UAB
Universitat Autònoma de Barcelona

Topology of manifolds

Code: 100114
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500149 Mathematics	OT	4

Contact

Name: Joan Porti Pique

Email: joan.porti@uab.cat

Teachers

Natalia Castellana Vila

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

The prerequisites are the first and second year courses as well as Topology. It is recommended to have taken the subject of Differential Geometry.

Objectives and Contextualisation

In this course we introduce the most basic algebraic invariants that we can associate with a topological space (pa

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
- Demonstrate a high capacity for abstraction.
- Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
- Effectively use bibliographies and electronic resources to obtain information.

- Formulate hypotheses and devise strategies to confirm or reject them.
- Generate innovative and competitive proposals for research and professional activities.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Learning Outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
2. Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
3. Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
4. Devise demonstrations of mathematical results in the field of geometry and topology.
5. Effectively use bibliographies and electronic resources to obtain information.
6. Generate innovative and competitive proposals for research and professional activities.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
9. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
10. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
11. Understand abstract language and in-depth demonstrations of some advanced theorems of geometry and topology.

Content

The course will address the topics below.

- Definition and examples of homotopy of applications and spaces.
- Topological and differentiable varieties.
- Chain complexes.
- Homology and cohomology.
- Fundamental group and covering spaces.

In addition, these topics will provide the following remarkable results:

- Classification of related compact surfaces.
- Brouwer's fixed point theorem.
- Jordan-Brouwer separation theorem.
- Topological invariance of the dimension of a variety.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem Sessions	15	0.6	2, 1, 3, 6, 10, 8, 7
Theory classes	30	1.2	2, 1, 3, 6, 10, 8, 7
Type: Supervised			
Seminars	6	0.24	2, 1, 3, 6, 10, 8, 7
Type: Autonomous			
Assimilations of theoretical results	45	1.8	6, 10, 8, 5
Homework	15	0.6	2, 11, 3, 10, 8, 5
Solving problems	30	1.2	11, 4, 10, 8

Classes where the concepts, arguments and basic results of the subject are exposed This is complemented by problem sessions, seminars and participatory oral presentations from students, according to the contents of the course and achieves the knowledges and the capacities to use these materials in readings or studies of close or more advanced topics.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam	40%	4	0.16	11, 1, 3, 4, 9, 7, 5
Homework assignments	30%	4	0.16	11, 3, 4, 10, 9, 5
Oral presentation, type P.	30%	1	0.04	2, 11, 1, 3, 6, 9, 8, 7, 5

The qualification is the weigthed mean of the following marks:

- exercises (30%),
- exam (40%)
- ellaboration of a work on a proposed subject (30%)

A minimum mark of 3.5 for each evaluated activity is required. If necessary, the exam and the work will be reevaluated. The "matrícula d'honor" will be decided before reevaluations.

The one day assessment (avaluació unica) will take place on the same day as the final course presentations. The one day assessment will consist of the delivery of exercices (previously assignes), the final presentation and an exam,

Disclaimer: I have made my best to translate into English the Catalan version. In the unlikely case of differences between versions, we'll follow the Catalan one.

Bibliography

Main references:

- W. Fulton, Algebraic topology. A first course. Graduate Texts in Mathematics, 153. *Springer-Verlag, New York,* 1995.
- A. Hatcher, Algebraic topology. Cambridge University Press, Cambridge, 2002. xii+544 pp. (http://www.math.cornell.edu/~hatcher/AT/ATpage.html)
- J. M. Lee, Introduction to Topological Manifolds, , Graduate Texts in Mathematics 202, Springer-Verlag, New York, 2011.

Additional refs:

- L. W. Tu, An introduction to manifolds. Universitext. Springer, New York, second edition, 2011.
- R. Bott and L.W. Tu, Differential forms in algebraic topology. Graduate Texts in Mathematics, 82. Springer-Verlag, NewYork-Berlin, 1982.

Software

No software used

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(SEM) Seminars	1	Catalan	first semester	afternoon
(TE) Theory	1	Catalan	first semester	morning-mixed