Wstęp do metod numerycznych - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Wstęp do metod numerycznych
Kod przedmiotu	11.0-WK-MATP-WMN-Ć-S14_pNadGenVW6K7
Wydział	Wydział Matematyki, Informatyki i Ekonometrii
Kierunek	Mathematics
Profil	ogólnoakademicki
Rodzaj studiów	pierwszego stopnia z tyt. licencjata
Semestr rozpoczęcia	semestr zimowy 2020/2021

Informacje o przedmiocie

Semestr	5
Liczba punktów ECTS do zdobycia	7
Typ przedmiotu	obieralny
Język nauczania	polski
Sylabus opracował	• dr Maciej Niedziela

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Ćwiczenia	15	1	-	-	Zaliczenie na ocenę
Laboratorium	15	1	-	-	Zaliczenie na ocenę
Wykład	30	2	-	-	Egzamin

Cel przedmiotu

The goal of this course is to teach the basic theories and fundamentals of numerical methods and to give the student knowledge how to implement these methods for computer solutions of mathematical problems. Most of the applications are based on the use of mathematical software package (Matlab, Octave or Scilab). The course also provides an introduction to Matlab as well as practice in computer programming. Topics include analysis of errors, numerical linear algebra, solution of linear systems of equations and nonlinear equations, interpolation and approximation by polynomials and numerical integration. Examples are taken from a wide variety of engineering situations.

Wymagania wstępne

Students attending classes are expected to pass the following courses:
1. Mathematical Analysis 1,2;
2. Linear Algebra 1,2;

Zakres tematyczny

Lecture

1. Computer Arithmetic

- Floating-point numbers and round-off errors (1 hour).
- Absolute and relative errors, loss of significance (2 hours).
- Stable and unstable computations (1 hour).

2. Solution of Nonlinear Equations

- Bisection method, Newton's method, secant method, Steffensen’s method (5 hours).
- Computing zeros of polynomials (1 hour).

3. Solving Systems of Linear Equations

- Matrix algebra, norms and the analysis of errors (2 hours).
- LU and Cholesky factorizations (2 hours).
- Gaussian elimination (2 hours).
- Solution of equations by iterative methods (2 hours).
- Steepest descent and conjugate gradient methods (2 hours).

4. Interpolation and Polynomial Approximation

- Taylor polynomials, Newton’s Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomial, Hermite interpolation, cubic spline interpolation, Chebyshev polynomials (6 hours).

5. Numerical Integration

- Simpson’s rule, trapezoidal rule, Gaussian quadrature (4 hours).

Class

1. Computer Arithmetic

- Floating-point numbers and round-off errors, absolute and relative errors (1 hour).
- Stable and unstable algorithms (1 hour).

2. Solution of Nonlinear Equations

- Bisection method, Newton's method, secant method – application of appropriate formulas and convergence theorems (4 hours).

3. Solving Systems of Linear Equations

- Matrix norms, condition number (1 hour).
- Mid-term test (1 godz.).
- LU and Cholesky factorizations – application of appropriate formulas and convergence theorems (2 hours).
- Jacobi method, Gauss-Seidel method, relaxation methods – application of appropriate formulas and convergence theorems (2 hours).

4. Interpolation and Polynomial Approximation

- Interpolation methods – application of appropriate formulas and convergence theorems (2 hours).
- Mid-term test (1 hour).

Laboratory

1. Computer Arithmetic

- Introduction to mathematical software package (Matlab, Octave or Scilab) (2 hours).
- Construction and implementation of simple algorithms – numerical solutions and stability problem (2 hours).

2. Solution of Nonlinear Equations

- Bisection method, Newton's method, secant method – implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (4 hours).

3. Solving Systems of Linear Equations

- LU and Cholesky factorizations, Jacobi method, Gauss-Seidel method, relaxation methods – implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (5 hours).

4. Interpolation and Polynomial Approximation

- Interpolation methods - implementation of algorithms, numerical solution of the problems, interpretation of the results, the use of mathematical software package (2 hours).

Metody kształcenia

Solving appropriate selected problems in the class and laboratory students can familiarize themselves with numerical methods provided during the lectures.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Student is able to solve simple mathematical problems by selecting and applying appropriate numerical method and using a mathematical package.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia
Student knows a basic mathematical package used for numerical computations.		• egzamin - ustny, opisowy, testowy i inne • obserwacja i ocena aktywności na zajęciach • test	• Wykład • Laboratorium • Ćwiczenia

Warunki zaliczenia

Verifying the level of preparation of students and their activities during the classes and laboratories.
Tests with tasks of different difficulty which help to assess whether students have achieved effects of the course in a minimum degree.
The assessment of the course consists of the grades of the exercises and laboratories (40%) and the written exam (60%). Student takes an exam under the condition of a positive evaluation of the exercise.
Student passes the course under the condition of a positive evaluation of the exercise, laboratory and written exam.

Literatura podstawowa

1. A.Björck, G.Dahlquist, Numerical Methods in Scientific Computing, SIAM, 2008.;
2. R.L.Burden, J.D.Faires, Numerical analysis, Prindle, Weber & Schmidt, Boston, Massachusetts, 1981;
3. J.Stoer, R.Bulirsch, Introduction to Numerical Analysis, Springer, 1993;

Literatura uzupełniająca

1. A.Quarteroni, R.Sacco, F.Saleri, Numerical mathematics, Springer, 2002;
2. A.Quarteroni, F.Saleri, Scientific Computing with Matlab and Octave, Springer, 2006;
3. P.Deuflhard, A.Hohmann Numerical analysis in modern scientific computing. An introduction, Springer, 2003;

Uwagi

Zmodyfikowane przez dr Alina Szelecka (ostatnia modyfikacja: 18-09-2020 13:45)