Content

Course Code	Course Name	Semester	Theory	Practice	Lab	Credit	ECTS
MAT301	Metric Topology	5	3	2	0	5	8

Prerequisites	MAT101, MAT102
Admission Requirements	MAT101, MAT102

Language of Instruction	French
Course Type	Compulsory
Course Level	Bachelor Degree
Objective	The aim of this course is to introduce the theory of metric spaces and teach the fundamental properties and applications of these structures. By learning the concept of metric spaces, students will gain a deep understanding of important results in analysis and topology. Additionally, the course aims to develop students' skills in abstract mathematical thinking.
Content	The course generalises to arbitrary metric spaces the notions of nearness, convergence and continuity known on R. It covers: distances, their examples and their constructions; the topological vocabulary (balls, open and closed sets, interior, closure, boundary); sequences and convergence; continuous maps and homeomorphisms; compactness; normed vector spaces; connectedness; and completeness up to the Banach fixed-point theorem.
References	https://github.com/onayg/mat301 An introduction to real analysis, Tosun Terzioğlu Burroni E, La topologie des espaces métriques : niveau L3 : cours et exercices corrigés

Theory Topics

Week	Weekly Contents
1	Preliminaries: N, Z, Q, R; the least upper bound property.
2	Distances: axioms; usual, discrete, SNCF and p-adic examples.
3	Constructions: induced distance, pullback, product, norm.
4	Balls, neighbourhoods, open and closed sets.
5	Interior, closure, boundary; topological equivalence of metrics.
6	Sequences: accumulation points, convergence, sequential characterisation of closed sets.
7	Continuous maps; Lipschitz maps; homeomorphisms.
8	Compactness: finite subcovers, Bolzano-Weierstrass.
9	Lebesgue number; Heine-Borel theorem; compact subsets.
10	Normed vector spaces: continuity of linear maps.
11	Equivalence of norms in finite dimension; Riesz's lemma; local compactness.
12	Connectedness: characterisations, connected components, intermediate value theorem.
13	Path-connectedness; convexity in normed vector spaces.
14	Completeness: Cauchy sequences, Cantor's criterion; Banach fixed-point theorem.