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

DESCRIPTION OF THE COURSE OF STUDY

Course code	0541.6.MAT1.D.TKAT	
Name of the course in	Polish	**Teoria kategorii**
	English	**Category 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	Undergraduate (Bachelor)
1.4. Profile of study*	general academic profile of studies
1.5. Person/s preparing the course description	dr Joanna Garbulińska-Węgrzyn
1.6. Contact	jgarbulinska@ujk.edu.pl

2. GENERAL CHARACTERISTICS OF THE COURSE OF STUDY

2.1. Language of instruction	Polish and English
2.2. Prerequisites*	Topology I, Mathematical Analysis IV

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		Exam (lectures), graded credit (classes)
3.4. Teaching methods		Lectures – information lecture Classes - discussions, solving problems
3.5. Bibliography	**Required reading**	A. Asperti, G. Longo, Categories, Types and Structures. An introduction to Category Theory for the working Computer Scientist, MIT Press, 1991. M. Barr, C. Wells, Category Theory for Computing Science, Cambridge University Press, 1995. S. MacLane, Categories for the Working Mathematician, Springer 1991.
	Further reading	S. Awodey Category theory. Wykład z uniwersytetu Carnegie Mellon. http://www.andrew.cmu.edu/course/80-413-713/notes/ D. Turi, Category Theory Lecture Notes. Wykład z uniwersytetu w Edynburgu. http://www.dcs.ed.ac.uk/home/dt/CT/

4. OBJECTIVES, SYLLABUS CONTENT AND INTENDED LEARNING OUTCOMES

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

Lecture:

C1. To familiarize students with examples of categories, categorical properties of pullback and pushout.
C2. To present the basic properties of diagrams, limits and colimits for universal constructions.

Classes:
C1. Acquisition of basic skills in the use of the category properties of pullbacks and pushouts.
C2. Application of facts from category theory to the construction of universal objects in other branches of mathematics.
C3. Formation of attitudes for proper student self-evaluation.

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

Lectures

1. Category theory as an abstract theory of functions: definition, examples: discrete category, concrete category, Pos, monoids, groups as categories, etc., isomorphisms, set theory fundamentals: small, large, locally small categories.
2. Special morphisms: monomorphisms and epimorphisms, sections and retractions, generalized elements.
3. Principle of duality and simple universal constructions: products and coproducts, pullbaks and pushouts, equalizers and coequalizers, final and initial object, properties of pullbaks.
4. Natural functors and transformations: concept of functor, examples, forgetting functors, full and faithful functors, natural transformations; natural isomorphisms.
5. Equivalence of categories: Stone duality. Diagrams, limits and colimits: universal constructions as limits, preservation of limits by functors; continuous functors, limits in categories of functors, complete and cocomplete categories.

Classes

1. Category theory as an abstract theory of functions: definition, examples: discrete category, concrete category, Pos, monoids, groups as categories, etc., isomorphisms, set theory fundamentals: small, large, locally small categories.
2. Special morphisms: monomorphisms and epimorphisms, sections and retractions, generalized elements.
3. Principle of duality and simple universal constructions: products and coproducts, pulbaks and pushouts, equalizers and coequalizers, final and initial object, properties of pullbaks.

4. Natural functors and transformations: concept of functor, examples, forgetting functors, full and faithful functors, natural transformations; natural isomorphisms.
5. Equivalence of categories: Stone duality. Diagrams, limits and colimits: universal constructions as limits, preservation of limits by functors; continuous functors, limits in categories of functors, complete and cocomplete categories.

4.3 Intended learning outcomes

Code	A student, who passed the course	Relation to learning outcomes
within the scope of **KNOWLEDGE:**		
W01	Defines the basic concepts of category theory	MAT1A_W01 MAT1A_W03 MAT1A_W04 MAT1A_W17
W02	Defines basic category properties such as pullbaks and pushouts	MAT1A_W02 MAT1A_W03 MAT1A_W04
W03	Explains the applications of diagrams, limits, and colimits to the construction of universal objects from various areas of mathematics	MAT1A_W01
within the scope of **ABILITIES:**		
U01	Constructs universal objects using the properties of diagrams, limits and colimits	MAT1A_U01 MAT1A_U19
U02	Determines special objects in defined categories: final and initial object	MAT1A_U01 MAT1A_U19
U03	Determines special morphisms in the given category	MAT1A_U01 MAT1A_U19
within the scope of **SOCIAL COMPETENCE:**		
K01	Precisely formulates questions, serving to deepen one's own understanding of the essence of the subject area	MAT1A_K02

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. standardized 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					+			+		+	+		+	+							
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	
*Preparation in the exam/ final test**	2	
*Others (please specify e.g. e-learning)**		
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	
*Gathering materials for the project/Internet query**		
Preparation of multimedia presentation		
*Others **		
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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