COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical methods in engineering [S2Eltech1E>MNwT]

Course

Field of study
Electrical Engineering

Year/Semester
1/2

Area of study (specialization)
Microprocessor Control Systems in Electrical Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

The student starting this subject should have knowledge and skills of a numerical methods course from first-cycle studies. The student should have extended and deepened knowledge of mathematics (in the field of first-cycle engineering studies) and computer science (in the field of programming in a high-level language). The student should be aware of the need to expand their competences, know the limitations of their own knowledge and understand the need for further education.

Course objective

Presentation of advanced numerical methods useful in solving complex engineering problems, including in the field of electrical engineering. Support of engineering calculations with appropriate IT tools.

Course-related learning outcomes

Knowledge:
1. Has an expanded and in-depth knowledge of some mathematics fields, including elements of discrete and applied mathematics, necessary for modeling and analyzing the operation of advanced electrical devices and systems as well as describing and analyzing the operation and synthesis of complex

electrical systems. [K2_W01]
2. Has an expanded knowledge of advanced numerical methods used to solve complex technical tasks in electrical engineering. Knows and understands English terminology related to the field of studies. [K2_W02]
3. Has extended knowledge of computer-aided design. Knows and understands ergonomic rules, health and safety at work [K2_W18]

Skills:
1. Can obtain information from literature, database and from other sources as well as interpret, evaluate and critically analyze and formulate them with adding justified opinions [K2_U01]
2. Can work individually and as a part of a team, can drive the team in order to achieve deadlines; can determine directions of his and others further learning [K2_U02]
3. In formulating and solving engineering tasks, he can integrate knowledge from many sources and related disciplines. Can use analytical, simulation and experimental methods [K2_U16]

Social competences:
1. Recognizes the importance of knowledge in solving cognitive and practical problems and understands that in technology knowledge and skills quickly become obsolete and therefore require constant replenishment [K2_K01]
2. Is aware of the importance to develop professional achievements and comply with the rules of work ethics. [K2_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

LECTURE
Knowledge acquired during the lecture is assessed by a short written test. Points are converted into a final grade. The passing score is 50%. Points can be earned for completing additional assignments. Additional points can be earned for participating in class activities.
LABORATORY
Skills acquired during laboratory classes are verified on the basis of:
- obtaining a Matlab certificate (20 points = 20%),
- implementation (individually or in groups) of tasks during lab classes (30 points = 30%),
- implementation and development (in groups) on of the project (50 points = 50%).

Tasks should be posted through e-courses by the specified deadline.

NOTE: Creating and posting the project and tasks completed during lab classes is only possible after obtaining a MATLAB certificate.

There are 100 points to be earned in total. The points are converted into a final grade. The pass mark is 50% of the points.

The following percentage thresholds were adopted for both classes:
below 50% grade 2.0
50%-59% grade 3.0
60%-69% grade 3.5
70%-79% grade 4.0
80%-89% grade 4.5
90%-100% grade 5.0

Programme content

Advanced numerical methods for solving systems of equations and initial and boundary value problems.

Course topics

LECTURE
1. Finding solutions to systems of linear equations using numerical elimination-decomposition and iterative methods.

2. Numerical determination of solutions to systems of nonlinear equations.
3. Numerical methods for solving initial-value problems for ordinary differential equations and systems of equations.
4. Boundary-value and boundary-initial-value problems for partial differential equations. The finite difference method.
LABORATORY
1. Matlab.
2. Numerical methods for solving systems of linear equations. Elimination-decomposition methods (Gaussian elimination method, LU decomposition, Gauss-Jordan method). Iterative methods (Jacobi method, Gauss-Seidel method).
3. Numerical methods for solving systems of nonlinear equations (Newton-Raphson method).
4. Numerical methods for solving initial value problems for ordinary differential equations. Selected single-step Runge-Kutta methods. The influence of the order of convergence of methods on the quality of the solution. Stability and instability of solutions. Investigation of the relationship between the integration step, the convergence of the solution, and the method error.
5. Systems of ordinary differential equations. Selected single-step Runge-Kutta methods. Investigation of the relationship between the integration step, the convergence of the solution, and the method error. Stability and instability of solutions.
6. Boundary value problems for partial differential equations. Finite difference method. Convergence of solutions using the example of Laplace's equation.

Teaching methods

1. Multimedia lectures are conducted interactively, with questions posed to students, illustrated with examples solved by the lecturer on the board.
2. Laboratory activities include: review of reports by the teacher and discussion of comments, use of tools enabling students to complete assignments at home, demonstrations, individual and team work, and computational experiments.

Bibliography

Basic
1. D. Kincaid, W. Cheney, Numerical Mathematics and Computing, Thomson Books/Cole, Belmont 2008
2. R.L. Burden, J.D. Faires, Numerical analysis, Brooks/Cole, Boston 2011

Additional
1. E. Suli, D. Mayers, An Introduction to Numerical Analysis, Cambridge University Press 2003
2. L.R. Scott, Numerical Analysis, Princeton University Press, Princeton 2011

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00