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	**Computers and Information Technology**
1.5 Study cycle	**Bachelor**
1.6 Study programme / Qualification	**Information Engineering**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Differential Equations/ Ecuatii diferentiale**				
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 DF**
2.8 Code of the discipline		MLE0009					

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

3.1 Hours per week	4	Of which: 3.2 course	3	3.3 seminar/laboratory	1 LP
3.4 Total hours in the curriculum	56	Of which: 3.5 course	42	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					15
Additional documentation (in libraries, on electronic platforms, field documentation)					15
Preparation for seminars/labs, homework, papers, portfolios and essays					10
Tutorship					20
Evaluations					9
Other activities:					

3.7 Total individual study hours	69
3.8 Total hours per semester	125
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	•
4.2. competencies	•

5. Conditions (if necessary)

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

6. Specific competencies acquired

Professional competencies	C1.1 Recognizing and describing specific concepts to calculability, complexity, programming paradigms and modeling of computing and communication systems C1.5 Providing theoretical background for the characteristics of the designed systems
Transversal competencies	CT1 Honorable, responsible, ethical behavior, in the spirit of the law, to ensure the professional reputation CT3 Demonstrating initiative and pro-active behavior for updating professional, economical and organizational culture knowledge

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	• 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 Laboratory		
1. Introduction to SageMath	• Exercise • Explanation • Individual study	
2. Solving differential equations with SageMath	• 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 paper		

Bibliography

1. P. Zimmerman, Computational Mathematics with SageMath, Creative CommonsAttribution-ShareAlike 4.0 International, 2018
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 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	80%
10.5 Seminar/lab activities	Ability to apply concepts and results acquired during the course in Differential Equations	Laboratory practical test	20%
	Knowledge of concepts and basic results		
10.6 Minimum performance standards			

- Fulfillment of the laboratory attendance criterion (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
17.05.2022	Assoc. Prof. PhD. Marcel-Adrian ŞERBAN	Assoc. Prof. PhD. Marcel-Adrian ŞERBAN

Date of approval	Signature of the head of department
.....	Prof. dr. Laura Dioşan
24.05.2022