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 Mathematics
1.4 Field of study	Mathematics
1.5 Study cycle	Master
1.6 Study programme / Qualification	**Master of Advanced Mathematics**

2. Information regarding the discipline

2.1 Name of the discipline	**Qualitative theory of 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	**3**	2.6. Type of evaluation	**E**	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	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					33
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					30
Evaluations					20
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	Mathematical Analysis; Differential Equations
4.2. competencies	Logical thinking, as well mathematical notions and properties from the above mentioned fields

5. Conditions (if necessary)

5.1. for the course	•
5.2. for the seminar /lab activities	•

6. Specific competencies acquired

Professional competencies	• Ability to understand and manipulate advanced concepts, results and theories in the fields of mathematics.	
Transversal competencies	• Ability to inform themselves, to work independently or in a team in order to realize studies and to solve complex problems. • Ability for continuous self-perfecting and study.	

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

7.1 General objective of the discipline	• To be familiar with the important problems that appear when studying the existence and stability of periodic solutions for periodic differential systems	•
7.2 Specific objective of the discipline	• To be able to prove the main results • To be able to apply the main results in examples and physical models • To have an intuition on the variety of problems that can appear in studying the differential equations	•

8. Content

8.1 Course	Teaching methods	Remarks
1. Linear differential systems. General theory.	Interactive exposure Explanation Conversation Demonstration	
2. Linear differential systems with constant coefficients. The exponential matrix for a diagonalizable matrix.	Interactive exposure Explanation Conversation Demonstration	
3. Linear differential systems with constant coefficients. The exponential matrix for a deffective matrix.	Interactive exposure Explanation Conversation Demonstration	
4. The asymptotic behaviour of the solutions of linear systems with constant coefficients. Stable, unstable, center manifolds.	Interactive exposure Explanation Conversation Demonstration	
5. The fundamental theorems for nonlinear systems: the existence and uniqueness theorem	Interactive exposure Explanation Conversation Demonstration	
6. The fundamental theorems for nonlinear systems: maximal interval of existence	Interactive exposure Explanation Conversation Demonstration	
	Interactive exposure	

7. The fundamental theorems for nonlinear systems: continuity and differentiability with respect to parameters and initial data	Explanation Conversation Demonstration	
8. Stability of equilibria of nonlinear autonomous systems by linearization	Interactive exposure Explanation Conversation Demonstration	
9. Stability of equilibria of nonlinear autonomous systems by the Lyapunov functions method	Interactive exposure Explanation Conversation Demonstration	
10. Stability of nonautonomous linear differential systems	Interactive exposure Explanation Conversation Demonstration	
11. Stability of periodic linear differential systems. Floquet theory I	Interactive exposure Explanation Conversation Demonstration	
12. Stability of periodic linear differential systems. Floquet theory II	Interactive exposure Explanation Conversation Demonstration	
13. Periodic solutions of linear periodic systems	Interactive exposure Explanation Conversation Demonstration	
14. Stability of periodic solutions of periodic nonlinear systems	Interactive exposure Explanation Conversation Demonstration	

Bibliography

1. A. Buică, Periodic solutions for nonlinear systems, Cluj University Press, 2006.
2. C. Chicone, Ordinary differential equations with applications, Springer, 2006.
3. E.A. Coddington, N. Levinson, Theory of ordinary differential equations, 1959.
4. J.K. Hale, Ordinary differential equations, Krieger, 1980.
5. P. Hartman, Ordinary differential equations, SIAM, 2002.
6. L. Perko, Differential equations and dynamical systems, Springer, 2001.
7. G. Teschl, Ordinary differential equations and dynamical systems, American Mathematical Society, 2012.
8. M. Viana, J.M Espinar, Differential equations: a dynamical systems approach to theory and practice, American Mathematical Society, 2021.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
2. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
3. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
4. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
5. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
6. Various problems and exercises on the theme	Explanation Conversation	

of the same week lecture.		
7. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
8. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
9. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
10. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
11. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
12. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
13. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	
14. Various problems and exercises on the theme of the same week lecture.	Explanation Conversation	

Bibliography

1. A. Buică, Periodic solutions for nonlinear systems, Cluj University Press, 2006.
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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 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 prove the main theoretical results.	Exam	60%
	To develop a specific subject by reading the bibliography.	Report	20%
10.5 Seminar/lab activities	• Solving problems skills	Evaluation of the homeworks	20%
	• Active participation in the classroom		
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 Buica	Conf. dr. Adriana Buica

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