Politechnika Krakowska
im. Tadeusza Kościuszki

COURSE TITLE: Numerical Methods in Engineering
Number of contact hours: 45
Duration: 1 semester (spring)
ECTS credits: 4

Programme description:

This course introduces numerical techniques for solving engineering problems. Topics include root finding, linear systems, interpolation, numerical integration, and differential equations, with applications in engineering design and analysis.

Learning Objectives: a) Develop and implement numerical methods for engineering applications. b) Analyze the stability, accuracy, and convergence of numerical solutions. c) Solve linear and nonlinear equations using iterative methods. d) Apply numerical techniques to differential equations. e) Use computational tools such as MATLAB for problem-solving.

Course Outline:

1. Introduction to Numerical Methods: Role and limitations in engineering.
2. Root Finding: Bisection, Newton-Raphson, and Secant methods.
3. Linear Systems: Direct and iterative solvers (Gaussian elimination, Jacobi, Gauss-Seidel).
4. Interpolation and Curve Fitting: Polynomial and spline interpolation, least squares.
5. Numerical Differentiation and Integration: Finite difference, Trapezoidal, and Simpson's rules.
6. Ordinary Differential Equations: Initial and boundary value problems (Euler, Runge-Kutta).
7. Partial Differential Equations: Finite difference methods for heat and wave equations.
8. Applications in Engineering: Structural analysis, fluid mechanics, and heat transfer.

Course type: a) Lectures (15): Theoretical background and numerical algorithms b) Computer Lab: programming in MATLAB (30).

Literature:

1. Kiusalaas, J. (2015). Numerical Methods in Engineering with MATLAB® (3rd ed.). Cambridge: Cambridge University Press.
2. Taler J, Duda P. (2006). Solving Direct and Inverse Heat Conduction Problems. Springer International Publishing.

Assessment method: Reports from computer laboratories

Lecturer: Prof. Paweł Ocłoń

Contact person: Paweł Ocłoń (e-mail: pawel.oclon@pk.edu.pl)