SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Computer science/ Engineer
1.7 Form of education	Full time
1.8 Subject code	24.

2. Data about the subject

2.1 Subject name	***Numerical methods***				
2.2 Course responsible/lecturer	Prof. dr. Dumitru Mircea Ivan – mircea.ivan@math.utcluj.ro				
2.3 Teachers in charge of seminars/ laboratory/ project	Prof. dr. Daniela ROSCA – daniela.rosca@math.utcluj.ro				
2.4 Year of study	II	2.5 Semester	2	2.6 Type of assessment (E - exam, C - colloquium, V - verification)	E
2.7 Subject category	*DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară*				DF
	DI – Impusă, DOp – opțională, DFac – facultativă				DI

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminars		Laboratory	2	Project	
3.2 Number of hours per semester	56	of which:	Course	28	Seminars		Laboratory	28	Project	
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										15
(b) Supplementary study in the library, online and in the field										10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										15
(d) Tutoring										0
(e) Exams and tests										4
(f) Other activities:										0

3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	44
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Basic knowledge of Differential and Integral Calculus
4.2 Competence	Competences in elementary Differential and Integral Calculus: derivatives, integrals, series

5. Requirements (where appropriate)

5.1. For the course	
5.2. For the applications	

6. Specific competence

6.1 Professional competences	**C1 –** Operating with basic Mathematical, Engineering and Computer Science concepts (5 credits) **C1.1 -** Recognizing and describing specific concepts to calculability, complexity, programming paradigms and modeling of computing and communication systems **C1.2 -** Using specific theories and tools (algorithms, schemes, models, protocols, etc.) for explaining the structure and the functioning of hardware,

	software and communication systems **C1.3 -** Building models for various components of computing systems **C1.4 -** Formal evaluation of the functional and non-functional characteristics of computing systems **C1.5 -** Providing theoretical background for the characteristics of the designed systems
6.2 Cross competences	N/A

7. Discipline objective (as results from the *key competences gained*)

7.1 General objective	A presentation of the concepts, notions, methods and fundamental techniques used in differential calculus.
7.2 Specific objectives	Use of the differential calculus in order to solve problems in engineering.

8. Contents

8.1 Lectures	Hours	Teaching methods	Notes
Elements of Error Theory. Floating Point Arithmetic. Absolute and Relative Errors.	2	Explanation Demonstration Collaboration Interactive activities	
Numerical Methods in Linear Algebra. Special Types of Matrices. Norms of Vectors and Matrices. Eigenvalues and Eigenvectors. Error Estimation. Matrix Equations. Pivoting Elimination. Improved Solutions of Matrix Equations. Partitioning Methods for Matrix Inversion. LU Factorization. Doolittle's Factorization. Choleski's Factorization Method. Iterative Techniques for Solving Linear Systems. Jacobi Iterative Method. Gauss-Seidel Iterative Method. Relaxation Methods. Characteristic Polynomial: Leverrier Method. Characteristic Polynomial: Fadeev-Frame Method.	4		
Solutions of Nonlinear Equations. Method of Successive Approximation. The Bisection Method. The Newton-Raphson Method. The Secant Method. False Position Method. The Chebyshev Method. Numerical Solutions of Nonlinear Systems of Equations. Newton's Method for Systems of Nonlinear Equations. Steepest Descent Method.	4		
Elements of Interpolation Theory. Lagrange Interpolation. Divided Difference. Mean Value Properties in Lagrange Interpolation. Approximation by Interpolation. Hermite Interpolating Polynomial. Finite Differences. Interpolation of Multivariable Functions. Scattered Data Interpolation. Shepard's Method. Splines. B-splines.	6		
Elements of Numerical Integration. Richardson's Extrapolation. Numerical Quadrature. Error Bounds in the Quadrature Methods. Trapezoidal Rule. Richardson's Deferred Approach to the Limit. Romberg Integration. Newton-Cotes Formulas. Simpson's Rule. Gaussian Quadrature.	4		
Elements of Approximation Theory. Discrete Least Squares Approximation. Orthogonal Polynomials and Least Squares Approximation. Rational Function Approximation. Padé Approximation. Trigonometric Polynomial Approximation. Fast Fourier Transform. Bernstein Polynomial. Bézier Curves. *METAFONT.*	4		
Integration of Ordinary/Partial Differential Equations. The Euler Method. The Taylor Series Method. The Runge-Kutta Method. The Runge-Kutta Method for Systems of Equations. **Integration of Partial Differential Equations.** Parabolic Partial-Differential Equations. Hyperbolic Partial Differential Equations. Elliptic Partial Differential Equations.	4		

Bibliography

1. Dumitru Mircea Ivan. Calculus. Editura Mediamira, Cluj-Napoca, 2002. ISBN 973-9358-88-8.
2. Mircea Ivan and Kálmán Pusztai. Numerical Methods with Mathematica. Mediamira, Cluj-Napoca, 2003. ISBN

973-9357-41-5. 3. Ioan-Adrian Viorel, Dumitru Mircea Ivan, and Loránd Szabó. Metode numerice cu aplicaţii în ingineria electrică. Editura Universităţii din Oradea, 4. Mircea Ivan and Kálmán Pusztai. Mathematics by Computer. Comprex Publishing House, Cluj-Napoca, 1992.

8.2 Applications – Seminars/Laboratory/Project	Hours	Teaching methods	Notes
The applications follow the topics of the courses.	28	Explanation Demonstration Collaboration Interactive activities	

Bibliography

1. Mircea Ivan and Kálmán Pusztai. Numerical Methods with Mathematica. Mediamira, Cluj-Napoca, 2003. ISBN 973-9357-41-5.
2. Ioan-Adrian Viorel, Dumitru Mircea Ivan, and Loránd Szabó. Metode numerice cu aplicaţii în ingineria electrică. Editura Universităţii din Oradea,

Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Collaboration with engineers in order to identify and solve problems raised by the market.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Abilities of understanding and using creatively the concepts and proofs	Written examination	30%
Seminar			
Laboratory	Abilities of solving problems and applying algorithms	Written examination	70%
Project			

Minimum standard of performance:
Ability to present coherently a theoretical subject and to solve problems with practical content.

Date of filling in:	**Titulari**	**Titlu Prenume NUME**	**Semnătura**
	Course	Prof.dr. Dumitru Mircea IVAN	
	Applications	Prof. dr. Daniela ROSCA	

Date of approval in the department	Head of department Prof.dr.ing. Rodica Potolea
Date of approval in the Faculty Council	Dean Prof.dr.ing. Liviu Miclea