SYLLABUS OF A MODULE

Polish name of a module	**Teoria gier i decyzji**
English name of a module	**Theory of games and decisions**
ISCED classification	0541
ISCED classification – Field of study	Mathematics
Languages of instruction	*English*
Level of qualification	*Second degree*
Number of ECTS credit points	*6*
Examination	*EW*
Available in semester	*A*

Number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Others
30 E	0	30	15	0	0

MODULE DESCRIPTION

Module objectives

O1. To provide students with a foundation to normative decision theory, especially the theory of games, and equip them with basic mathematical concepts and tools that are used to analyze and solve decision problems.

O2. To present various and sometime unexpected real-world applications of this abstract mathematical theory.

O3. To equip students with knowledge which is sufficient to recognize and assess archetypal decision-making situations in complicated real-world settings.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic probability theory, basic linear algebra, general mathematical maturity.

LEARNING OUTCOMES

LO 1 – The student characterizes the theoretical and practical importance of the axioms, definitions and theorems occurring in the normative decision theory .

LO 2 – Student lists the most important classes of models appearing in the theory, and makes appropriate and varied interpretations. He/she recognizes archetypal decision-making situations in exemplary real-world decision problem settings.

LO 3 – Student explains different key concepts of solutions to the game problems. He/she explains the practical consequences of using particular concept of a solution. Student applies the theory to solve basic/classical problems in exemplary real-world settings.

MODULE CONTENT

Type of classes – Lectures		Number of hours
Lect. 1	Overview of decision theory - introduction. Behavioral vs. normative theory. Classification of decision problems.	**2**
Lect. 2,3	Linear programming tasks as problems of decision making under certainty. Decision making under risk: stochastic programming and chance-constrained programming.	**3**
Lect. 3,4	Fundamentals of the utility theory. Axioms of the preference relation. Utility function: basic concept and theorems	**3**
Lect. 5	Extensive-form games. The notion of a strategy.	**2**
Lect. 6	Normal-form games. Matrix games. Various concepts of solutions.	**2**

Lect. 7,8	Zero-sum two-person games. Von Neumann minimax theorem.	4
Lect. 9	Cooperative vs. non-cooperative games. "Prisoner dilemma" problem and its various interpretations.	2
Lect. 10	Two-person cooperative games. Nash bargaining axioms and bargaining–problem solution.	2
Lect. 11-12	Duopoly analysis. Stackelberg games and repeatable games	4
Lect. 13-15	Selected problems in contemporary decision-making theory.	6
Type of classes– Laboratory		**Number of hours**
L. 1	Introduction. Matrices and vectors. Discrete probability distributions.	2
L. 2,3	Decision making with the help of mathematical programming models	4
L. 4	Preferences and utility function.	2
L. 5	Games in the extensive-form. Strategies.	2
L. 6	Matrix games - various concepts of solutions.	2
L. 7	**Analysis of students achievments with discussion**	2
L. 8	Zero-sum matrix games. Examples. Saddle points.	2
L. 9	Mixed strategies - the concept and the payoff.	2
L. 10	The Solution of a zero-sum game in mixed strategies.	2
L. 11	Cooperative games - exemplary analysis.	2
L. 12	Computing arbitration pairs.	2
L. 13	Contemporary decision-making problems - 1	2
L. 14	Contemporary decision-making problems - 2	2

L. 15	Analysis of students achievments with discussion	2
Type of classes– seminars Topics of the seminars are generally connected with various real-world applications of the decision-making theory. During each seminar students present some examples of such applications along with their formal models and solutions.		**Number of hours**
Sem. 1	Introduction	1
Sem. 2,3,4,5,6	Single-person decisions, including the Lagrange method, as well as important classes of linear programming problems	5
Sem. 7,8,	Sequential games	2
Sem. 9,10,11,12,13,14	N-person games including coalition games and allocation rules	6
Sem. 13	Final discussion on seminar topics	1

TEACHING TOOLS

1.	multimedia presentations
2.	electronic lecture notes
3.	problem sets for students
4.	traditional face-to-face, blackboard supported tutorials

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE

F1. – assessment of student's activity (during all types of classes)
F2. – assessment of the correctness of solutions to given problems (during tutorials)
F3. – assessment of the quality of presentation of acquired knowledge and skills (during tutorials and seminars)
S1. – assessment of problem-solving skills - a **report** containing complete solutions to problems from Problem Sets given during classes **plus achievement test**

S2. – assessment of the degree to which the teaching material is known and understood by student – **open-book exam**		
F1. – assessment of student's activity (during all types of classes)		

*) warunkiem uzyskania zaliczenia jest otrzymanie pozytywnych ocen ze wszystkich ćwiczeń laboratoryjnych oraz realizacji zadania sprawdzającego

STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
1. Contact hours with teacher		
1.1	Lectures	30
1.2	Tutorials	0
1.3	Laboratory	30
1.4	Seminar	15
1.5	Project	0
Total number of contact hours with teacher:		75
2. Student's individual work		
2.1	Preparation for tutorials and tests	0
2.2	Preparation for laboratory exercises, writing reports on laboratories	26
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	0
2.5	Preparation for examination	11
2.6	Individual study of literature	38
Total numer of hours of student's individual work:		75
Overall student's workload:		150
Overall number of ECTS credits for the module		6
Number of ECTS points that student receives in classes requiring teacher's supervision:		3

Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects :	1,2

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

RECOMMENDED readings (all available at various internet book-shops and libraries):
Morris P. , Introduction to game theory, Spriger-Verlag 1994
Webb J. N., Game Theory: Decisions, Interaction and Evolution, Springer Verlag, London, 2007
Lindgren B.W., Elements of decision theory, Macmillan, London, 1971
Luce D. R., Raiffa H. , Games and decisions; introduction and critical survey, Wiley, New York, 1957.
ADDITIONAL readings:
Rasmusen E., Games And Information, An Introduction To Game Theory, Blackwell Publishers Inc., Oxford,UK,, 2007
Geçkil Il. K. Anderson, P.L , Applied game theory and strategic behavior, Taylor and Francis Group, 2010
Osborne M.J., Rubinstein A., A Course in Game Theory, MIT Press, 1994.
Hargreaves-Heap S.P. , Varoufakis Y. , Game Theory-A Critical Introduction, Taylor & Francis e-Library, London, New York 2003
Journal-papers devoted to various aspects of contemporary decision-making theory - provided for students during classes

MODULE COORDINATOR (NAME, SURNAME, INSTITUTE, E-MAIL ADDRESS)

1. dr hab. inż. Andrzej Grzybowski, prof. PCz, andrzej.grzybowski@pcz.pl