BACHELOR 'S PROGRAMME
2nd YEAR OF STUDY, 1st SEMESTER

COURSE TITLE	PHYSICAL DATA PROCESSING AND NUMERICAL METHODS
COURSE CODE	
COURSE TYPE	full attendance
COURSE LEVEL	1st cycle (bachelor's degree)
YEAR OF STUDY, SEMESTER	2nd year of study, 1st semester
NUMBER OF ECTS CREDITS	5
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar hours)
NAME OF LECTURE HOLDER	Assoc. prof. dr. Ioan DUMITRU
NAME OF SEMINAR HOLDER	Assoc. prof. dr. Ioan DUMITRU
PREREQUISITES	Advanced level of English

A — GENERAL AND COURSE-SPECIFIC COMPETENCES

General competences:

- → Applying teamwork techniques to solve a given physical problem.
- → Effective use of source information and communication resources and assisted training (portals, internet, specialized software applications, databases, on-line courses, etc.)

Course-specific competences:

- → Identifying how to use the basic IT concepts (algorithms, programming languages, specific software, numerical modeling) in the study of physics.
- → Explain the specific steps needed to develop algorithms to solve some problems with medium difficulty.
- → Estimating the degree of uncertainty of the experimental results obtained and the implementation of the physical models in the problems.

B — LEARNING OUTCOMES

Upon successful completion of this discipline, students will be able to:

- → Describe the algorithms used for numerical calculation methods
- → Transfer algorithms of computation into programming language
- → To search, process and analyze information from various program libraries to solve some numerical problems
- → To criticize the usefulness of a program sequence and to appreciate the errors that may occur
- → Assemble numerical methods in a process simulation or physical phenomenon.

C — LECTURE CONTENT

Introduction to numerical methods. C-specific elements of numerical methods
Number representation and numeric precision. Errors in numerical calculation.
Numerical solving of equations.
Elements of linear algebra. Matrix operations and calculus of determinants. Systems of linear equations.
Nonlinear equations and polynomial roots. Iterative methods.
Eigenvalues and Eigenvectors
Approximation of the functions of a real variable. Polynomial and spline interpolation.
Fitting experimental data. The method of Least Squares
Numerical derivation and integration.
Solving of differential equations. Solving differential equations with partial derivatives.
Use of numerical libraries in numerical computation

D — RECOMMENDED READING FOR LECTURES

1. Ioan Dumitru, Numerical Methods - www.phys.uaic.ro platform
2. J. M. McDonough - Lectures on basic computational numerical analysis, University of Kentucky Lexington, KY 40506, http://web.engr.uky.edu/~acfd/egr537-lctrs.pdf
3. Doron Levy - Introduction to Numerical Analysis - Department of Mathematics and Center for Scientific Computation and Mathematical Modeling (CSCAMM), University of Maryland, http://www.math.umd.edu/~dlevy/books/na.pdf
4. C. Berbente, S. Mitran, S. Zancu, Metode Numerice, Editura Tehnica, 1997. 304
5. Adrin BRADU - Analiza Numerica - exercitii si probleme, Editura UAIC
6. Numerical Recipes in C. The Art of Scientific Computing, 2nd Edition, 1992

E — SEMINAR CONTENT

Rounding and truncating numbers. Operations with strings. Methods for function approximation.
Root finding by the secant and the bisection methods.
Matrix calculation. Solving systems of linear and nonlinear equations.
Numerical derivation (Central finite differences, Finite ascending sifferences and Numerical integration (Newton Cotes, Simpson, Methods).

	The least squares method. Approximation with interpolation function. Newton interpolation polynomials with finite differences. Approximate functions by cubic spline functions. Finite difference method for solving differential equations. Solving differential equation systems (Runge Kutta method). Using the GSL library in numerical calculations. Summarizing and restating on main numerical methods. Laboratory colloquium
F	RECOMMENDED READING FOR SEMINARS
	1. Alejandro L. Garcia, Numerical Methods for Physics (Prentice Hall, Englewood Cliffs NJ, 1994) 2. J.M. Thijssen, Computational Physics. Springer Verlag, 1999. 3. GNU Scientific Library – Reference Manual - http://www.gnu.org/software/gsl/manual/html_node/ 4. Titus Adrian Beu, Calcul numeric în C, Microinformatica, Cluj, 2000 5. Alexandru LUPAS, Metode Numerice, Editura Constant Sibiu, 2001
G	EDUCATION STYLE
LEARNING AND TEACHING METHODS	Lecture, debate, discovery, problematizing, algorithm, debate, individual project
ASSESSMENT METHODS	• Exam: Written test: solving problems • Laboratory colloquium
LANGUAGE OF INSTRUCTION	English