M031	FIN, MR, IPM - elective – Year 1	**Metric Spaces**	L+P+S 2+2+0	ECTS 6

Course objectives. Many notions and facts students have encountered in mathematical analysis and linear algebra, did not, in fact, depend on the rich structure of the Euclidean space, but only on the metric and/or topological structure. The purpose of this course is to discuss these structures and notions more deeply, being fundamental to mathematical analysis.

Course prerequisites. Real Analysis.

Syllabus.

1. Introduction: real numbers, sequences, limits of functions, continuity.
2. Metric spaces: motivation, examples, open sets, equivalent metrics, continuity.
3. Topological spaces: definition, basis, subbasis, subspace, product, homeomorphism, quotient space.
4. Separation axioms.
5. Compactness: definition, compactness of the closed interval, continuous functions on compact spaces, compactness in $\mathbf{R}^n$, compactness and uniform continuity.
6. Connectedness, path connectedness, components.
7. Convergence in metric spaces.
8. Uniform convergence.
9. Complete metric spaces: definition and examples, Banach's fixed point theorem, applications, Cantor and Baire theorems.
10. Compactness criteria in metric spaces, Arzelà-Ascoli theorem.

Expected learning outcomes.
After completing the course, students are expected to:

- analyze and synthesize knowledges acquired earlier in calculus and analysis courses;
- make informed judgment on mathematical structures needed to prove the most important assertions in mathematical analysis;
- classify metric and topological spaces according to various topological properties;
- formulate hypotheses related to the subject matter, and prove or disprove them;
- present the acquired knowledge to a wide audience as well as to experts.

Teaching methods and student assessment.
Attending lectures and problem sessions is compulsory for all students. The final exam, which consists of a written and an oral part, has to be taken after completion of all lectures and problem sessions. Acceptable mid-term exam scores replace the written examination.

Can the course be taught in English: Yes.

Basic literature:

1. S. Mardešić, Matematička analiza, 1. dio, Školska knjiga, Zagreb 1979.
2. Š. Ungar, Matematička analiza 3, treće dopunjeno izdanje, PMF-Matematički odjel, Zagreb 2002.
3. http://web.math.pmf.unizg.hr/~ungar/NASTAVA/MA/Analiza3.pdf

Recommended literature:

1. W. Rudin, Principles of Mathematical Analysis, McGraw - Hill 1964.
2. W.A. Sutherland, Introduction to metric and topological spaces, Claredon Press, Oxford, 1975.