SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeş-Bolyai University, Cluj-Napoca
1.2 Faculty	Faculty of Mathematics and Computer Sciences
1.3 Department	Department of Mathematics
1.4 Field of study	Mathematics
1.5 Study cycle	Licence
1.6 Study programme / Qualification	Mathematics and Computer Science

2. Information regarding the discipline

2.1 Name of the discipline	Calculus 1 (Calculus on R)						
2.2 Course coordinator	Lect. dr. GRAD ANCA						
2.3 Seminar coordinator	Lect. dr. GRAD ANCA						
2.4. Year of study	1	2.5 Semester	1	2.6. Type of evaluation	Written exam	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	3	3.3 seminar/laboratory	2
3.4 Total hours in the curriculum	70	Of which: 3.5 course	42	3.6 seminar/laboratory	28

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	25
Additional documentation (in libraries, on electronic platforms, field documentation)	10
Preparation for seminars/labs, homework, papers, portfolios and essays	25
Tutorship	10
Evaluations	10
Other activities:	

3.7 Total individual study hours	80
3.8 Total hours per semester	150
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	• High-school calculus
4.2. competencies	• Mathematical thinking, logical thinking

5. Conditions (if necessary)

5.1. for the course	• Lecture hall with large board and beamer
5.2. for the seminar /lab activities	• Seminar hall with large board

6. Specific competencies acquired

Professional competencies	C4.1. Defining basic concepts, theory and mathematical models C4.2 Interpretation of mathematical models C4.3 Identifying the appropriate models and methods for solving real-life problems C4.5 Embedding formal models in applications from various areas
Transversal competencies	CT1 Application of efficient and rigorous working rules, manifest responsible attitudes towards the scientific and didactic field, respecting the professional and ethical principles. CT3 Use of efficient methods and techniques for learning, information, research and development of abilities for knowledge acquiring, for adapting to the needs of dynamic society and for communication in Romanian as well as in a widely used foreign language.

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

7.1 General objective of the discipline	➢ Acquiring knowledge about the algebraic and topological structure of the space R, differential and integral calculus
7.2 Specific objective of the discipline	➢ Presentation of the basic notions and concepts connected to the topology of R ➢ Presentation of the basic notoions and results concerning sequences and series of real numbers ➢ Presentation of the basic notions and results concerning the differential and integral calulus of real functions of one real variable

8. Content

8.1 Course	Teaching methods	Remarks
1. The system of real numbers (upper and lower bound of a set; minimum and maximum of a set; infimum and supremum of a set; the infimum principle, the supremum principle and its consequences; the sets of natural numbers, the set integer numbers, the set of rational numbers, and the set of irrational numbers; the extended set of real numbers). Topology of the real axis (neighbourhoods, open sets, interior set, exterior set, boundary set, closure, accumulation points)	Lecture, discussion, didactic proofs	[1] pp. 125-157 or [4] pp. 80-97
2. Sequences of real numbers (existence of the limit for monotone sequences; applications: the irrational number e)	Lecture, discussion, didactic proofs	[4] pp. 159-195, 259-263
3. Fundamental sequences. Series of real numbers (convergence/divergence criteria for series: Cauchy's general criterion, Cauchy's condensation criterion, comparison criteria, the root criterion, Kummer's, D'Alembert's and Raabe-Duhamel's criteria)	Lecture, discussion, didactic proofs	[4] pp. 313-346

4. Series of real numbers; comparison criteria.	Lecture, discussion, didactic proofs	[4] pp. 367-396
5. Series of real numbers (Abel-Dirichlet criterion; absolutely convergent series; the Leibniz criterion for alternant series; convolutive product of series).	Lecture, discussion, didactic proofs	[2], pp. 193 – 204 pp. 232 – 244 [6], pp. 290 – 298 pp. 348 – 353
6. Limits of real-valued functions, characterization theorems. Continuous functions, characterization theorems.	Lecture, discussion, didactic proofs	[4] pp.
7. Differential calculus. Mean theorems	Lecture, discussion, didactic proofs	[1] pp. 195-232 or [4] pp. 409-420, 459-472, 486-507
8. Higher order derivatives; Taylor's theorem and applications.	Lecture, discussion, didactic proofs	[1] pp. 233-263 or [4] pag. 579-594
9. Sequences of functions (convergence and uniform convergence; properties of the sum function).	Lecture, discussion, didactic proofs	[4], pp. 427 – 441
10. Series of functions (convergence and uniform convergence; properties of the sum function). Power series. Taylor's theorem	Lecture, discussion, didactic proofs	[4], pp. 361 – 365 pp. 441 – 445
11. The Riemann integral (definition, characterizations of inerrability; properties of the Riemann integral)	Lecture, discussion, didactic proofs	[4], pp. 365 – 384
12 Primitives, the Leibniz-Newton formula.	Lecture, discussion, didactic proofs	[1] pp. 314-388
13. Improper integrals	Lecture, discussion, didactic proofs	[4], pp. 379-391
14. The Riemann-Stieltejes integral	Lecture, discussion, didactic proofs	[7], pp. 221 – 240

Bibliography

1. D. Andrica, D.I. Duca, I. Purdea, I. Pop: Matematica de baza, Editura Studium, Cluj-Napoca, 2004
2. W.W. Breckner: Analiza matematica. Topologia spatiului R^n, Universitatea din Cluj-Napoca, Cluj-Napoca, 1985
3. S. Cobzas: Analiza matematica (Calcul diferential), Presa Universitara Clujeana, Cluj-Napoca, 1997
4. D.I. Duca: Analiza matematica (vol. I), Casa Cartii de Stiinta, Cluj-Napoca, 2013
5. D.I. Duca, E. Duca: Exercitii si probleme de analiza matematica (vol. I), Editura Casa Cartii de Stiinta, Cluj-Napoca, 2007
6. D.I. Duca, E. Duca: Exercitii si probleme de analiza matematica (vol II), Editura Casa Cartii de Stiinta, Cluj-Napoca, 2009
7. M. Megan: Bazele Analizei matematice, vol. 1,2,3, Editura Eurobit, 1997, 1997, 1998
8. Gh. Siretchi: Calcul diferential si integral, vol. I si II, Editura Stiintifica si Enciclopedica, Bucuresti,1985
9. V.A. Zorich: Mathematical Analysis, Springer, Berlin, 2004

8.2 Seminar / laboratory	Teaching methods	Remarks
1. The set of real numbers. Topology of the set of real numbers.	Discussions, problematisation, self-tanking, team-work	[5] 1.2-1.4; 1.7-1.10; 1.12-1.16; 2.2; 2.4-2.6; 2. 8-2.9; 2.11-2.32
2. . Real number sequences; convergence of the monotone sequences.	Discussions, problematisation, self-tanking, team-work	[5] 3.24; 3.26; 3.33; 3.39; 3. 43; 3.47; 3.54; 3.59; 3.67-3.73; 3.85; 3.90; 3.95; 3.99-3.108
3. Fundamental sequences. Series of real numbers.	Discussions, problematisation, self-thinking, team-work	List of problems edited by the lecturer
4. Series of real numbers.	Discussions, problematisation, self-thinking, team-work	List of problems edited by the lecturer
5. Limits of functions. Continuous functions	Discussions, problematisation, self-thinking, team-work	[5] 4.2-4.3; 4.7; 4.12; 4.16; 4.18; 4.22; 4.24-4.26; 4.41; 4.45; 4.47; 4.50; 4.56; 4.73-4.75; 4.79; 4.80; 4.84; 4.94 5.2; 5.8; 5.11; 5.15-5.19; 5.22; 5.26; 5.29; 5.31; 5.35; 5.40; 5.41
6. Limits of real-valued functions, characterization theorems. Continuous functions, characterization theorems.	Discussions, problematisation, self-thinking, team-work	[3] 6.2; 6.14-6.17; 6.21; 6.26-6.32; 6.92-6.95; 7.10; 7.12-7.17; 7.24-7.36; 7.48; 7.52; 7.57-7.63
7. Differential calculus. Mean theorems	Discussions, problematisation, self-thinking, team-work	[3] 6.68-6.90; 6.169-6.187
8. Higher order derivatives; Taylor's theorem and applications.	Discussions, problematisation, self-thinking, team-work	[4] 1.2; 1.14; 1.20; 1.22; 1.32; 1.39-1.40; 1.65-1.66; 1.126; 2.6-2.42; 2.46-2.51; 2.60; 2.68; 2.72-2.74; 2.78; 2.82-2.89; 2.130-2.131; 2.139; 2.147; 2.171; 2.224; 2.262; 2.303; 2.307; 2.314

9. Sequences of functions (convergence and uniform convergence; properties of the sum function).	Discussions, problematisation, self-thinking, team-work	[1] pp. 339-352
10. Series of functions (convergence and uniform convergence; properties of the sum function). Power series. Taylor's theorem	Discussions, problematisation, self-thinking, team-work	List of problems edited by the lecturer
11. The Riemann integral (definition, characterizations of inerrability; properties of the Riemann integral)	Discussions, problematisation, self-thinking, team-work	[1] pag. 277-313
12 Primitives, the Leibniz-Newton formula.	Discussions, problematisation, self-thinking, team-work	[1] pag. 314-338
13. Improper integrals	Discussions, problematisation, self-thinking, team-work	[8] pag. 379-391
14. The Riemann-Stieltejes integral	Discussions, problematisation, self-thinking, team-work	[7] pp. 221-240

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 course can be encountered in the syllabbus of every respected university in land or aboroad. It represents a basic part not onlu for mathematicl teachers but also for researchers..

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	knowledge of the basic notions and results	Final written exam	60%
	knowledge of the proofs for the main theoretical results		
10.5 Seminar/lab activities	Homework including problems based on the theory presented at the lecture	Continuous evaluation during the seminar	20%
	application of the theroretical results to practical problems	written quizzes during the seminar	20%
10.6 Minimum performance standards			
➢ The definitions, the statement of the theoretical results and straight-forward applications			

➢ Idenfitication and proper selection of the solving methods for various practical problems

Date	Signature of course coordinator	Signature of seminar coordinator
04.05.2020	Lect. dr. GRAD ANCA	Lect. dr. GRAD ANCA

Date of approval	Signature of the head of department
....	Prof. dr. AGRATINI OCTAVIAN