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	**O**

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 systems with periodic coefficients. Floquet theory.	Interactive exposure Explanation Conversation Demonstration	
2. Periodic solutions of linear systems: existence and stability.	Interactive exposure Explanation Conversation Demonstration	
3. The Poincarè translation map for nonlinear nonautonomous systems.	Interactive exposure Explanation Conversation Demonstration	
4. Periodic solutions of weakly nonlinear nonautonomous systems in the noncritical case.	Interactive exposure Explanation Conversation Demonstration	
5. Periodic solutions of weakly nonlinear nonautonomous systems in the critical case: the method of averaging. I	Interactive exposure Explanation Conversation Demonstration	
6. The method of averaging. II	Interactive exposure Explanation Conversation Demonstration	
	Interactive exposure	

7. The method of averaging. III	Explanation Conversation Demonstration	
8. First integrals and inverse Jacobi multipliers for nonautonomous systems.	Interactive exposure Explanation Conversation Demonstration	
9. Periodic solutions for systems with first integrals and/or inverse Jacobi multipliers.	Interactive exposure Explanation Conversation Demonstration	
10. The averaging method applied to obtain the existence and stability of limit cycles for planar autonomous systems.	Interactive exposure Explanation Conversation Demonstration	
11. Action-angle variables for higher dimensional autonomous systems.	Interactive exposure Explanation Conversation Demonstration	
12. The averaging method applied to obtain the existence and stability of limit cycles for higher dimensional autonomous systems.	Interactive exposure Explanation Conversation Demonstration	
13. Poincaré-Andronov-Hopf bifurcation.	Interactive exposure Explanation Conversation Demonstration	
14. Multiple Hopf bifurcation.	Interactive exposure Explanation Conversation Demonstration	

Bibliography

1. A. Buică, Periodic solutions for nonlinear systems, Cluj University Press, 2006.
2. A. Buică, J. Giné, J. Llibre, Periodic solutions for nonlinear for nonlinear periodic differential systems: the second order bifurcation function, Topological Methods in Nonlinear Analysis, 43 (2014), 403-419.
3. A. Buică, I.A. García, Inverse Jacobi last multipliers and first integrals for nonautonomous differential systems, Zeitschrift für angewandte Mathematik und Physik, in press.
4. C. Chicone, Ordinary differential equations with applications, Springer, 2006.
5. J.K. Hale, Ordinary differential equations, Krieger, 1980.
6. P. Hartman, Ordinary differential equations, SIAM, 2002.
7. M.W. Hirsch, S. Smale, R.L. Devaney, Differential equations, dynamical systems, and an introduction to chaos, Elsevier, 2013.

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	
	Explanation	

6. Various problems and exercises on the theme of the same week lecture.	Conversation	
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.
2. A. Buică, J. Giné, J. Llibre, Periodic solutions for nonlinear for nonlinear periodic differential systems: the second order bifurcation function, Topological Methods in Nonlinear Analysis, 43 (2014), 403-419.
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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.	Two ongoing tests (week 6 and week 12)	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
28-04-2021	Conf. dr. Adriana Buica	Conf. dr. Adriana Buica

Date of approval	Signature of the head of department
28-04-2021	Prof. dr. Octavian Agratini