COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical methods for integral equations [S2MwT1>PO2-MNRC]

Course

Field of study
Mathematics in Technology

Year/Semester
1/2

Area of study (specialization)
Programming in Technology

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Student should have basic knowledge from calculus, linear algebra, basics of functional analysis and numerical methods.

Course objective

The aim of the subject is presentation of a few bacis methods for solving analytically and numerically integral equations. Curriculum of lectures and lab classes includes basic knowledge from Volterra and Fredholm integral equations of the first and second kind. The basic theory of multidimensional integral equations will be also presented.

Course-related learning outcomes

Knowledge:
1. Has extended and in-depth general knowledge of various branches of higher mathematics
2. Knows advanced numerical methods and algorithms
3. Knows at least one numerical software

Skills:

1. Is able to construct and analyse complex mathematical models
2. Can construct an algorithm for solving a complex engineering task or a simple research problem and implement and test it in a selected programming environment

Social competences:
1. Is aware of the possibility of making mistakes by himself and others
2. Is ready to think and act in a creative and entrepreneurial way, taking into account safety, work ergonomics and its economic aspects
3. Is aware of the importance of intellectual honesty in own and other people"s actions

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Oral exam from lecture part. Final project summary of designed algorithms.

Programme content

1. Introduction (lecture)
- normed spaces, operators, integral operator
- Banach and Schauder fixed point theorem
- Hilbert spaces, L2 space
- continuity of integral operators
2. Linear and non-linear integral equations (lecture)
- Fredholm and Volterra integral equations of the first and second kind, Abel equation
- physical and technical examples of integral equations
3. Neumann method (lecture and lab classes)
4. Degenerated kernel method (lecture and lab classes)
5. The finite sum method (lecture and lab classes)
6. Collocation method (lecture and lab classes)
7. Projection methods (lecture and lab classes)
8. Multidimensional integral equations (lecture and lab classes)
9. The finite sum method for systems of integral equations (lecture and lab classes)
10. Integro-differential equations (lecture)

Teaching methods

Lecture: traditional form given on the blackboard with discussion
Lab classes: creating and algorithms and solving numerically problems given by integral equations

Bibliography

Basic
1. R. Grzymkowski, Wybrane metody obliczeniowe równań całkowych, WPŚ, Gliwice 2015
2. A. Piskorek, Równania całkowe, WNT, Warszawa 1980
3. J. Wolska-Bochenek, Zarys równań całkowych i równań różniczkowych cząstkowych, PWN, Warszawa 1981
Additional
1. K. Atkinson, The numerical solution of the integral equations of the second kind, CUP, Cambridge 1997
2. A. M. Wazwaz, Linear and nonlinear integral equations, Springer, Beijing 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,00