Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-000000J-0122	Name of the course	Polish	**Stosowane struktury uporządkowane**	
			English	**Applied ordered structures**	
Type of the course	Specialty subjects				
Course coordinator	Dr hab. Inż. Anna Zamojska-Dzienio		Course teacher	Dr hab. Inż. Anna Zamojska-Dzienio	
Implementing unit	MiNI	Scientific discipline / disciplines*	mathematics		
Level of education	Doctoral studies	Semester	spring		
Language of the course	English				
Type of assessment	Grading	Number of hours in a semester	45	ECTS credits	3
Minimum number of participants	10	Maximum number of participants	30	Available for students (BSc, MSc)	Yes/~~No~~

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	2	1			
	in a semester	30	15			
Estimated date for the implementation of the course	day of the week	Wednesday		Teaching location	Building	Room number
	hours	16:15-19:00				

* does not apply to the Researcher's Workshop

1. Prerequisites

Elementary linear algebra (vector spaces), basic logic (propositional calculus) and set theory.

2. Course objectives

A partially ordered set is a set endowed with an ordering criterion, which enables to compare pairs of elements of the set but we do not assume that it can be done for every pair of elements (so it is why we use "partial" here). The aim of this lecture is to introduce partially ordered sets of different types, together with their applications in combinatorics, computer science, physical sciences, and data analysis. During the lecture, students learn about various aspects of ordered sets theory, richly illustrated with examples. During the classes, students will give their own talks (presentations) on various applications of ordered structures, consistent with their scientific interests, prepared on the basis of, for example (but not limited to), materials from the supplementary literature [1] - [3]. Each talk will be followed by a group discussion. The lecture will be available to students with the knowledge of mathematics after graduating from engineering studies.

3. Course content (separate for each type of classes)

Lecture

Theory of partially ordered sets and lattices together with a brief introduction to applications:

1. Partial order and partially ordered sets. Diagrams.
2. Lattices and complete lattices.
3. Formal Concept Analysis (concept lattices) and Galois connections.
4. Distributive and Boolean lattices.
5. Boolean algebras.
6. Complete partially ordered sets and fixpoint theorems.
7. Domains and information systems.
8. Chu Spaces.

Classes

More detailed information on various applications of structures introduced during the lecture. Knowledge achieved due to listening to peers talks, taking part in discussions and preparing student's own presentation and talk.

4. Learning outcomes

Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	The PhD student knows definitions, properties and examples of ordering relations, partially ordered sets and lattices and basic constructions for them.	SD_W2	presentation; student-activity evaluation
K02	The PhD student knows various examples of applications of ordered structures.	SD_W3	presentation; student-activity evaluation
Skills			
S01	The PhD student is able to prepare and present a talk in English based on English-language literature, that is accessible for non-specialists in his/her field.	SD_U4, SD_U6	presentation; student-activity evaluation
S02	The PhD student is able to take a part in a scientific discussion.	SD_U5	presentation; student-activity evaluation
S03	The PhD student is able to evaluate the usefulness and the possibility of applying the results of theoretical work in practice.	SD_U2	presentation; student-activity evaluation
Social competences			
SC01	The PhD student recognizes the importance of knowledge and scientific achievements in solving cognitive and practical problems.	SD_K2	presentation; student-activity evaluation

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria

Overall knowledge will be validated on the basis of presentations prepared by PhD students and the activity during discussions.

6. Literature

Primary references:

[1] B.A. Davey, H.A. Priestley, Introduction to lattices and order. Second edition , Cambridge University Press 2002.

Secondary references:

[1] V.K. Garg, Introduction to Lattice Theory with Computer Science Applications , Wiley 2015.

[2] M. Fattore, R. Bruggemann (Eds.), Partial order concepts in applied sciences, Springer, Berlin 2017.

[3] B. Coecke (Ed.), New Structures for Physics, Lecture Notes in Physics 813, Springer, Berlin, 2011.

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	45
2	Hours of consultations with the academic teacher, exams, tests, etc.	10
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	20
4	Amount of time devoted to the preparation for exams, test, assessments	10
	Total number of hours	**85**
	ECTS credits	**3**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	2
Number of ECTS credits earned by a student in a practical course	1