

| UČNI NAČRT PREDMETA / COURSE SYLLABUS | | | | | | |
|--|---|--|-------------------------------------|------------------------------------|---|-------------|
| 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 | | |
| 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. Bojan Peter Magajna, prof. Peter Šemrl, prof. Roman Drnovšek | | | | |
| 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: | | |
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| Vsebina: | | | | Content (Syllabus outline): | | |
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| <p>Hilbertovi prostori. Ortonormirani sistemi. Besslova neenakost. Kompletnost. Fouriereve vrste. Parsevalova enakost.</p> <p>Linearni operatorji in funkcionali na Hilbertovih prostorih.</p> <p>Reprezentacija zveznega linearnega funkcionala.</p> <p>Adjungirani operator. Sebiadjungirani in normalni operatorji.</p> <p>Projektorji in idempotenti. Invariantni podprostori.</p> <p>Kompaktni operatorji. Spekter kompaktnega operatorja.</p> <p>Diagonalizacija kompaktnega sebiadjungiranega operatorja.</p> <p>Uporaba: Sturm-Liouvillovi sistemi.</p> <p>Banachovi prostori. Primeri.</p> <p>Linearni operatorji in funkcionali na Banachovih prostorih.</p> <p>Končnorazsežni normirani prostori. Kvocienti in produkti normiranih prostorov.</p> <p>Hahn-Banachov izrek in posledice. Separacija konveksnih množic.</p> | <p>Hilbert spaces. Orthonormal systems. Bessel's inequality. Completeness. Fourier series. Parseval's identity.</p> <p>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.</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.
- 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 seznanj pri reševanju Sturm-Liouville 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:

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

Reference nosilca / Lecturer's references:

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| <p>Roman Drnovšek:</p> <ul style="list-style-type: none"> - DRNOVŠEK, Roman. An irreducible semigroup of idempotents. <i>Studia Mathematica</i>, ISSN 0039-3223, 1997, let. 125, št. 1, str. 97-99 [COBISS.SI-ID 7436633] - DRNOVŠEK, Roman. Common invariant subspaces for collections of operators. <i>Integral equations and operator theory</i>, 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. <i>Journal of functional analysis</i>, ISSN 0022-1236, 2009, vol. 256, iss. 12, str. 4187-4196 [COBISS.SI-ID 15167321] <p>Bojan Peter Magajna:</p> <ul style="list-style-type: none"> - MAGAJNA, Bojan. On completely bounded bimodule maps over $W[\ast]$-algebras. <i>Studia Mathematica</i>, ISSN 0039-3223, 2003, t. 154, fasc. 2, str. 137-164 [COBISS.SI-ID 12278105] - MAGAJNA, Bojan. Duality and normal parts of operator modules. <i>Journal of functional analysis</i>, ISSN 0022-1236, 2005, vol. 219, no. 2, str. 306-339 [COBISS.SI-ID 13366105] - MAGAJNA, Bojan. On tensor products of operator modules. <i>Journal of operator theory</i>, ISSN 0379-4024, 2005, vol. 54, no. 2, str. 317-337 [COBISS.SI-ID 13920089] <p>Peter Šemrl:</p> |
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- 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]