<table>
<tr><td>COURSE NAME</td><td colspan="6">Normed spaces</td></tr>
<tr><td>Code</td><td>PMM215</td><td>Year of study</td><td colspan="4">1st or 2nd year of graduate study</td></tr>
<tr><td>Course teacher</td><td>Vlasta Matijević</td><td>Credits (ECTS)</td><td colspan="4">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td></td></tr>
<tr><td>45</td><td>15</td><td></td><td></td></tr>
<tr><td>Status of the course</td><td>Compulsory and elective</td><td>Percentage of application of e-learning</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">The course objective is to introduce students with advanced knowledge of normed spaces with special emphasis on Hilbert and Banach space theory. This gives the basics for more advanced studies in modern functional analysis, in particular in operator algebra theory.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">Courses taken: Metric spaces, Vector spaces</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">It is expected that a student will
- understand special properties of basic topological concepts (convergence, continuity, compactness) and metric concepts (boundedness, total boundedness, completness, uniform continuity) in normed spaces
- be able to state and prove basic results about Hilbert and Banach spaces and bounded operators between such spaces
- be able to apply the theory in the course to solve a variety of problems at an appropriate level of difficulty
- be able to decide whether a simple statement about normed spaces and bounded operators is true, providing a proof or counterexample as appropriate
- develop critical and analytical thinking and demonstrate skills in communicating mathematics orally and in writing</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">- Basic notions (12 hours)
Algebraic basis and dimension of a vector space. Norm and inner product. Equivalence of norms. Bounded linear operators. Normed space of bounded linear operators. Dual space of a normed space. Complete normed space. Completion of a normed space. Riesz lemma. Finite-dimensional normed space. Schauder basis of a normed space.
- Spaces lp and Lp (8 hours)
Spaces lp and their dual spaces. Spaces Cp([a,b]) and their completions Lp([a,b])
- Orthonormal basis (6 hours)
- Hahn-Banach extension theorem and consequences (6 hours)
- Hilber spaces (6 hours)
Riesz projection theorem. Riesz representation theorem. Characterization of Hilbert spaces.
- Classical theorems of functional analysis (6 hours)
Uniform boundedness principle. Banach-Steinhaus theorem. The open mapping theorem. Banach inverse mapping theorem. The closed graph theorem.</td></tr>
<tr><td>Format of instruction</td><td colspan="6">Lectures and seminars</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Attendance at lectures and seminars, written assignments, self-study using required and optional literature</td></tr>
<tr><td>Screening student work (name the</td><td colspan="6">Lecture attendance 0,5 ECTS
Exam 5,5 ECTS</td></tr>
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proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)	
Grading and evaluating student work in class and at the final exam	The exam consists of written and oral part. The oral part comes after positively graded (at least 50%) written part Both parts of the exam are equally evaluated in the final grade.
Required literature (available in the library and via other media)	E. Kreyszig, *Introductory functional analysis*, John Wiley and sons, New York, 1978. S. Kurepa, *Funkcionalna analiza*, Liber, Zagreb, 1992. J.J. Koliha, *Metrics, Norms, Integrals*, World Scientific, London, 2008.
Optional literature (at the time of submission of study programme proposal)	G. Bachman, L. Narici, *Functional analysis*, Dover Publications, New York, 2000. W. Rudin, *Functional analysis*, McGraw-Hill, New York, 1973.
Quality assurance methods that ensure the acquisition of exit competences	Exam statistics and students' quality evaluation through anonymous poles
Other (as the proposer wishes to add)	