SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University Cluj-Napoca
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	Bachelor
1.6 Study programme / Qualification	Computer Mathematics

2. Information regarding the discipline

2.1 Name of the discipline	**Differential Equations**						
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	**2**	2.5 Semester	**3**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**compulsory**

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

3.1 Hours per week	5	Of which: 3.2 course	2	3.3 seminar/laboratory	2/1
3.4 Total hours in the curriculum	70	Of which: 3.5 course	28	3.6 seminar/laboratory	28/14

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	10
Additional documentation (in libraries, on electronic platforms, field documentation)	10
Preparation for seminars/labs, homework, papers, portfolios and essays	10
Tutorship	15
Evaluations	10
Other activities:	-

3.7 Total individual study hours	55
3.8 Total hours per semester	125
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	Mathematical Analysis (I-II)
4.2. competencies	Mathematical Analysis (I-II), Geometry (I)

5. Conditions (if necessary)

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

6. Specific competencies acquired

Professional competencies	• C1.2 Correct explanation and interpretation of mathematical concepts, using specific language • C 2.4 Comparative analysis of the results obtained by solving problems with pre-existing data • C4.2 Explain and interpret mathematical models
Transversal competencies	• CT 1. Applying the rules of rigorous and efficient work, manifesting responsible attitudes towards the scientific and didactic field, for the optimal and creative capitalization of one's own potential in specific situations, respecting the principles and norms of professional ethics. • CT 3. Efficient use of information sources and resources of communication and assisted professional training, both in Romanian and in a language of international circulation

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

7.1 General objective of the discipline	• to present the basic concepts and results in differential equations theory
7.2 Specific objective of the discipline	• basic concepts and tools of differential equations which can be effectively solved • main concepts and results concerning the qualitative theory of differential equations • basic problems related to differential equations • mathematical model given by differential equations

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction to Differential Equations	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
2. Analysis in Banach spaces. Contraction principle. Abstract data dependence principle	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
3. The Cauchy problem. The existence and uniqueness theorem in the space	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
4. The Cauchy problem. The existence and uniqueness theorem in the ball	• Interactive exposure • Explanation • Conversation	

	• Didactical demonstration	
5. Mathematical models governed by differential equations (I)	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
6. Mathematical models governed by differential equations (II)	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
7. Linear differential equations	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
8. Linear differential equations with constant coefficients	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
9. Systems of linear differential equations of first order	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
10. Systems of linear differential equations with constant coefficients	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
11. Dynamical systems generated by autonomous scalar differential equations	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
12. Dynamical systems generated by planar system of differential equations	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
13. Applications of dynamical systems theory to some models	• Interactive exposure • Conversation	
14. Approximating methods for the Cauchy problem	• Interactive exposure • Conversation	

Bibliography

1. I. A. Rus, Ecuaţii diferenţiale, ecuaţii integrale si sisteme dinamice, Transilvania Press, Cluj-Napoca, 1996.
2. M.A. Şerban, Ecuaţii şi sisteme de ecuaţii diferenţiale, Ed. Presa Univ. Clujană, Cluj-Napoca, 2009.
3. S.L. Campbell, R. Haberman, Introduction to Differential Equations with Dynamical Systems, Princeton Univ. Press, 2008

8.2 Seminar	Teaching methods	Remarks
1. Solvable first order differential equations (I): separable differential equations, reducible to separable differential equations, Euler homogeneous differential equations	• Exercise • Explanation • Didactical demonstration	
2. Solvable first order differential equations (II): linear differential equations, Bernoulli equations, Riccati equations	• Exercise • Explanation • Didactical demonstration	
3. Solvable first order differential equations in implicit form: Claireaut equations, Lagrange equation, exact equation	• Exercise • Explanation • Didactical demonstration	
4. Higher order solvable differential equations	• Exercise • Explanation • Didactical demonstration	
5. Initial value problems. Boundary value problems	• Exercise • Explanation • Didactical demonstration	
6. Written test	•	
7. The Cauchy problem: applications of the existence and uniqueness theorems	• Exercise • Explanation • Didactical demonstration	
8. Linear differential equations	• Exercise • Explanation • Didactical demonstration	
9. Linear differential equations with constant coefficients	• Exercise • Explanation • Didactical demonstration	
10. Systems of linear differential equations of first order	• Exercise • Explanation • Didactical demonstration	
11. Systems of differential equations with constant coefficient	• Exercise • Explanation • Didactical demonstration	
12. Dynamical systems generated by autonomous scalar differential equations: equilibrium solutions, stability	• Exercise • Explanation • Didactical demonstration	
13. Dynamical systems generated by planar system of differential equations: equilibrium solutions, stability	• Exercise • Explanation • Didactical demonstration	

14. Final and synthesis problems	• Exercise • Explanation • Didactical demonstration	
Bibliography 1. R. PRECUP, Ecuatii diferentiale, Risoprint, Cluj-Napoca, 2011. 2. G. MOROSANU, Ecuatii diferentiale. Aplicatii, Ed. Acad., Bucuresti, 1990. 3. G. MICULA, P. PAVEL, Ecuatii diferentiale si integrale prin exercitii si probleme, Ed. Dacia, Cluj, 1989. 4. M.A. Şerban, Ecuaţii şi sisteme de ecuaţii diferenţiale, Ed. Presa Univ. Clujană, Cluj-Napoca, 2009.		
8.3 Laboratory	Teaching methods	Remarks
1. Introduction to MAPLE	• Exercise • Explanation • Individual study	
2. Solving differential equations with MAPLE	• Exercise • Explanation • Individual study	
3. Mathematical models given by differential equations	• Exercise • Explanation • Individual study	
4. Systems of differential equations	• Exercise • Explanation • Individual study	
5. Higher order linear differential equations	• Exercise • Explanation • Individual study	
6. Equilibrium points. Stability	• Exercise • Explanation • Individual study	
7. Laboratory test		
Bibliography 1. S. Lynch, Dynamical Systems with Applications using MAPLE, Birkauser, 2001. 2. M.A. Şerban, Ecuaţii şi sisteme de ecuaţii diferenţiale, Ed. Presa Univ. Clujană, Cluj-Napoca, 2009.		

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 syllabus of this course is focused on the differential equations theory, as a basis for a better understanding of the partial differential equations and mathematical models. Moreover, the course propose the following three important directions:
1. the understanding of the main concepts and methods in the classical theory of differential equations;
2. the use of Banach's contraction principle in the qualitative theory of differential equations
3. the applications of the differential equations theory to real world problems.
The content of this discipline is in accordance with the curricula of the most important universities in Romania and abroad. This discipline is useful in preparing future teachers and researchers in pure and applied mathematics, as well as those who use mathematical models and advanced methods of study in other areas.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	• Knowledge of concepts and basic results		
	• Ability to justify by proofs theoretical results	Final written exam	70%
10.5 Seminar/lab activities	• Ability to apply concepts and results acquired during the course in Differential Equations	Seminar written test Laboratory practical test	20% 10%
10.6 Minimum performance standards			
• Fulfillment of the seminar / laboratory attendance criterion (75% seminar attendance, 90% laboratory attendance) • Successful passing of the exam is conditioned by the final grade that has to be at least 5.			

Date	Signature of course coordinator	Signature of seminar coordinator
04.05.2020	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. Octavian AGRATINI