

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
<b>Predmet:</b>		Funkcionalna analiza				
<b>Course title:</b>		Functional analysis				
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year	<b>Semester</b> Semester	
Magistrski študijski program Finančna matematika		ni smeri		1 ali 2	prvi ali drugi	
Master's study programme Financial Mathematics		none		1 or 2	first or second	
<b>Vrsta predmeta / Course type</b>				izbirni		
<b>Univerzitetna koda predmeta / University course code:</b>				M2116		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike</b> študija	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
45		30			105	6
<b>Nosilec predmeta / Lecturer:</b>		prof. Peter Šemrl, prof. Roman Drnovšek				
<b>Jeziki /</b> <b>Languages:</b>	<b>Predavanja /</b> <b>Lectures:</b>		slovenski/Slovene, angleški/English			
	<b>Vaje / Tutorial:</b>		slovenski/Slovene, angleški/English			
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>		
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>		

<p>Banachovi prostori. Linearni operatorji in funkcionali na Banachovih prostorih.</p> <p>Izrek o odprti preslikavi. Izrek o zaprtem grafu. Princip enakomerne omejenosti. Drugi dual.</p> <p>Adjungirani operator na Banachovem prostoru.</p> <p>Šibke topologije. Banach-Alaoglujev izrek.</p> <p>Krein-Milmanov izrek o ekstremnih točkah.</p> <p>Banachove algebre. Ideali in kvocienti. Spekter elementa. Rieszov funkcijski račun. Gelfandova transformacija.</p> <p><math>C^*</math>-algebre. Približne enote. Ideali in kvocienti. Komutativne <math>C^*</math>-algebre. Funkcijski račun v <math>C^*</math>-algebrah. Gelfand-Naimark-Segalova konstrukcija.</p>	<p>Banach spaces. Linear operators and functionals on Banach spaces. The open mapping theorem. The closed graph theorem. The principle of uniform boundedness. The second dual. The adjoint operator on a Banach space. Weak topologies. The Banach-Alaoglu theorem. The Krein-Milman theorem on extreme points. Banach algebras. Ideals and quotients. The spectrum of an element. Riesz functional calculus. The Gelfand transform. <math>C^*</math>-algebras. Approximate units. Ideals and quotients. Commutative <math>C^*</math>-algebras. The functional calculus in <math>C^*</math>-algebras. The Gelfand-Naimark-Segal construction.</p>
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#### Temeljni literatura in viri / Readings:

B. Bollobás: Linear Analysis : An Introductory Course, 2nd edition, Cambridge Univ. Press, Cambridge, 1999.

J. B. Conway: A Course in Functional Analysis, 2nd edition, Springer, New York, 1990.

Y. Eidelman, V. Milman, A. Tzolomitis: Functional Analysis : An Introduction, AMS, Providence, 2004.

M. Hladnik: Naloge in primeri iz funkcionalne analize in teorije mere, DMFA-založništvo, Ljubljana, 1985.

R. Meise, D. Vogt: Introduction to Functional Analysis, Oxford Univ. Press, Oxford, 1997.

G. K. Pedersen: Analysis Now, Springer, New York, 1996.

W. Rudin: Functional Analysis, 2nd edition, McGraw-Hill, New York, 1991.

I. Vidav: Linearni operatorji v Banachovih prostorih, DMFA-založništvo, Ljubljana, 1982.

- I. Vidav: Banachove algebre, DMFA-založništvo, Ljubljana, 1982.

I. Vidav: Uvod v teorijo  $C^*$ -algeber, DMFA-založništvo, Ljubljana, 1982.

**Cilji in kompetence:**

Slušatelj spozna osnove funkcionalne analize in povezavo z drugimi področji analize.

**Objectives and competences:**

Students learn the basics of functional analysis and links with other areas of analysis.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Obvladanje osnovnih pojmov funkcionalne analize. Sposobnost rekonstrukcije (vsaj lažjih) dokazov. Sposobnost aplikacije pridobljenega znanja.

Uporaba: Uporaba funkcionalne analize sega tudi v naravoslovje in druga področja znanosti kot na primer ekonomijo.

Refleksija: Razumevanje teorije na podlagi uporabe.

Prenosljive spretnosti – niso vezane le na en predmet: Sposobnost abstraktnega razmišljanja. Spretnost uporabe domače in tuje literature.

**Intended learning outcomes:**

Knowledge and understanding: Understanding basic concepts of functional analysis. Ability of the reconstruction (at least easier) proofs. Ability of the application of acquired knowledge.

Application: Functional analysis is used in natural sciences and other areas of science such as economics.

Reflection: Understanding of the theory on the basis of examples.

Transferable skills: Ability to use abstract methods to solve problems. Ability to use a wide range of references and critical thinking.

**Metode poučevanja in učenja:**

predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

Lectures, exercises, homeworks, consultations

**Načini ocenjevanja:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):  
domače naloge

Delež (v %) /

Weight (in %)

**Assessment:**

Type (examination, oral, coursework, project):  
homeworks

10%  
50%

izpit iz vaj		written exam
ustni izpit		oral exam
Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	40%	Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

**Reference nosilca / Lecturer's references:**

Roman Drnovšek:

- DRNOVŠEK, Roman. Common invariant subspaces for collections of operators. Integral equations and operator theory, ISSN 0378-620X, 2001, vol. 39, no. 3, str. 253-266 [COBISS.SI-ID 10597721]
- DRNOVŠEK, Roman. Invariant subspaces for operator semigroups with commutators of rank at most one. Journal of functional analysis, ISSN 0022-1236, 2009, vol. 256, iss. 12, str. 4187-4196 [COBISS.SI-ID 15167321]
- DRNOVŠEK, Roman. An infinite-dimensional generalization of Zenger's lemma. Journal of mathematical analysis and applications, ISSN 0022-247X. [Print ed.], 2012, vol. 388, iss. 2, str. 1233-1238 [COBISS.SI-ID 16214617]

Peter Šemrl:

- ŠEMRL, Peter. Applying projective geometry to transformations on rank one idempotents. Journal of functional analysis, ISSN 0022-1236, 2004, vol. 210, no. , str. 248-257 [COBISS.SI-ID 13012825]
- ŠEMRL, Peter. Similarity preserving linear maps. Journal of operator theory, ISSN 0379-4024, 2008, vol. 60, no. 1, str. 71-83 [COBISS.SI-ID 15079257]
- ŠEMRL, Peter. Symmetries on bounded observables: a unified approach based on adjacency preserving maps. Integral equations and operator theory, ISSN 0378-620X, 2012, vol. 72, iss. 1, str. 7-66 [COBISS.SI-ID 16568665]