Załącznik Nr 5 do Zarz. Nr 33/11/12

(*faculty stamp*) **COURSE DESCRIPTION**

1. Course title: INTRODUCTION TO ALGEBRAIC DYNAMICS	**2. Course code: WM1**
3. Validity of course description: 2018/2019	
4. Level of studies: 2nd cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: MATHEMATICS	(FACULTY SYMBOL) RMS
7. Profile of studies: general	
8. Programme: all	
9. Semester: III	
10. Faculty teaching the course: Faculty of Applied Mathematics	
11. Course instructor: professor Bogdana Oliynyk	
12. Course classification: course of limited choice	
13. Course status: monographic	
14. Language of instruction: English	
15. Pre-requisite qualifications: Mathematical Analysis, Algebra, Topology, Graph Theory, English.	
16. Course objectives: The aim of the course is to familiarize students with fundamental notions and problems of Dynamical Systems and to study connections of dynamic systems with different algebraic objects.	

17. Description of learning outcomes:

A student who completes the course successfully should

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	understand notions of dynamic system, periodic point of a dynamical system, fixed point of a dynamical system, know examples of dynamic systems	test	lecture class	K2A_W03 K2A_W04 K2A_W05 K2A_K01 K2A_K06
2.	understand notion of algebraic dynamical system over some field K	test	lecture class	K2A_W03 K2A_W04 K2A_W05 K2A_K01 K2A_K06
3.	understand notion of shift space, know examples of shift spaces, characterize shift spaces in terms of languages	test	lecture class	K2A_U12 K2A_U13 K2A_K02
4.	construct graph representations of shifts of finite type	test	lecture class	K2A_U12 K2A_U13 K2A_K02
5.	know basic concepts and results of Perron-Frobenius theory	test	lecture class	K2A_W03 K2A_W04 K2A_W05 K2A_K01
6.	compute entropy of shifts spaces	test	lecture class	K2A_U12 K2A_U13

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Lecture 30h. Class 30h.

19. Syllabus description:

Lecture: Semigroups, monoids and groups: basic concepts and examples. Metric spaces: basic concepts and examples. The notion of a dynamical system. Circle rotations. Sharkovsky's Theorem. The notion of an algebraic dynamical system over some field K. Shift spaces. Examples. Languages of shift spaces. Sliding block codes. Examples. Characterization of a shift space in metric terms. Curtis-Lyndon-Hedlund Theorem. Shifts of finite type. Graph representations of shifts of finite type. Data storage and shifts of finite type. Sofic shifts. Characterizations of sofic shifts. Perron-Frobenius theory. Computing entropy of shifts spaces.

Class: Solve exercise approach to theory and examples presented at lecture

20. Examination: no

21. Primary sources:

1. D. Lind, B. Marcus. An introduction to symbolic dynamics and coding, Cambridge University Press, 1995.
2. M. Brin, G. Stuck. Introduction to Dynamical Systems, Cambridge University Press, 2002.
3. B. Hasselblat, A. Katok. A first course in dynamics: with a panorama of recent developments, Cambridge University Press, 2003.
4. V. Anashin, A. Khrennikov, Algebraic Dynamics, De Gruyter Expositions in Mathematics 49, 2017.

22. Secondary sources:

1. B. P. Kitchens, Symbolic Dynamics: One-Sided, Two Sided and Countable State Markov Shifts, Springer, New York, 1998.
2. Shlomo Sternberg. Dynamical Systems. Online book. http://www.math.harvard.edu/library/sternberg/text/book.pdf
3. P. Kurka, Topological and symbolic dynamics, Cours Specialises [Specialized Courses], 11. Societe Mathematique de France, Paris, 2003.
4. Combinatorics, Words and Symbolic Dynamics (Encyclopedia of Mathematics and its Applications), edited by Valérie Berthé, Michel Rigo, Cambridge University Press, 2016.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/30
2	Classes	30/30
3	Laboratory	/
4	Project	/
5	BA/ MA Seminar	/
6	Other: consultations, use of e-learning webpage	/
	Total number of hours	60/60

24. Total hours: 120

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 4

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 0

26. Comments:

Test I – 25 points, Test II – 25 points, Test III – 25 points, Test IV – 25 points,

To pass, it is necessary to obtain a total of 41 points, including at least 30% of the points of each learning outcome component.

Approved:

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(date, Instructor's signature)

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(date , the Director of the Faculty Unit signature)