

Course title: Introduction to numerical methods

ECTS credit allocation (and other scores): 3,0

Semester: spring

Level of study: ISCED-6 - first-cycle programmes (EQF-6)

Branch of science: Engineering and technology

Language: English

Number of hours per semester: 30 + 15 = 45

Course coordinator/ Department and e-mail: Prof. Grzegorz Zboiński, D.Sc., Ph.D., M.Sc./Department of Mechanics and Bases of Machine Design, zboi@uwm.edu.pl

Type of classes: classes and lectures

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#### Substantive content

**CLASSES:** Programming the procedures of six basic tasks of numerical methods in MATLAB. Analysis and description of the obtained numerical results from different variants of the solution algorithm.

**LECTURES:** Interests of numerical methods, main types of computational tasks, application of numerical methods in mechanics. Fixed- and floating-point notation of real numbers, binary and decimal cases. Errors in numerical methods, Wilkinson Lemma. Stability and correctness of the algorithm, conditioning of the task. Polynomial interpolation of functions, method based on determination of polynomial coefficients, Lagrange's algorithm, Newton's algorithm, interpolation errors. Approximation of functions, base functions, mean square approximation: polynomial and trigonometric, approximation errors, least squares method algorithms based on algebraic and trigonometric polynomials. Solving systems of linear equations: elimination methods, approximate methods: iterative approach. Solving nonlinear equations: bisection method. Numerical differentiation, algorithms. Numerical integration, the method of rectangles, quadratures: methods of trapezoids and parabolas, Gauss quadrature.

**Learning purpose:** To gain the knowledge on basic problems of numerical methods and the ability to program them.

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On completion of the study programme the graduate will gain:

**Knowledge:** Basic knowledge of numerical methods and their applications in mechanics and other sciences.

**Skills:** Ability to define a numerical problem, program it, solve it, draw conclusions and make its description.

**Social Competencies:** Ability to cooperate with others in the field of programming the basic tasks of numerical methods.

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**Basic literature:** 1) Z. Fortuna, B. Macukow, J. Wąsowski, Metody numeryczne, wyd. WNT, Warszawa, 1993 (in Polish). A. Szatkowski, J. Cichosz, Metody numeryczne. Podstawy teoretyczne, wyd. Wydawnictwo PG, Gdańsk, 2002 (in Polish). G. Dahlquist, A. Bjork, Metody numeryczne, wyd. PWN, Warszawa, 1983 (in Polish). J. i M. Jankowscy, Przegląd metod i algorytmów numerycznych, wyd. WNT, Warszawa, 1981 (in Polish). A. Jankowski, Algorytmy metod numerycznych, wyd. Wyd. PG, 1981 (in Polish)

**Supplementary literature:** A. Zalewski, R. Cegieła, MATLAB – obliczenia numeryczne i ich zastosowania, wyd. Wyd. Nadkom, Poznań, 1997 (in Polish)

The allocated number of ECTS points consists of: 1,96 + 1,04 = 3,0

Contact hours with an academic teacher: 49 hours

Student's independent work: 26 hours