DOCTORAL (PHD) STUDIES
COURSE DESCRIPTION

Course title	Field of science	Faculty	Institute
Functional Analysis	Mathematics (N 001)	Faculty of Mathematics and Informatics	Institute of Applied Mathematics
Study method	Number of credits	Study method	Number of credits
Lectures	2	Consultations	1
Individual work	7	Seminars	0

Course summary
1. **Sets and relations**. Basic concepts and axioms. 2. **Metric spaces**. Sets of metric spaces. Complete metric spaces. Contraction mapping. Baire category theorem. Separable spaces. 3. **Topological spaces**. Bases. Nets. Continuous functions. Compact spaces. Topological vector spaces. 4. **Compactness in metric spaces**. 5. **Linear spaces**. Convex sets and functionals. Hahn–Banach theorem. 6. **Normed vector spaces and their geometric properties**. Banach spaces. Spaces with Schauder basis. 7. **Inner product spaces**. Hilbert spaces. Fourier series. 8. **Linear functionals.** Dual continuous space. Weak topologies. Distributions. 9. **Continuous linear operators.** Uniform boundedness principle. Closed graph theorem. Inverse, regular and adjoint operators. Compact operators. 10. **Elements of spectral theory.** Spectrum and resolvent. Spectrum of self-adjoint operators.. 11. **Linear equations**. Fredholm – Riesz – Schauder theory. 12. **Differential calculus**. Fréchet, Gateaux derivatives. Higher order derivatives, Taylor formula. Newton's method. 13. **Nonlinear equations**. Schauder principle. Fixed point theorems. **Total number of contact hours: 64 academic hours.**
Main literature
1. V. Paulauskas, A. Račkauskas. *Funkcinė analizė*. I knyga. Erdvės; II knyga. Funkcijos ir lygtys. 2007, Vilnius.
2. A.N. Kolmogorov, S.V. Fomin. *Introductory Real Analysis*. Dover, New York, 1970
3. G. K Pedersen. *Analysis Now*. 1988, Springer, New York.
4. D.H. Griffel. *Applied Functional Analysis*. 1981, Wiley, New York.

Consulting teacher	Scientific degree	Pedagogical name	Main publications in the field of science of the last 5 year period
Artūras Štikonas	Dr. (HP)	Prof.	1. K. Bingelė, A. Bankauskienė, A. Štikonas. Spectrum curves for a discrete Sturm–Liouville problem with one integral boundary condition. *Nonlinear Anal. Model. Control*, 24(5):755–774, 2019. https://doi.org/10.15388/NA.2019.5.5 2. M. Sapagovas, J. Novickij, A. Štikonas. Stability analysis of a weighted difference scheme for two-dimensional hyperbolic equations with integral conditions. *Electron. J. Differential Equations*, 2019(04):1–13, 2019. https://ejde.math.txstate.edu/Volumes/2019/04/abstr.html 3. K. Bingelė, A. Bankauskienė, A. Štikonas. Investigation of spectrum curves for a Sturm–Liouville problem with two-point nonlocal boundary conditions. *Math. Model. Anal.*, 25(1):53–70, 2020. https://doi.org/10.3846/mma.2020.10787

			4. E. Şen, A. Štikonas. Asymptotic distribution of eigenvalues and eigenfunctions of a nonlocal boundary value problem. *Math. Model. Anal*., 26(2):253–266, 2021. https://doi.org/10.3846/mma.2021.13056 5. A. Štikonas, E. Şen. Asymptotic analysis of Sturm–Liouville problem with nonlocal integral-type boundary condition. *Nonlinear Anal. Model. Control*, 26(5):969–991, 2021. https://doi.org/10.15388/namc.2021.26.24299
Alfredas Račkauskas	Habil. dr.	Prof.	1. A. Račkauskas. Asymptotic normality of sums of Hilbert space valued random elements. *Georgian mathematical journal.* 28(3):459–469, 2021. https://doi.org/10.1515/gmj-2019-2075 2. R. Norvaiša, A. Račkauskas. Uniform asymptotic normality of weighted sums of short-memory linear processes. *Journal of applied probability*, 57(1):174–195, 2020. https://doi.org/10.1017/jpr.2019.86 3. A. Račkauskas, M. Wendler. Convergence of U-processes in Holder spaces with application to robust detection of a changed segment. *Statistical papers*, 61(4):1409–1435 https://doi.org/10.1007/s00362-020-01161-9 4. A. Račkauskas, Ch. Suquet. On Bernstein-Kantorovich invariance principle in Holder spaces and weighted scan statistics, *ESAIM: probability and statistics,* 24:186–206, 2020. https://doi.org/10.1051/ps/2019027 5. R. Norvaiša, A. Račkauskas. Uniform asymptotic normality of self-normalized weighted sums of random variables *Lithuanian mathematical journal,* 59(4): 575–594, 2019 https://doi.org/10.1007/s10986-019-09461-w

Approved by the Board of Faculty of Mathematics and Informatics 10/12/2021. Resolution No. (1.5 E) 110000-TPN-42
Board Chairman – assoc. prof. dr. Kristina Lapin