Attachment No. 5 to Rector's ordinance No. 22/2020

DESCRIPTION OF THE COURSE OF STUDY

Course code	0541.6.MAT2.D.TFRAK	
Name of the course in	Polish	**Teoria fraktali**
	English	**Fractals Theory**

1. LOCATION OF THE COURSE OF STUDY WITHIN THE SYSTEM OF STUDIES

1.1. Field of study	mathematics
1.2. Mode of study	full-time studies
1.3. Level of study	Graduate (Master)
1.4. Profile of study*	general academic profile of studies
1.5. Person/s preparing the course description	dr Magdalena Nowak
1.6. Contact	mnowak@ujk.edu.pl

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Language of instruction	Polish and English
2.2. Prerequisites*	Topology II, Mathematical Analysis III

3. DETAILED CHARACTERISTICS OF THE COURSE OF STUDY

3.1. Form of classes		lectures and classes
3.2. Place of classes		classes in the UJK teaching room
3.3. Form of assessment		graded credit
3.4. Teaching methods		lecture – information lecture classes– subject exercises
3.5. Bibliography	**Required reading**	Barnsley M.F.: Fractals everywhere, 2nd ed. Academic Press, Boston,1993
	Further reading	Falconer K.: Fractal geometry. Mathematical foundations and applications. John Wiley & Sons, Chichester, 1990 Mackey M.C., Lasota A.: Chaos, Fractals, and Noise: Stochastic Aspects of Dynamics (Applied Mathematical Sciences), Springer; 2nd edition (October 22, 1993) Engelking R.: Topologia ogólna. PWN, Warszawa 1976

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

4.1. Course objectives *(including form of classes)*

Lectures

C1 - familiarization with the issues of classical fractal theory and its applications in computer graphics.

Classes

C1 - the ability to generate fractal structures and their application in computer graphics and long symbolic strings analysis (e.g., DNA sequences).

C2 - the ability to self-educate.

4.2. Detailed syllabus *(including form of classes)*

Lectures

1. Concept of fractal and space of fractals.
2. Hausdorff metric and its properties.
3. Iterated functional systems and their attractors.
4. Fractal dimension.
5. Examples of fractals and their properties. Cantor set, Julia sets, Mandelbrot set.
6. Fractal graphics.
7. Elements of the theory of dynamical systems.

Classes

1. Transformations of the plane.
2. Construction of iterated functional systems (with condensation) and their attractors.
3. Analysis of properties of selected fractals - Cantor set, Julia sets, Mandelbrot set.
4. Fractal graphics - generation of fractal images on the computer.

4.3 Intended learning outcomes

Code	A student, who passed the course	Relation to learning outcomes
within the scope of **KNOWLEDGE:**		
W01	knows the basic terminology and defines the classical problems of fractal theory	MAT2A_W01

		MAT2A_W02
W02	has an in-depth knowledge in fractal theory, knows most of the definitions and theorems and their proofs	MAT2A_W01 MAT2A_W02
W03	knows algorithms and techniques for creating fractal structures and understands their limitations	MAT2A_W01 MAT2A_W04
within the scope of **ABILITIES:**		
U01	is able to use basic topological properties of sets, functions and plane transformations to analyze fractals	MAT2A_U11
U02	analyzes attractors of iterated function systems and identifies the mechanisms of their origin	MAT2A_U11
U03	discusses algorithms with good numerical properties for drawing fractals and analyzing long sequences of symbols	MAT2A_U11 MAT2A_U15
U04	identifies fractal structures in mathematical objects and in the surrounding world	MAT2A_U11
within the scope of **SOCIAL COMPETENCE:**		
K01	plans his work	MAT2A_K01

4.4. Methods of assessment of the intended learning outcomes

Teaching outcomes *(code)*	**Method of assessment (+/-)**																				
	Exam oral/written*			**Test***			**Project***			**Effort in class***			**Self-study***			**Group work***			**Others* e.g. standard-ized test used in e-learning**		
	Form of classes			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***			***Form of classes***		
	L	*C*	*...*	*L*	*C*	*...*	*L*	*C*	*...*	*L*	*C*	*...*	*L*	*C*	*...*	*L*	*C*	*...*	*L*	*C*	*..*
W01				+						+	+		+	+							
W02				+						+	+		+	+							
W03				+						+	+		+	+							
U01					+					+	+		+	+							
U02					+					+	+		+	+							
U03					+					+	+		+	+							
U04					+					+	+		+	+							
K01					+					+	+		+	+							

delete as appropriate

4.5. Criteria of assessment of the intended learning outcomes

Form of classes	**Grade**	**Criterion of assessment**
lecture (L) (including e-learning)	**3**	at least 50% and no more than 60% of the total number of points possible
	3,5	more than 60% and no more than 70% of the total number of points possible
	4	more than 70% and no more than 80% of the total number of points possible
	4,5	more than 80% and no more than 90% of the total number of points possible
	5	more than 90% of the total number of points possible
classes (C)* (including e-learning)	**3**	at least 50% and no more than 60% of the total number of points possible
	3,5	more than 60% and no more than 70% of the total number of points possible
	4	more than 70% and no more than 80% of the total number of points possible
	4,5	more than 80% and no more than 90% of the total number of points possible
	5	more than 90% of the total number of points possible

5. BALANCE OF ECTS CREDITS – STUDENT'S WORK INPUT

Category	**Student's workload**	
	Full-time studies	**Extramural studies**
NUMBER OF HOURS WITH THE DIRECT PARTICIPATION OF THE TEACHER /CONTACT HOURS/	***47***	
*Participation in lectures**	15	
*Participation in classes, seminars, laboratories**	30	
*Participation in the exam/ final test**	2	

INDEPENDENT WORK OF THE STUDENT/NON-CONTACT HOURS/	***53***	
*Preparation for the lecture**	10	
*Preparation for the classes, seminars, laboratories**	20	
*Preparation for the exam/test**	23	
TOTAL NUMBER OF HOURS	***100***	
ECTS credits for the course of study	***4***	

delete as appropriate

Accepted for execution *(date and legible signatures of the teachers running the course in the given academic year)*

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