**Nazwa przedmiotu:**

Mathematics III - Numerical Methods

**Koordynator przedmiotu:**

Dr Anna Zapart

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Civil Engineering

**Grupa przedmiotów:**

 Obligatory

**Kod przedmiotu:**

1120-BU000-ISA-9004

**Semestr nominalny:**

3 / rok ak. 2021/2022

**Liczba punktów ECTS:**

3

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

Total 80 h = 3 ECTS: lectures 15 h; laboratories 30 h; preparation for laboratories and tests 20 h; preparation for the exam and the exam 15 h.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

Total 45 h =1,5 ECTS: lectures 15 h; laboratories 30 h.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

Total 50 h = 2 ECTS: the presence on laboratories 30 h; preparation to laboratories 20 h.

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład:  | 15h |
| Ćwiczenia:  | 0h |
| Laboratorium:  | 30h |
| Projekt:  | 0h |
| Lekcje komputerowe:  | 0h |

**Wymagania wstępne:**

The knowledge of mathematics from first year is demanded to understand lectures and laboratories of numerical methods.

**Limit liczby studentów:**

bez limitu

**Cel przedmiotu:**

Mastery of basic numerical techniques concerning rootfinding for nonlinear equations, interpolations and approximations of functions, numerical integration and approximate solutions of differentials equations.
Skill of understanding basic numerical methods. Emphasis on advantages and weaknesses of numerical solutions. Knowledge of theorems concerning convergence of numerical methods.
Formation of skills to formulate and write calculation programmes in MATHCAD 2000.

**Treści kształcenia:**

1. Introduction to the numerical methods. The errors and their estimations. The well-posed problems and the ill-posed problems. The condition number. Stability of numerical algorithms.
2. Rootfinding for nonlinear equations and for systems of nonlinear equations. The bisection method, the secant method, Newton’s Method.
3. The polynomial interpolation. The interpolation by splines functions.
4. The method of least squares. The polynomial approximation. The trigonometric approximation.
5. The numerical integration. The simple and the composite trapezoidal quadratures. The simple and the composite Simpson’s quadratures. The Gauss-Legendre quadratures.
6. Numerical methods for ordinary differential equations. The approximate solution of the Cauchy problem. The analytical method – the Taylor expansion. The discrete methods: Euler’s methods, the Runge-Kutta methods.
Laboratory is conducted on the basis of MATHCAD 2000. During laboratory exercises each student learns MATHCAD 2000 and writes, uses and analyses computer programmes, which realize treating numerical methods.

**Metody oceny:**

Obligatory conditions to fulfill:
1. Credit for laboratory achieved by passing two practical tests and three theoretical tests.
The maximum number of possibly obtained points is 50 points. The minimum number
of points to obtain the credit for laboratory is 26 points.
 To take an exam a student must have credit for laboratory.
2. Passing a written exam including practical and theoretical problems. The maximum number of possibly obtained points is 50 points.
 The minimum number of points to pass the exam is 51 points (it is the sum of points
 obtained for laboratory and the exam).

**Egzamin:**

tak

**Literatura:**

[1] Atkinson K, E: An Introduction to Numerical Analysis, John Wiley & Sons, 2004.
[2] Auxiliary materials accessing on the server K of the Faculty of Civil Engineering (catalog: metnum).
[3] Grabarski A., Musiał-Walczak I., Sadkowski W., Smoktunowicz A., Wąsowski J. : Ćwiczenia laboratoryjne z metod numerycznych, OWPW Warszawa 2002.

**Witryna www przedmiotu:**

The server K of the Faculty of Civil Engineering (catalog:metnum).

**Uwagi:**

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka W1:**

He knowns the basic numerical techniques for solving nonlinear equations, interpolations and approximations of functions, numerical calculation of integrals and solving differential equations. He knows the theorems concerning the convergence of numerical methods. He has knowledge about the limitations of these methods.

Weryfikacja:

Two tests during the semester and the exam.

**Powiązane charakterystyki kierunkowe:** K1\_W01

**Powiązane charakterystyki obszarowe:** I.P6S\_WG.o, P6U\_W

### Profil ogólnoakademicki - umiejętności

**Charakterystyka U1:**

He can do calculations in MathCAD package implementing kwnow numerical methods. Able to assess the mistakes made in calculations.

Weryfikacja:

Tests

**Powiązane charakterystyki kierunkowe:** K1\_U01

**Powiązane charakterystyki obszarowe:** P6U\_U, I.P6S\_UW.o

### Profil ogólnoakademicki - kompetencje społeczne

**Charakterystyka K1:**

Student is able to work individually and in teams.

Weryfikacja:

By observing students in the course of lectures and classes.

**Powiązane charakterystyki kierunkowe:** K1\_K01

**Powiązane charakterystyki obszarowe:** P6U\_K, I.P6S\_KR