Universitat Autònoma de Barcelona

2020/2021

Topology

Code: 100106
ECTS Credits: 6

Degree	Type	Year	Semester
2500149 Mathematics	OB	3	1

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)

Some groups entirely in English: No

Some groups entirely in Catalan: Yes

Some groups entirely in Spanish: No

Other comments on languages

The default language is Catalan, but some of the material for the seminars o complementary material will be offered in English.

Teachers

Guillermo Carrión Santiago

Prerequisites

Experience shows that it is extremely important for students to be familiar the basics of logic deduction. The students needs to feel comfortable with axiomatic methods, the basic principles of logic, and the different strategies and methods of proof (deduction, counterexamples,..). The student needs to know how to negate a proposition, how to use quantifiers (there exists, for all,...) and the idea of implication (if, only if, if and only if).

The idea is to reformulate and generalize from a broader point of view several concepts which are known in the context of metric spaces, then the student should have a good background on the topology of metric spaces, specially euclidean spaces.

Objectives and Contextualisation

The main goal of the course is to understand that ia topology in a set is the right structure to understabd the notion of continuity.

Several problems stated in terms of geometric objects do not depend on rigid properties like distances, angles, ... but on some continuity of the shape of those. Those are topological problems. The concept of topological space wants to model geometric objects like surfaces in space but goes beyind and the topology became present in many areas of mathematics.

We will through known concepts for metric spaces: open subset, closed subse, continuity and compactness. But the student should understand that this new axiomatic point of view is more general and more flexible than the iodea from metric spaces.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of ones work.
- Apply critical spirit and thoroughness to validate or reject both ones own arguments and those of others.
- Assimilate the definition of new mathematical objects, relate them with other contents and deduce their properties.
- Demonstrate a high capacity for abstraction.
- Identify the essential ideas of the demonstrations of certain basic theorems and know how to adapt them to obtain other results.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- 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 ones work.
2. Apply critical spirit and thoroughness to validate or reject both ones own arguments and those of others.
3. Construct examples of topological spaces using the notions of topological subspace, product space and quotient space.
4. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
5. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
6. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
7. 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.
8. Topologically recognise compact spaces and their classification.
9. Use the basic concepts associated to the notions of metric and topological space: compactness and connection.

Content

1. Topological properties of metric spaces.
2. Topological spaces: axioms.
3. Neighbourhoods, interiors and closures.
4. Continous maps.
5. Subspaces.
6. Product topology.
7. Quotient topology.

8. Compact spaces.
9. Hausdorff spaces.
10. Connectedness.
11. Topological varieties.
12. The classification of compact surfaces.

Methodology

There are three type of activities the student is supposed to attend: the lectures (2 hours /week) mainly concerned with the description of the theoretical concepts, problem solving sessions (1 hour/week) and seminars (6 hours on three weeks), similar to the problem solving sessions but where students work ingroups supervised by a teaching assistant.

The course has a web page in the UAB online campus gathering all information and communications between students and professors, and where all material, including problem sheets, some solutions, etc are published regularly.

Students are supposed to submit exercise sets to be evaluated.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	30	1.2	
Problem session	15	0.6	
Working Seminars	6	0.24	
Type: Autonomous			
Studying theoretical concepts and solving problems	88	3.52	

Assessment

There will be a specific evaluation of the activity developed in the seminars, which will count 20% of the final grade.

There will be two written tests: a partial exam in the middle of the semester (25% of the final grade) and a final exam (55% of the final grade).
If the mark of the end is better, it will count 80% and will not count the one of the partial one.

A minimum of 4 must be taken to the final exam (or to the complementary test) to pass.

Students who want to improve their mark obtained with this continuous assessment may submit to a supplementary written exam.
In this case, the final final grade will be obtained from the seminar note (20%), and the note of this complementary exam (80%).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final Exam	55%	4	0.16	3, 1, 7, 6, 5, 4, 8, 9
Mid-term exam	25%	4	0.16	3, 1, 7, 6, 5, 4, 9
Submission of exercises sets	20%	3	0.12	2, 3, 1, 7, 6, 5, 4, 8, 9

Bibliography

- Czes Kosniowski, *A first course in algebraic topology*. Cambridge University Press 1980.
- William S. Massey, *A basic course in algebraic topology*. Springer-Verlag 1991.
- Klaus Jänich, *Topology*. Springer-Verlag 1984.
- Jaume Aguadé, *Apunts d'un curs de topologia elemental.* http://mat.uab.es/~aguade/teaching.html
- Colin Adams, Robert Franzosa, *Introduction to Topology: Pure and Applied*, Prentice-Hall, 2008
- James Munkres, *General Topology*, Prentice-Hall, 2000.