UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2016/17)			
Predmet:	Uvod v funkcionalno analizo		
Course title:	Introduction to functional analysis		

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **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

Vrsta predmeta / Course type	izbirni / elective

Univerzitetna koda predmeta / University course code:	M2111

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike** **študija**	**Samost. delo** **Individ. work**		**ECTS**
45		30			105		6

Nosilec predmeta / Lecturer:	prof. dr. Roman Drnovšek, prof. dr. Bojan Magajna, prof. dr. Peter Šemrl

Jeziki / **Languages:**	**Predavanja /** **Lectures:**	slovenski / Slovene, angleški / English
	Vaje / Tutorial:	slovenski / Slovene, angleški / English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vpis v letnik študija.	Enrolment in the programme.

Vsebina:	**Content (Syllabus outline):**

Hilbertovi prostori. Ortonormirani sistemi. Besslova neenakost. Kompletnost. Fouriereve vrste. Parsevalova enakost.	Hilbert spaces. Orthonormal systems. Bessel's inequality. Completeness. Fourier series. Parseval's identity.
Linearni operatorji in funkcionali na Hilbertovih prostorih.	Linear operators and functionals on Hilbert spaces.The representation of a continuous linear functional.Adjoint operator. Selfadjoint and normal operators.Projectors and idempotents. Invariant subspaces.Compact operators. The spectrum of a compact operator.Diagonalization of a selfadjoint compact operator.An application: Sturm-Liouville systems.Banach spaces. Examples.Linear operators and functionals on Banach spaces.Finite dimensional normed spaces. Quotients and products of normed spaces.The Hahn-Banach theorem and consequences. Separation of convex sets.
Reprezentacija zveznega linearnega funkcionala.	
Adjungirani operator. Sebiadjungirani in normalni operatorji.	
Projektorji in idempotenti. Invariantni podprostori.	
Kompaktni operatorji. Spekter kompaktnega operatorja.	
Diagonalizacija kompaktnega sebiadjungiranega operatorja.	
Uporaba: Sturm-Liouvillovi sistemi.	
Banachovi prostori. Primeri.	
Linearni operatorji in funkcionali na Banachovih prostorih.	
Končnorazsežni normirani prostori. Kvocienti in produkti normiranih prostorov.	
Hahn-Banachov izrek in posledice. Separacija konveksnih množic.	

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. Tsolomitis: Functional Analysis : An Introduction, AMS, Providence, 2004.

D. H. Griffel: Applied Functional Analysis, Dover Publications, Mineola, 2002.

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

E. Zeidler: Applied Functional Analysis : Main Principles and Their Applications, Springer, New York, 1995.

Cilji in kompetence:

Študent spozna osnovne pojme teorije Hilbertovih prostorov in linearnih operatorjev med njimi. Z njeno uporabo se seznani pri reševanju Sturm-Liouvillovega problema. Nekoliko spozna tudi teorijo Banachovih prostorov, ki so posplošitev Hilbertovih prostorov.

Objectives and competences:

Students acquire basic knowledge of the theory of Hilbert spaces and linear operators between them. The theory is applied for solving simple Sturm-Liouville problems. Students also learn some basic concepts from the theory of Banach spaces, which are a generalization of Hilbert spaces.

Predvideni študijski rezultati:

Znanje in razumevanje: Razumevanje teorije Hilbertovih prostorov s teoretičnega in uporabnega vidika.
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 of the theory of Hilbert spaces.

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:

Learning and teaching methods:

predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homeworks, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): domače naloge izpit iz vaj ustni izpit Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	 10% 50% 40%	Type (examination, oral, coursework, project): homeworks written exam oral exam Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Roman Drnovšek:

DRNOVŠEK, Roman. An irreducible semigroup of idempotents. Studia Mathematica, ISSN 0039-3223, 1997, let. 125, št. 1, str. 97-99. [COBISS.SI-ID 7436633]

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]

Bojan Magajna:

MAGAJNA, Bojan. On tensor products of operator modules. Journal of operator theory, ISSN 0379-4024, 2005, vol. 54, no. 2, str. 317-337. [COBISS.SI-ID 13920089]

MAGAJNA, Bojan. Duality and normal parts of operator modules. Journal of functional analysis, ISSN 0022-1236, 2005, vol. 219, no. 2, str. 306-339. [COBISS.SI-ID 13366105]

MAGAJNA, Bojan. On completely bounded bimodule maps over W[ast]-algebras. Studia

Mathematica, ISSN 0039-3223, 2003, t. 154, fasc. 2, str. 137-164. [COBISS.SI-ID 12278105]

Peter Šemrl:

ŠEMRL, Peter, VÄISÄLÄ, Jussi. Nonsurjective nearisometries of Banach spaces. Journal of functional analysis, ISSN 0022-1236, 2003, vol. 198, no. 1, str. 268-278. [COBISS.SI-ID 12371545]

ŠEMRL, Peter. Generalized symmetry transformations on quaternionic indefinite inner product spaces: an extension of quaternionic version of Wigner's theorem. Communications in Mathematical Physics, ISSN 0010-3616, 2003, vol. 242, no. 3, str. 579-584. [COBISS.SI-ID 12770649]

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]