COURSE DATA

DATA SUBJECT

Code: 34164
Name: Topology
Cycle: Undergraduate Studies
ECTS Credits: 12
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	2	Annual, Sin determinar
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	2	Annual, Sin determinar
1935 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	2	Annual, Sin determinar
1936 - Double Degree Program in Mathematics-Telematics Engineering	Facultat de Ciències Matemàtiques	2	Annual, Sin determinar

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Topology and differential geometry	COMPULSORY
1928 - Double Degree Program Physics-Mathematics	Segundo Curso (Obligatorio)	COMPULSORY
1935 - Double Degree Program in Mathematics-Telematics Engineering	Segundo curso	COMPULSORY
1936 - Double Degree Program in Mathematics-Telematics Engineering	Segundo curso	COMPULSORY

COORDINATION

NUÑO BALLESTEROS JUAN JOSE

OSET SINHA RAUL ADRIAN

SUMMARY

The overall objective of this course is to introduce students to the basics of topology. Most of the course is devoted to general topology, which provides basic language for understanding other subjects such as geometry or analysis. We will also introduce at the end of the course certain concepts less instrumental and more typical of other variants of the topology, such as geometric topology and algebraic topology.

Topology is the branch of mathematics devoted to the study of those properties of geometric shapes that

do not depend on quantities and are invariant under continuous transformations. This study is based on the concept of proximity, and allows us to establish an axiomatic approach to the concepts of neighborhood, open set, closed set, continuity, and so on, using as main tool the language of set theory.

Based on the previous experience of the student with the topology of the real line, we introduce first metric spaces, prior to the further abstraction of topological space. Next we will study ways of getting new examples of topological spaces by the construction of subspaces, products and quotients. To finish the general part, we introduce the most important topological properties (connection and compactness) and metric properties (completeness).

Finally we dedicate the last part of the course to the classification of compact surfaces, and a brief introduction to the fundamental group. These are concepts more applicable to geometric topology (or to low dimensional topology) and algebraic topology and which require further development of the geometric intuition of the students.

The contents of this course are metric spaces, topological spaces, countability properties, separation, convergence and continuity, subspaces and products of topological spaces, compactness and completeness, connection and introduction to the fundamental group, quotient topological spaces and the description of compact surfaces.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is desirable that the student has completed the first year core subjects, especially Basic Mathematics and Analysis I.

COMPETENCES / LEARNING OUTCOMES

1107 - Degree in Mathematics

Ability to work in teams.

Capacity for analysis and synthesis.

Capacity of abstraction and modeling.

Expressing mathematically in a rigorous and clear manner.

Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.

Learn autonomously.

Possess and understand the mathematical knowledge.

Reason logically and identify errors in the procedures.

Solve problems that require the use of mathematical tools.

Visualize and interpret the solutions obtained.

DESCRIPTION OF CONTENTS

1. Metric spaces.

Definition and examples of metric spaces.
Balls. Bounded metric spaces.
Open subsets and properties.
Neighborhoods. Closed subsets.

2. Topological spaces.

Definition and examples of topological spaces.
Closed subsets. Neighborhoods.
Countability Axioms and Hausdorff topological spaces.
Equivalent metrics.

3. Particular points.

Adherency points and related concepts.
Boundary points. Interior points.
Characterization by sequences.

4. Continuity.

Continuity of a map at a point.
Global continuity of a map.

Uniform continuity and isometries.

5. Subspaces.

Relative topology.
Relative closure, interior and boundary.
Continuity and subspaces.

6. Connection.

Connection.
Connected subsapaces of R.
Other properties of the connection.
Path connection.

7. Products.

Product topology.
Closure, interior and boundary of a product.
Continuity and products.

8. Compactness.

Definition and Examples.
Compact subspaces. Characterization of compact subspaces of R and Rn.
Relationship with continuous maps.
Sequentially compact spaces.

9. Completeness.

Complete metric spaces.
Some theorems on complete spaces.

10. Quotients.

Definition and basic properties.
Relationship with subspaces and products.
The Hausdorff property in quotients.

11. Fundamental group.

Definition of fundamental group.
Continuous maps and fundamental group.
The fundamental group of the circle.
The Brouwer fixed point theorem in dimensión 2.

12. Classificacion of surfaces.

Definition and examples of surfaces.
Triangulation of compact surfaces.
Orientable and nonorientable surfaces.
Classification of compact surfaces.
The Euler characteristic.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	60,00
Other activities	15,00
Classroom practices	45,00

	Total hours	120,00

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	15,00
Independent study and work	15,00
Preparation of lessons	90,00
Preparation for assessment activities	60,00
Resolution of case studies	0,00
Total hours	**180,00**

TEACHING METHODOLOGY

The theoretical part will be developed in lectures where the lecturer will introduce gradually the mathematical content and method. On each U.T., besides the theoretical knowledge, the lecturer will include quite a number of examples and will solve exercises specific to that part. At the end of each U.T. the lecturer will provide lists of exercises to be solved by the students.

The more practical part will developed in smaller groups where students will practice working in stable groups of three or four students under the supervision of the teacher. Each group will hand in writing the answers of the exercises to be marked by the teacher.

Both theoretical and practical classes will make use of tools for visualization of geometric objects.

Finally, there will be regular seminars in which the students will solve doubts and will discuss with the teacher those aspects of the subject they deem appropriate. In addition, different activities to be undertaken by students under teacher supervision shall be proposed.

EVALUATION

The assessment of learning knowledge and skills achieved by students will be made continuously throughout the course, and consists of the following items:

1. **Tests**: Two written tests of a theoretical-practical nature one at the end of each semester, with a weight of 70% of the final grade.

2. **Practice**: assessment of participation in practice sessions and the written presentation of the results of these sessions. This will have a weigh of 20% of the final grade.

3. **Tutorials and Seminars**: assessment of participation in tutorial sessions and seminars and carrying out the proposed activities. The weight will be 10% of the final grade.

Comments:

• Block 1 requires a minimum mark of 4/10 in each test in order to average with blocks 2 and 3.

• Marks in blocks 2 and 3 are kept if there is a resit exam of the course in the same academic year.

REFERENCES

- F. Mascaró, J. Monterde, J.J. Nuño i R. Sivera, Introducció a la topologia. Universitat de València (1997).
- M.A. Armstrong, Topología Básica. Reverté (1987).
- W.S. Massey, Introducción a la topología algebraica. Reverté (1982).
- J.R. Munkres, Topologia (2ª Edición) Prentice-Hall (2002).