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	Applied Mathematics

2. Information regarding the discipline

2.1 Name of the discipline	***Linear Approximation Processes***						
2.2 Course coordinator	Associate professor Teodora Catinas						
2.3 Seminar coordinator	Associate professor Teodora Catinas						
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	3	Of which: 3.2 course	2	3.3 laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					40
Additional documentation (in libraries, on electronic platforms, field documentation)					44
Preparation for seminars/labs, homework, papers, portfolios and essays					50
Tutorship					10
Evaluations					14
Other activities:					--

3.7 Total individual study hours	158
3.8 Total hours per semester	200
3.9 Number of ECTS credits	8

4. Prerequisites (if necessary)

4.1. curriculum	• Mathematical Analysis • Special Topics in Numerical Analysis
4.2. competencies	• Comparative assessment and efficient use of various methods of demonstration

5. Conditions (if necessary)

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

6. Specific competencies acquired

Professional competencies	• The ability to understand and manipulate concepts, results and theories advanced in mathematics • Ability to use the knowledge gained and complementary in achieving a PhD in Mathematics
Transversal competencies	• Ability to self-improvement and to train continuously • Ability to use mathematical software and advanced methods of numerical analysis and programming for numerical solving of problems. • Ability to model and analyze from a mathematical point of view real processes from other sciences, economics and engineering

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

7.1 General objective of the discipline	• Assimilation of modern techniques of approximation of functions
7.2 Specific objective of the discipline	• Deepening different construction methods of linear positive operators • Knowledge of the outstanding classes of approximation operators of discrete and continuous type • Ability to apply numerical algorithms to solve practical and real life problems.

8. Content

8.1 Course	Teaching methods	Remarks
1. Positive linear operators: preliminaries, definitions, properties, Bohman-Korovkin theorems.	Interactive exposure: explanation, conversation	
2. Moduli of continuity, moduli of smoothness. Properties	Interactive exposure: explanation, conversation	
3. Quantitative estimates. The approximation error. K – functionals. Properties.	Interactive exposure: explanation, conversation	
4. Bernstein operators.	Interactive exposure: explanation, conversation	
5. Operators of Bernstein type: Schurer, Cheney-Sharma, Stancu, Kantorovich and Durrmeyer operators.	Interactive exposure: explanation, conversation	
6. Construction of some approximation processes: Bleimann-Butzer-Hahn, Mastroianni, Szasz, Baskakov, Meyer-Konig, Zeller operators.	Interactive exposure: explanation, conversation	
7. Sumation methods: Cesaro, Euler, Jakimovski.	Interactive exposure: explanation, conversation	
8. Least square approximation. Discrete least squares approximation: linear and polynomial least squares.	Interactive exposure: explanation, conversation	

9. Orthogonal polynomials and least squares approximation.	Interactive exposure: explanation, conversation	
10. Extensions of some classical univariate interpolation methods to multivariate case: extension of Lagrange, Newton, Hermite and Lidstone interpolation.	Interactive exposure: explanation, conversation	
11. Interpolation by means of Newton's algorithm.	Interactive exposure: explanation, conversation	
12. Interpolation processes on domains with curved sides.	Interactive exposure: explanation, conversation	
13. Some applications of the interpolation processes to surfaces generation.	Interactive exposure: explanation, conversation	
14. Some applications to numerical integration of functions.	Interactive exposure: explanation, conversation	

Bibliography

1. O. Agratini, *Aproximare prin operatori liniari*, Ed. Presa Univ. Clujeană, 2000.
2. O. Agratini, I. Chiorean, Gh. Coman, R.T. Trîmbitaş, *Analiză Numerică şi Teoria Aproximării*, vol. III, Ed. Presa Univ. Clujeană, 2002;
3. F. Altomare, M. Campiti, *Korovkin – type Approximation Theory and its Applications*, de Gruyter Studies in Mathematics, Vol. 17, Walter de Gruyter, Berlin New York, 1994.
4. R. L. Burden, J. D. Faires, *Numerical Analysis*, PWS Publishing Company, 1985.
5. T. Cătinaş, Interpolation of scattered data, Ed. Casa Carţii de Ştiinţă, 2007.
6. I. Chiorean, T. Cătinaş, R. Trîmbitaş, *Analiză numerică*, Ed. Presa Univ. Clujeană, 2010.
7. Gh. Coman, T. Cătinaş, şi alţii, *Interpolation operators*, Ed. Casa Cărţii de Ştiinţă, Cluj-Napoca, 2004.
8. Gh. Coman, I. Chiorean, T. Cătinaş, *Numerical Analysis. An Advanced Course*, Ed. Presa Univ. Clujeană, 2007.
9. D.D. Stancu, Gh. Coman, O. Agratini, R. Trimbitas, *Analiză Numerică şi Teoria Aproximării*, vol. I, Ed. Presa Univ. Clujeană, 2001;
10. D.D. Stancu, Gh. Coman, P. Blaga, *Analiză Numerică şi Teoria Aproximării*, vol. II, Ed. Presa Univ. Clujeană, 2002;

8.2 Seminar / laboratory		Teaching methods	Remarks
1.	Introductory examples and problems in Matlab.	Explanation, dialogue, practical examples.	
2.	Generation of Bernstein polynomials.	Explanation, dialogue, examples.	
3.	Generation of some Bernstein-type operators.	Explanation, dialogue, practical examples.	
4.	Discrete least square approximation (linear and polynomial) and continuous least square approximation. Practical examples.	Explanation, dialogue, examples.	
5.	Interpolation by means of Newton's algorithm. Computation of some tensorial product and boolean sum operators for domains with curved sides. Graphical representations.	Explanation, dialogue, practical examples.	
6.	Generation of some roof surfaces. Graphical representations.	Explanation, dialogue, practical examples.	
7.	Generation of some numerical integration formulas.	Explanation, dialogue, practical examples.	

Bibliography

1. Agratini, O., *Aproximare prin operatori liniari*, Presa Universitară Clujeană, Cluj-Napoca, 2000.
2. Agratini, O., Chiorean, I., Coman, Gh., Trîmbiţaş, R., *Analiză numerică şi teoria aproximării*, Vol. III, Presa Universitară Clujeană, Cluj-Napoca, 2002.

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

- This program covers the necessary basic knowledge in this area
- The content of the course is important for seeing the application of mathematical knowledge in solving practical and real life problems.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course		Written exam	70%
10.5 Seminar/lab activities	- be able to implement course concepts and the numerical algorithms - apply techniques for different practical problems	Evaluation and continuous observations during the semester.	30%
10.6 Minimum performance standards			
At least grade 5 (from a scale of 1 to 10) at written exam			

Date	Signature of course coordinator	Signature of seminar coordinator
September 16, 2015	Teodora Catinas	Octavian Agratini