SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babes-Bolyai University**
1.2 Faculty	**Mathematics and Computer Science**
1.3 Department	**Mathematics and Computer Science of the Hungarian Line**
1.4 Field of study	**Mathematics**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Computational mathematics**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Game theory**				
2.2 Course coordinator			**Prof. dr. Kassay Gábor**				
2.3 Seminar coordinator			**Prof. dr. Kassay Gábor**				
2.4. Year of study	**1**	2.5 Semester	**1**	2.6. Type of evaluation	**Ex**	2.7 Type of discipline	**Optional**
2.8 Code of the discipline	MME3062						

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					40
Additional documentation (in libraries, on electronic platforms, field documentation)					37
Preparation for seminars/labs, homework, papers, portfolios and essays					40
Tutorship					10
Evaluations					6
Other activities:					
3.7 Total individual study hours		133			
3.8 Total hours per semester	175				
3.9 Number of ECTS credits	7				

4. Prerequisites (if necessary)

4.1. curriculum	• no
4.2. competencies	• Elementary knowledges from Mathematical Analysis and Probability Theory

5. Conditions (if necessary)

5.1. for the course	• Video projector, blackboard
5.2. for the seminar /lab activities	• Video projector, blackboard

6. Specific competencies acquired

Professional competencies	- Development of elementary modelling competencies - Analysis and developments of algorithms - Elementary competences in proving minimax and saddle-point theorems
Transversal competencies	Developing problem solving competencies

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Learnig about some important concepts, theorems and applications of game theory,
7.2 Specific objective of the discipline	• Learnig about the most important minimax theorems • Learnig about classical noncooperative games • Game theoretical modelling of some real world problems • Introduction to elementary cooperative game theory • Algorithms for solving game theoretical problems

8. Content

8.1 Course	Teaching methods	Remarks
1. The mathematical concept of a game. Conflict situations. Pure and mixed strategies, optimal strategies.	teacher's exposition, induction, excercising	
2. Matrix games. Models leading to matrix games. Necessary and sufficient conditions of the existence of a saddle-point.	teacher's exposition, induction, excercising	
3. Bimatrix games. Examples. Extending the strategy sets and payoff functions. Duopoly economy.	teacher's exposition, induction, excercising	
4. Theorem of John von Neumann, the cornerstone of game theory.	teacher's exposition, induction, excercising	
5. Two person cooperative games. Extension of noncooperative game to the cooperative case.	teacher's exposition, induction, excercising	
6. Nash's bargaining function.	teacher's exposition, induction, excercising	
7. The algorithm for finding the Nash's bargaining solution.	teacher's exposition, induction, excercising	
8. The simplex method for solving linear optimization problems.	teacher's exposition, induction, excercising	
9. The dual simplex method.	teacher's exposition, induction, excercising	
10-11. Solving matrix games using simplex and/or dual simplex method.	teacher's exposition, induction, excercising	

12. Solving matrix games using graphical method.	teacher's exposition, induction, excercising	
13-14. n-person games. Nash's equilibrium points (NEP). Nash's theorems for the existence of NEP.	teacher's exposition, induction, excercising	

Bibliography

1. J.P. Aubin: Mathematical methods of game and economic theory, North Holland, Amsterdam, 1979.

2. J.B.G Frenk, G. Kassay: Introduction to Convex and Quasiconvex Analysis, in: Handbook of Generalized Convexity and Monotonicity, Series: Nonconvex Optimization and its Applications, Vol. 76, Hadjisavvas,Nicolas; Komósi, Sándor; Schaible, Siegfried (Eds.), pp. 3-87 Springer, Berlin-Heidelberg-New York 2005.

3. J.B.G. Frenk, G. Kassay: On noncooperative games, minimax theorems and equilibrium problems, in: Pareto Optimality, Game Theory and Equilibria, Athanasios Migdalas (Crete), Panos Pardalos (Florida), Leonidas Pitsoulis (London) and Altannar Chinchuluun (Florida) (Eds.), Springer Verlag, t2007.

4. A.J. Jones: Game theory: mathematical models of conflict, Horwood Publishing, Chicester, 2000.

5. G. Kassay: The Equilibrium Problem and Related Topics, Risoprint, Cluj, 2000.

6. G. Kassay, V. Rădulescu: *Equilibrium Problems and Applications,* Series: Mathematics in Science and Engineering, Academic Press – an imprint of Elsevier, London-San Diego-Cambridge MA-Oxford, 2019.

7. J. Nash: Non-cooperative games, Ann. of Math. 54:286—295, 1951. 7. J. von Neumann, O. Morgenstern: Theory of games and economic behavior, Princeton University Press, Princeton, 1944

8. R.T. Rockafellar: Convex analysis, Princeton University Press, Princeton, 1972.

9. J. Szép, F. Forgó: Introduction to the theory of games, Akadémiai Kiadó, Budapest, 1985.

10. Christian-Oliver Ewald: Games, Fixed Points and Mathematical Economics, http://ssrn.com/abstract=976592

8.2 Seminar / laboratory	Teaching methods	Remarks
1-2. Matrix having saddle-points. Examples and exercises leading to matrix games.		
3-4. Finding saddle-points in case of some special functions.		
5-6. Algorithm of finding the Nash's bargaining solutions.		
7-8. Exercising the simplex algorithm.		
9-10. Exercisind the dual simplex algoritm.		
11-12. Exercising the graphical method.		
13-14. Repetition and concluding remarks.		

Bibliography

Bibliography

1. J.P. Aubin: Mathematical methods of game and economic theory, North Holland, Amsterdam, 1979.

2. J.B.G Frenk, G. Kassay: Introduction to Convex and Quasiconvex Analysis, in: Handbook of Generalized Convexity and Monotonicity, Series: Nonconvex Optimization and its Applications, Vol. 76, Hadjisavvas,Nicolas; Komósi, Sándor; Schaible, Siegfried (Eds.), pp. 3-87 Springer, Berlin-Heidelberg-New York 2005.

3. J.B.G. Frenk, G. Kassay: On noncooperative games, minimax theorems and equilibrium problems, in: Pareto Optimality, Game Theory and Equilibria, Athanasios Migdalas (Crete), Panos Pardalos (Florida), Leonidas Pitsoulis (London) and Altannar Chinchuluun (Florida) (Eds.), Springer Verlag, t2007.

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7. J. Nash: Non-cooperative games, Ann. of Math. 54:286—295, 1951. 7. J. von Neumann, O. Morgenstern: Theory of games and economic behavior, Princeton University Press, Princeton, 1944

8. R.T. Rockafellar: Convex analysis, Princeton University Press, Princeton, 1972.

9. J. Szép, F. Forgó: Introduction to the theory of games, Akadémiai Kiadó, Budapest, 1985.

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9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The content of the course/seminar is similar and in accordance with those taught in most European universities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)

10.4 Course	Writing exam at the end of semester	Evaluation	60%
10.5 Seminar/lab activities	Presentation of different topics by the students and assigned homeworks	According points	40%
10.6 Minimum performance standards			
➢ Compulsory to gather half of the total points accorded for presentations and homeworks			

Date	Signature of course coordinator	Signature of seminar coordinator
03.05.2020	Prof. dr. Kassay Gábor	Prof. dr. Kassay Gábor

Date of approval	Signature of the head of department
.....	Conf. dr. András Szilárd