SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computer Science**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Applied Computational Intelligence**

2. Information regarding the discipline

2.1 Name of the discipline	**Mathematical Modeling**						
2.2 Course coordinator	**Assoc. Prof. PhD. Marcel-Adrian Şerban**						
2.3 Seminar coordinator	**Assoc. Prof. PhD. Marcel-Adrian Şerban**						
2.4. Year of study	**1**	2.5 Semester	**1**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Optional**
2.8 Course code	**MME3030**						

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory/project	1sem/ 1 pr
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory/project	28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					16
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					20
Evaluations					20
Other activities:					-

3.7 Total individual study hours	94
3.8 Total hours per semester	150
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	

5. Conditions (if necessary)

5.1. for the course	• basic knowledge in dynamical systems
5.2. for the seminar /lab activities	• Laboratory with computers; basic knowledge in MAPLE

6. Specific competencies acquired

Professional competencies	• Knowledge, understanding and use of basic concepts of discrete and continuous dynamical systems • Ability to work independently and/or in a team in order to solve problems in defined professional contexts. • Good programming skills in MAPLE
Transversal competencies	• Ability to apply mathematical tools to different real life problems • Ability to model phenomena using dynamical systems • Improved modeling abilities: mathematical modelling, model analysis, numerical simulations

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

7.1 General objective of the discipline	• Be able to describe real world phenomena in mathematical language • Improved modeling abilities: mathematical modelling, model analysis, numerical simulations
7.2 Specific objective of the discipline	• Acquire knowledge about discrete and continuous dynamical systems • Apply discrete and continuous dynamical systems in mathematical modelling of real world phenomena • Understand and work with mathematical models

8. Content

8.1 Course	Teaching methods	Remarks
1. Mathematical Models. Modelling Change with Difference Equations	Exposure: description, explanation, examples, discussion of case studies	
2. Difference Equations. Equilibrium Points. Periodic Points	Exposure: description, explanation, examples, discussion of case studies	
3. Solving Difference Equations with MAPLE	Exposure: description, explanation, examples, debate, dialogue	
4. Stability of the Equilibrium Points. Mathematical Models Given by Difference Equations	Exposure: description, explanation, examples, discussion of case studies	
5. Solving Differential Equations with MAPLE	Exposure: description, explanation, examples, proofs	
6. Approximating Solutions of Differential Equations	Exposure: description, explanation, examples, proofs, debate, dialogue	
7. Modelling with First Order Differential Equations	Exposure: description, explanation, examples, discussion of case studies	
8. Mathematical Models in One Population Dynamics	Exposure: description, explanation, examples	
9. Mathematical Models for Interacting Populations	Exposure: description, explanation, examples	

	discussion of case studies	
10. Modelling with Second Order Differential Equations	Exposure: description, explanation, examples, debate	
11. Vertical Stabilization of a Rocket on a Movable Platform	Exposure: description, explanation, discussion of case studies	
12. A Suspension Bridge Model	Exposure: description, explanation, discussion of case studies	
13. Chaos Theory: Chaotic Discrete-Time Models, the Discrete Logistical Model	Exposure: description, explanation, examples, discussion of case studies	
14. Chaos Theory: Chaotic Continuous-Time Models, the Loretnz Model	Exposure: description, examples, discussion of case studies, live demo	

Bibliography

1. I.A.Rus, C. Iancu, Mathematical modeling, Transilvania Press, 2000.
2. F.R. Giordano, M.D. Weir, W.P. Fox, A first course in mathematical modeling, Brooks/Coole, 2003.
3. D.K. Arrowsmith, Dynamical systems, Differential equations, maps and chaotic behaviour, Chapmann and Hall, 1992.
4. Lynch S. Dynamical systems with applications using MAPLE, Birkhauser, 2001.
5. Ronald W. Shonkwiler, Mathematical Biology. An Introduction with Maple and Matlab, Springer, 2009.
6. J.D. Murray, Mathematical biology, Springer, 2001.

8.2 Seminar	Teaching methods	Remarks
1. Solving difference equations with MAPLE	Explation, dialogue, case studies	
2. Stability of the Equilibrium Points for Diference Equations. Case Studies with MAPLE	Dialogue, debate, case studies, examples, proofs	
3. Mathematical Models Given by Difference Equations	Dialogue, debate, case studies, examples, proofs	
4. Solving Differential Equations with MAPLE	Dialogue, debate, case studies, examples	
5. Modelling with First Order Differential Equations	Dialogue, debate, case studies, examples	
6. Modelling with Second Order Differential Equations	Dialogue, debate, case studies, examples	
7. Mathematical Models for Interacting Populations	Dialogue, debate, case studies, examples	

Bibliography

1. F.R. Giordano, M.D. Weir, W.P. Fox, A first course in mathematical modeling, Brooks/Coole, 2003.
2. D.K. Arrowsmith, Dynamical systems, Differential equations, maps and chaotic behaviour, Chapmann and Hall, 1992.

3. Lynch S. Dynamical systems with applications using MAPLE, Birkhauser, 2001.

4. Ronald W. Shonkwiler, Mathematical Biology. An Introduction with Maple and Matlab, Springer, 2009.

8.3 Laboratory	Teaching methods	Remarks

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 course respects the IEEE and ACM Curricula Recommendations for Computer Science studies;
- The course exists in the studying program of all major universities in Romania and abroad;

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- know the basic principle of the domain; - apply the course concepts - problem solving	Written exam	70%
10.5 Seminar/lab activities	- be able to implement course concepts - apply techniques for different classes of mathematical models	-Practical examination -continuous observations	30%
10.6 Minimum performance standards			
➢ At least grade 5 (from a scale of 1 to 10) at both written exam and seminary work.			

Date	Signature of course coordinator	Signature of seminar coordinator
30.04.2024	Assoc. Prof. PhD. Marcel-Adrian ŞERBAN	Assoc. Prof. PhD. Marcel-Adrian ŞERBAN

Date of approval

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Signature of the head of department

Prof. PhD. Andrei Marcus