

## WROCLAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

<b>FACULTY OF PURE AND APPLIED MATHEMATICS</b>
<b>SUBJECT CARD</b>
Course name in Polish: Teoria Gier
Course name in English: Game Theory
Course language: Polish
University-wide general course type: 1) <u>basic course (mathematics, physics, chemistry, other)</u> 2) humanity course 3) managerial skills 4) English language 5) other modern language Departmental course developing professional skills: 1) specialized course 2) interdisciplinary course 3) seminar (interdisciplinary, specialized, departmental)
Type of course (obligatory, <u>optional</u> )
<b>Educational effects according to ZW 26/2017 regulations:  P8S_WG, P8S_UW, P8S_KK, P8S_KR</b>
Subject code: MAT1592

\*delete as applicable

	Lecture
Number of hours of organized classes in University (ZZU)	30
Number of hours of total student workload (CNPS)	90
Form of crediting	Exam
Number of ECTS points	3
including number of ECTS points for practical (P) classes	
including number of ECTS points for direct teacher-student contact (BK) classes	2

<b>PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES</b>
<ol style="list-style-type: none"> <li>1. Knowledge in real mathematical analysis and probability theory.</li> <li>2. Competence in reaching complementary areas of expertise.</li> </ol>

<b>SUBJECT OBJECTIVES</b>	
C1	Student will learn basic notions of cooperative and non-cooperative games, and their selected applications.
C2	Student will gain certain skills in modelling real-life conflicts with the aid of games.

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<b>SUBJECT EDUCATIONAL EFFECTS</b>	
<b>Relating to knowledge:</b>	
PEK_W01 – Student has a basic knowledge concerning mathematical methods applied in game theory	
PEK_W02 – Student has a basic knowledge concerning applications of games in different areas of expertise.	
<b>Relating to skills:</b>	
PEK_U01 – Student gains skills needed to perform his/her research.	
PEK_U02 – Student is able to conduct his/her research.	
<b>Relating to social competences:</b>	
PEK_K01 – Student is aware of the role of cooperation, including an international cooperation.	
PEK_K02 – Student is aware of the importance of the original research activity	

<b>PROGRAM CONTENTS</b>		
<b>Form of classes – lecture</b>		Number of hours
Lec 1	The importance of game theory in economics, engineering, computer science: examples of applications. A game in the strategic form. The notion of Nash equilibrium. Applications of game theory in auctions.	3
Lec 2	The Brouwer fixed point theorem and the Nash theorem.	2
Lec 3	The Kakutani theorem and its application to the Nash theorem.	4
Lec 4	Zero-sum games. Minimax theorems.	3
Lec5	Games in the extensive form. The notion of subgame perfect equilibrium. Behaviour strategies versus randomised strategies.	3
Lec6	Correlated equilibria.	2
Lec7	Cooperative games. Examples of cooperative games, the basic notions: characteristic function, imputation, core of a game.	2
Lec8	Shapley's axioms. The Shapley value. The power index of Shapley-Shubik.	3
Lec9	Bargaining. Non-cooperative game models in cooperative games.	2
Lec10	Dynamic stochastic games on a denumerable state space. The issue of an existence of stationary Nash equilibrium.	2
Lec11	Generalisation of the Kakutani theorem: the Glicksberg theorem. The application of the Glicksberg theorem in dynamic stochastic games.	4
	Total hours	30

<b>TEACHING TOOLS USED</b>	
N1	lecture
N2	consultation
N3	homework: solving problems and exercises

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<b>EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS</b>		
<b>Evaluation:</b> F – forming (partial) C – concluding	Educational effect number	Way of evaluating achievement of educational effects
F1	PEK_U01, PEK_U02, PEK_W01, PEK_W02	attendance of lectures
F2	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	solving problems and exercises
$C = 0.5 \cdot F1 + 0.5 \cdot F2$		

**PRIMARY AND SECONDARY LITERATURE****PRIMARY LITERATURE:**

- [1] M. Maschler, E.Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
- [2] D. Fudenberg, J. Tirole, Game Theory, MIT Press, 1991.
- [3] J. Filar, K. Vrieze, Competitive Markov Decision Processes, Springer-Verlag, 1996.

**SECONDARY LITERATURE:**

- [1] K. Binmore, Playing for Real. A text on Game Theory, Oxford University Press, 2007.
- [2] G. Owen, Teoria gier, PWN, 1975.

**SUBJECT SUPERVISOR**

(NAME AND SURNAME, E-MAIL ADDRESS)

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**WROCLAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES**

**MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS**

**FOR SUBJECT**

**GAME THEORY**

**AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY**

**Doctoral studies at Faculty of Pure and Applied Mathematics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives***	Programme content***	Teaching tool number***
(knowledge) PEK_W01	P8S_WG	C1,C2	Lec1-11	N1, N2, N3
PEK_W02	P8S_WG	C1,C2	Lec1-11	N1, N2, N3
(skills) PEK_U01	P8S_UW	C2	Lec1-11	N2, N3
PEK_U02	P8S_UW	C2,C3	Lec1-11	N2, N3
(competences) PEK_K01	P8S_KK	C3	Lec1-11	N2, N3
PEK_K02	P8S_KR	C3	Lec1-11	N2, N3

\*\* - enter symbols for main-field-of-study/specialization educational effects

\*\*\* - from table above