Course guide
200121 - TOP - Topology

Last modified: 01/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: ENRIC VENTURA CAPELL

Others: Segon quadrimestre:
MARTA CASANELLAS RIUS - CFIS, M-A, M-B
JOSEP ELGUETA MONTO - CFIS, M-A
LLUIS VENA CROS - CFIS, M-A, M-B
ENRIC VENTURA CAPELL - CFIS, M-A, M-B

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

Generical:
4. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
5. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
6. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
7. CG-1. Show knowledge and proficiency in the use of mathematical language.
8. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
9. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
10. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.

Transversal:
11. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.

TEACHING METHODOLOGY

(Section not available)

LEARNING OBJECTIVES OF THE SUBJECT

(Section not available)

STUDY LOAD

Type	Hours	Percentage
Self study	112,5	60.00
Hours small group	30,0	16.00
Hours large group	45,0	24.00

Total learning time: 187.5 h

CONTENTS

Metric spaces

Description:
Open and closed balls. Open sets. Continuous applications. Equivalent distances.

Full-or-part-time: 10h
Theory classes: 3h
Practical classes: 2h
Self study : 5h

Topological spaces

Description:
Open and closed. Bases, subbases, neighbourhoods. The second numerability axiom. Continuous maps, homeomorphisms. The first numerability axiom: characterization of topological properties using sequence limits.

Full-or-part-time: 24h
Theory classes: 7h
Practical classes: 5h
Self study : 12h

Building topological spaces

Description:
Subspaces. Topological space products. Quotient spaces and identifications. Examples: topological surfaces. Adjunction.

Full-or-part-time: 24h
Theory classes: 7h
Practical classes: 5h
Self study : 12h

Compactness

Description:
Compact spaces. Compact space products and quotients. The Heine-Borel theorem. The Tikhonov theorem and applications. Locally compact spaces. Alexandrov compactivity. Compactness in metric spaces: characterization by sequences.

Full-or-part-time: 14h
Theory classes: 4h
Practical classes: 3h
Self study : 7h

Connectedness

Description:
Connected spaces. Connected components. Continuity and connection. The mean value theorem. Arc-connected spaces. Arc-connected components. Locally connected and locally arc-connected spaces.

Full-or-part-time: 14h
Theory classes: 4h
Practical classes: 3h
Self study : 7h

Introduction to homotopy

Description:
Introduction to the homotopy of continuous maps. Contractile spaces. Deformation retracts. The set of homotopic classes [X,Y]. The abelian group [S^1,S^1]: degree of a map.

Full-or-part-time: 20h
Theory classes: 6h
Practical classes: 4h
Self study : 10h

Applications to plane topology

Description:
Index of a closed curve. The Poincaré-Böhl and Rouché theorems. The Bolzano theorem and the Brouwer fixed point theorem. The fundamental theorem of algebra. The Borsuk-Ulam theorem. Invariance of the dimension.

Full-or-part-time: 22h
Theory classes: 7h
Practical classes: 4h
Self study : 11h

Compact surfaces classification

Description:
Triangulation of compact surfaces. Poligonal surfaces. Standard surfaces. Connex sum of surfaces. Classification theorem. Orientation, genus and Euler's characteristic.

Full-or-part-time: 22h
Theory classes: 7h
Practical classes: 4h
Self study : 11h

GRADING SYSTEM

BIBLIOGRAPHY

Basic:
- Kosniowski, Czes. Topología algebraica. Barcelona: Reverté, 1992. ISBN 9788429150988.
- Munkres, James R. Topología. 2a ed. Madrid: Prentice-Hall, 2002. ISBN 8420531804.
- Pascual Gainza, P.; Roig, A. Topologia [on line]. Barcelona: Edicions UPC, 2004 [Consultation: 21/05/2020]. Available on: http://hdl.handle.net/2099.3/36790. ISBN 8483017504.
- Sieradski, A. An introduction to topology and homotopy. Boston: PWS-KENT, 1992. ISBN 0534929605.
- Viro, O. Ya [et al.]. Elementary topology : problem textbook [on line]. Providence: American Mathematical Society, 2008 [Consultation: 27/06/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4715680. ISBN 9780821845066.

Complementary:
- Wall, C.T.C. A geometric introduction to topology. New York: Dover, 1993. ISBN 0486678504.
- Jänich, Klaus. Topology. New York: Springer-Verlag, 1984. ISBN 0387908927.
- Massey, William S. A basic course in algebraic topology. New York: Springer-Verlag, 1991. ISBN 038797430X.
- Navarro Aznar, V.; Pascual Gainza, P. Topologia algebraica. Barcelona: Edicions UB, 1999. ISBN 8483381230.