SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Mathematics
1.4 Field of study	Mathematics and Informatics
1.5 Study cycle	Bachelor
1.6 Study programme / Qualification	Mathematics and Informatics

2. Information regarding the discipline

2.1 Name of the discipline	Special Chapters of Ordinary Differential Equations						
2.2 Course coordinator	Conf. dr. Adriana Buică						
2.3 Seminar coordinator	Conf. dr. Adriana Buică						
2.4. Year of study	**2**	2.5 Semester	**4**	2.6. Type of evaluation	**VP**	2.7 Type of discipline	**DS**

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	2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	28

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	30
Additional documentation (in libraries, on electronic platforms, field documentation)	10
Preparation for seminars/labs, homework, papers, portfolios and essays	40
Tutorship	10
Evaluations	4
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	First Course on Differential Equations
4.2. competencies	Mathematical analysis

5. Conditions (if necessary)

5.1. for the course	Classroom with blackboard
5.2. for the seminar /lab activities	Classroom with blackboard

6. Specific competencies acquired

Professional competencies	C 2.4. To recognize the main types of mathematical problems and to be able to select the proper techniques and methods for solving them. C 4.2. To explain and give a proper interpretation of the mathematical models. C 5.2. To be able to use the mathematical reasoning in the proofs.
Transversal competencies	• CT1 To apply the rules of organized and efficient work, of responsible attitudes toward the didactic-scientific domain, for the creative valorization of their own potential, respecting the principles and the norms of the professional ethic. • CT3 To use some efficient methods and techniques to learn, to inform themselves, to do research and to develop the abilities for the valorization of their knowledges, to adapt to a dynamical society, and to communicate.

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

7.1 General objective of the discipline	• A deeper understanding of the notions, results and applications of the theory of differential equations
7.2 Specific objective of the discipline	• To understand the different phenomena of dependence on initial conditions and parameters: continuous dependence, stability, topological equivalence, structural stability, bifurcations • Introduction to the existence and stability of the equilibria and of the periodic solutions

8. Content

8.1 Course	Teaching methods	Remarks
1. The first notions and problems in the qualitative theory of scalar nonautonomous differential equations.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
2. Maximal solutions.		
3. Lower and upper solutions, direction field, symmetries of differential equations		
4. Continuity and differentiability with respect to the initial data and parameters		
5. Scalar continuous dynamical systems.		
6. Scalar discrete dynamical systems.		
7. Scalar periodic differential equations: Massera's theorem. Test.		
8. Scalar periodic differential equations: The Poincare map.		
9. Scalar periodic differential equations: The averaging method.		
10. Planar autonomous systems: first integrals and conservative systems.		
11. Linear planar autonomous systems. Topological equivalence.		

12. Stability of equilibria of planar systems.		
13. Topological equivalence of two planar systems in a neighborhood of a hyperbolic equilibrium point. Test.		
14. Interesting phenomena in the theory of dynamical systems.		

Bibliography

1. A. Buica, Lecture notes available at the webpage http://www.math.ubbcluj.ro/~abuica/csEcDif.htm or posted in Teams
2. P. Blanchard, R.L. Devaney, G.R. Hall, Differential Equations, Brooks/Cole, Cengage Learning, 2012.
3. J. Hale, H. Koçak, Dynamics and bifurcations, Springer-Verlag, 1991.
4. R.Precup, Ecuatii diferentiale, Risoprint, Cluj-Napoca, 2011.

8.2 Seminar / laboratory	Teaching methods	Remarks
1-4. The study of scalar nonautonomous differential equations.	• Explanation • Conversation • Didactical demonstration	
5 Scalar autonomous differential equations: the study of some population dynamics models depending on some parameters.		
6. Scalar discrete dynamical systems: stability of fixed points		
7-10. Scalar autonomous periodic equations: the study of some population dynamics models.		
11-12. Planar autonomous systems: the harmonic oscillator equation, the pendulum equation, the Lotka-Volterra system.		
13-14. Planar autonomous systems: stability of equilibria.		

Bibliography

1. Lecture notes posted on the webpage of the course http://www.math.ubbcluj.ro/~abuica/csEcDif.htm or in Teams
2. P. Blanchard, R.L. Devaney, G.R. Hall, Differential Equations, Brooks/Cole, Cengage Learning, 2012.
3. J. Hale, H. Koçak, Dynamics and bifurcations, Springer-Verlag, 1991.
4. R. Precup, Differential equations, De Gruyter, 2018.

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 this discipline is synchronized with the curriculum of most of the important universities from our country and from abroad where the applied mathematics plays an important role.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	• To know the notions and their properties by examples or counterexamples. To be able to apply the theoretical results in	Two tests	60%

	concrete problems.		
10.5 Seminar activities	• Solving problems skills through homeworks		30%
10.6 Minimum performance standards			
• The minimum passing grade is 5.			

Date	Signature of course coordinator	Signature of seminar coordinator
15-04-2022	Conf. dr. Adriana Buică	Conf. dr. Adriana Buică

Date of approval	Signature of the head of department
15-04-2022	Prof. dr. Octavian Agratini