Z1-PU7	WYDANIE N1	Strona 1 z 3

(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: NUMERICAL METHODS	**2. Course code**
3. Validity of course description: 2012/2013	
4. Level of studies: 1st cycle of higher education	
5. Mode of studies: Intramural studies	
6. Field of study: MACROCOURSE	(FACULTY SYMBOL)
7. Profile of studies:	
8. Programme:	
9. Semester: 4	
10. Faculty teaching the course: Institute of Automatic Control	
11. Course instructor: PhD Janusz Wyrwał	
12. Course classification: common course	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Mathematics. It is assumed that before starting to attend this course student has adequate knowledge in the field related to linear algebra, calculus and differential equations.	
16. Course objectives: The aim of the course is to teach basic terms related to numerical analysis and numerical methods used for approximate solving fundamental engineering problems. After completing the course students should be ready on his own to choose proper numerical method for solving fundamental engineering problems.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Lecture Sem. 4 - 30 h/**Laboratory** Sem. 4 - 30 h

19. Syllabus description:

Semester 5 :

Basic notions: convergence rate, conditionnning, stability of algorithm, computational efficiency. Sources of errors. Absolute and relative error. Truncation and round-off error. Positional numeral systems.

Numbers representation in computer. Two's complements representation. Floating point representation. Floating point errors – Loss of significance. Errors of algebraic computations.

Computation of function values. Horner's scheme and its applications: evaluating polynomial values, dividing polynomial by binomial, determining

interval of real roots, evaluating values of polynomial derivatives, determining decimal representation of numbers of different positional numeral systems, expanding polynomial in terms of powers of binomial, determining coefficients of polynomial after change of variable.
Continued fractions. Convergents of the continued fractions. Continued fraction expression of a real number. Convergence of continued fractions. Definition of analytical function of real variable. Taylor and Maclaurin series expansions. Errors of series expansions.
Interpolation. Formulation of the interpolation problem. Geometric interpretation. Basis functions. Lagrange's interpolating polynomial. Newton's interpolating polynomial. Divided differences. Linear difference operators, their properties and computations schemes. Relationships between divided differences and difference operators. Newton's interpolation polynomial with divided differences and difference operators. Errors of interpolation. Relationships between different interpolation polynomials. Examples.
Numerical differentiation. Differential operators and their relationship with difference operators. Formulas for numerical differentiation. Examples.
Numerical integration. Formulation of numerical integration. Newton-Cotes formula for numerical integration. Other numerical integration methods – Gauss formula, Chebyshev formula. Relationships between different integration methods. Examples.
Approximation. Formulation of the approximation problem. Different types of approximation. Space of square integrable functions. Least square approximation method. Examples of orthogonal and orthonormal bases. Point approximation. Uniform approximation in the space of continuous functions. Weierstrass Theorem. Chebyshev polynomials and their application in uniform approximation. Examples.
Solution of systems of linear equations. Conditioning of systems of linear equations. Direct methods. Algorithm of Gauss elimination method with full and partial pivoting. Inverse matrix determination. LU factorization. Cholevsky method. Examples. Iterative methods.
Eigenvalues and eigenfunctions. Definitions of eigenvalues and eigenvectors. Finding the greatest real eigenvalue and corresponding eigenvector – Power method. Matrix reduction. Inverse iteration. Jacobi method. Examples.
Approximate solution of nonlinear equations. Bisection method. Regula falsi method. Newton's method. Secand method. Comparison of convergence rates. Bernoulli method. Examples.
Approximate solution of ordinary differential equations. Newton's method and its modifications. Runge-Kutty method. Taylor's method. Piccard's method. Examples.

Laboratory exercises

1. Theory of Errors
2. Calculation of Function Value
3. Interpolation
4. Numerical Differentiation
5. Numerical Integration
6. Approximation
7. Solving Systems of Linear Equations
8. Determining Eigenvalues And Eigenvectors of Matrix
9. Approximate Solving of Non-Linear Equations
10. Approximate Solving of Ordinary Differential Equations
11. Approximate Solving of Partial Differential Equations
12. Approximate Solving of Integral Equations

20. Examination: ----

21. Primary sources:

Klamka J., Pawełczyk M., Wyrwał J., Numerical Methods. students' book, Gliwice, 2001
Kincaid D., Cheney W., Numerical Analysis: mathematics of scientific computing. Pacific Grove: Books/Cole Publ. Co., 2002
Ralston A., A First Course In Numerical Analysis. McGraw-Hill, 1965.
Burden R., Faires J., Numerical Analysis. Boston: PWS-KENT Publ. Co, 1985.
Demidowicz B. P., Maron I., Computational mathematics. Moscow: Mir Publ., 1987.
Press W. H. [et al.], Numerical recipes : the art of scientific computing. Cambridge University Press, 2007.

22. Secondary sources:

Ayyub B., McCuen R., Numerical Analysis for Engineers. Prentice Hall, 1996

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/20
2	Classes	30/20
3	Laboratory	0/0
4	Project	0/0
5	BA/ MA Seminar	0/0
6	Other	0/0
	Total number of hours	60/40

24. Total hours:100

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 2
27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):2
26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*