3. Syllabus

1. Fundamental group.
    - Definition and preliminaries.
    - Calculations of fundamental groups.
    - The fundamental group of the circumference.
    - Seifert-Van Kampen theorem.
2. Classification of surfaces.
    - Connected sum. Surgery.
    - Triangulation. Euler characteristic.
    - Classification theorem.
3. Covering spaces.
    - G-spaces and group actions.
    - Definition and motivation of covering space.
    - Covering spaces of surfaces.
4. Introduction to knot theory.

## 4. Academic activities

Master classes: 45 hours.
Problem solving: 15 hours.
Project: 25 hours.
Study: 62 hours.
Assessment tests: 3 hours.

## 5. Assessment system

- 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 prepare a topic for the course, and if the schedule allows it, give an oral presentation about it.
- The final grade will be obtained averaging the degrees of all those tasks.

The students can take a written exam after the end of the classes. In that case, the final grade will be highest of the two grades.