Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Osnove teorije mere
Course title:	Basic measure theory

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika, 2. stopnja		**1. ali 2.**	**1. ali 3.**
Mathematics, 2nd degree		**1. or 2.**	**1. or 3.**

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45		**30**			**135**	**7**

Nosilec predmeta / Lecturer: Valerij Romanovskij

Jeziki / Languages:	**Predavanja / Lectures:**	SLOVENSKO/SLOVENE
	Vaje / Tutorial:	SLOVENSKO/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisits:

Vsebina:

- Osnovni pojmi teorije mere: Algebra, σ-algebra, Borelova σ-algebra na R^n. Mere in osnovne lastnosti mer. Merljivi prostori. Pozitivne mere. Zunanje mere. Lebesgueova mera na R^n.
- Funkcije in integrali: Merljive funkcije. Stopničaste funkcije. Integral stopničaste funkcije. Integral merljive funkcije. Izrek o monotoni konvergenci. Fatoujeva lema in Lebesgueov izrek o dominantni konvergenci. Povezanost Riemannovega in Lebesgueovega integrala.

Content (Syllabus outline):

- Basic concepts of measure theory: Algebra, σ-algebra, Borel σ-algebra on R^n. Measure and its basic properties. Measurable spaces. Positive measures. Outer measures. Lebesgue measure on R^n.
- Functions and integrals: Measurable functions. Simple measurable functions. The integral of a simple measurable function. The integral of a measurable function. The monotone convergence theorem. Fatou's lemma and Lebesgue's dominated convergence theorem. Relationships between

• Konvergenca: Zaporedja merljivih funkcij in konvergenca. Konvergenca skoraj povsod. Norma in normirani L^p-prostori. Neenakosti (Hölder, Minkowski). Dualni prostori. • Predznačne in kompleksne mere: Predznačne mere in Hahnov razcepni izrek. Kompleksne mere in Radon-Nikodymov izrek. Funkcije z omejeno varianco. • Lebesgue-Stieltjesov integral.	Riemann's and Lebesgue's integral. • Convergence: Sequences of measurable functions and convergence. Convergence almost everywhere. Norm and normed L^p-spaces. Inequalities (Hölder, Minkowski). Dual spaces. • Signed and complex measures: Signed measures and the Hahn decomposition theorem. Complex measures and the Radon-Nikodym theorem. Functions of bounded variation. • Lebesgue-Stieltjes integral

Temeljni literatura in viri / Readings:

1. M. Capinski, E. Kopp: *Measure, integral and probability*, Springer-Verlag London, 2004.
2. D. L. Cohn: *Measure theory*, Birkhäuser, 1994.
3. R. Drnovšek: *Rešene naloge iz teorije mere*, DMFA, 2001.
4. M. Hladnik: *Naloge in primeri iz funkcionalne analize in teorije mere*, DMFA, 1985.
5. W. Rudin: *Real and complex analysis, 3th edition*, Mc-Graw-Hill, 1986.
6. H. Sohrab, *Basic real analysis*, Birkhauser Boston, 2003.
7. I. Vidav, *Višja matematika II*, DZS, Ljubljana, 1975.

Cilji in kompetence:	**Objectives and competences:**
Glavni cilj predmeta je proučiti temeljne koncepte in rezultate teorije mere.	The main goal of the course is to study the fundamental concepts and results of measure theory.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • merljivi prostori, merljive funkcije, abstraktno integriranje, izreki o konvergenci, L^p-prostori, produktne mere, odvodi mer. Prenesljive/ključne spretnosti in drugi atributi: Poznavanje osnov teorije mere je podlaga za študij različnih matematičnih področij (funkcionalne analize, verjetnosti, parcialnih diferencialnih enačb itd.).	Knowledge and Understanding: • Measurable spaces, measurable functions, abstract integration, convergence theorems, L^p-spaces, product measures, differentiation of measures. Transferable/Key Skills and other attributes: Knowing the fundamentals of measure theory is a prerequisite for studying various mathematical areas (functional analysis, probability, partial differential equations etc.).

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Teoretične vaje	• Lectures • Theoretical exercises

Načini ocenjevanja: **Assessment:**

Način (pisni izpit, ustno izpraševanje,	Delež (v %) /	Type (examination, oral, coursework,

naloge, projekt) • Pisni izpit – problemi • Pisni izpit – teoretija Pisni izpit - problemi se lahko nadomesti z dvema delnima testoma (sprotni obveznosti) Pisni izpit - teorja se lahko nadomesti z dvema delnima testoma (sprotni obveznosti) Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.	Weight (in %) 50% 50%	project): • Written exam – problems • Written exam – theory Written exam – problems can be replaced by two parital tests (mid-term testing) Written exam – theory can be replaced by two parital tests (mid-term testing) Each of the mentioned commitments must be assessed with a passing grade.
Reference nosilca / Lecturer's references:		

1. CHEN, Xingwu, GINÉ, Jaume, ROMANOVSKI, Valery, SHAFER, Douglas. The 1: -q resonant center problem for certain cubic Lotka-Volterra systems. *Appl. math. comput.*. [Print ed.], Aug. 2012, vol. 218, iss. 32, str. 11620-11633. http://dx.doi.org/10.1016/j.amc.2012.05.045, doi: 10.1016/j.amc.2012.05.045. [COBISS.SI-ID 19321352]

2. BASOV, Vladimir V., ROMANOVSKI, Valery. Linearization of two-dimensional systems of ODEs without conditions on small denominators. *Appl. math. lett.*. [Print ed.], 2012, vol. 25, iss. 2, str. 99-103. http://dx.doi.org/10.1016/j.aml.2011.06.029, doi: 10.1016/j.aml.2011.06.029. [COBISS.SI-ID 18675208]

3. LEVANDOVSKYY, Viktor, PFISTER, Gerhard, ROMANOVSKI, Valery. Evaluating cyclicity of cubic systems with algorithms of computational algebra. *Commun. pure appl. anal.*, 2012, vol. 11, no. 5, str. 2023-2035, doi: 10.3934/cpaa.2012.11.2023. [COBISS.SI-ID 19075080]

4. WENTAO, Huang, CHEN, Xingwu, ROMANOVSKI, Valery. Linear centers with perturbations of degree 2d + 5. *Int. j. bifurc. chaos appl. sci. eng.*, 2012, vol. 22, no. 1, str. [1250007-1 - 1250007-12]. http://www.ejournals.wspc.com.sg/ijbc/22/2201/S0218127412500071.html, doi: 10.1142/S0218127412500071. [COBISS.SI-ID 69213185]

5. HAN, Maoan, ROMANOVSKI, Valery. Isochronicity and normal forms of polynomial systems of ODEs. *J. symb. comput.*, Oct. 2012, vol. 47, iss. 10, str. 1163-1174. http://dx.doi.org/10.1016/j.jsc.2011.12.039, doi: 10.1016/j.jsc.2011.12.039. [COBISS.SI-ID 19324168]