COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical Methods

Course

Field of study
Electronics and Telecommunications

Year/Semester
3/5

Area of study (specialization)
Information and Communication Technologies

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
english

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes

Other (e.g. online)

Tutorials

Projects/seminars
15

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr inż. Krzysztof Malczewski

krzysztof.malczewski@put.poznan.pl

Responsible for the course/lecturer:

Prerequisites

The formal prerequisites reflect the fact that incoming students should have basic knowledge of ordinary differential equations and have had a first course in numerical methods. Indirectly, the prerequisites ensure that students have had multivariable calculus.

Course objective

After taking this course, students should be able to:

1. Apply standard techniques to analyze key properties of numerical algorithms such as stability and convergence,

2. Understand and analyze common pitfalls in numerical computing such as ill-conditioning and Instability,

3. Perform data analysis efficiently and accurately using data fitting methods,

4. Derive and analyze numerical methods for ODEs and PDEs,

5. Perform optimization using well-established algorithms,

6. Implement a range of numerical algorithms efficiently in Matlab.

Course-related learning outcomes

Knowledge

Construction and use of numerical systems.

Influence of data representation and computer architectures on algorithms choice and development.

Skills

How to:

- use numerical methods for solving a problem,

- locate and use good mathematical software,

- get the accuracy you need from the computer,

- assess the reliability of the numerical results,

and

- determine the effect of roundoff error or loss of significance.

Social competences

Accepts responsibilities for initiating scientific research, experiments or observations; understands social aspects of applying the acquired knowledge and skills and assumes the responsibility for the outcome; develops entrepreneurial skills.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Final exam following lectures - short written answers to 10 questions covering the whole lecture program Laboratory reports.

Knowledge testing on the fly during laboratories (entrance or final tests, knowledge checking during lab exercises) .

Grade breakdown:

<= 50% 2.0

51%-60% 3.0

61%-70% 3.5

71%-80% 4.0

81%-90% 4.5

91%-100% 5.0

Programme content

This course will emphasize the development of numerical algorithms to provide solutions to common problems formulated in science and engineering. The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use. The emphasis of the course will be the thorough study of numerical algorithms to understand (i) the guaranteed accuracy that various methods provide, (2) the efficiency and scalability for large scale systems. and (3) issues of stability. Topics include the standard algorithms for numerical computation: root finding for nonlinear equations, interpolation and approximation of functions by simpler computational building blocks (for example - polynomials and splines), numerical differentiation and divided differences, numerical quadrature and integration, numerical solutions of ordinary differential equations and boundary value problems, numerical optimization and regularization algorithms.

An important component of numerical analysis is computational implementation of algorithms which are developed in the course in order to observe first hand the issues of accuracy, computational work effort, and stability. Exercises will include computational experiments in a programming language of the student's choice. One class lecture will be devoted to a high level pseudo-code type programming language (Matlab) which will suffice in case students have not had prior programming experience. Attendence is required and the exams will be over the lectures and homework.

Teaching methods

Lectures supported by multimedia presentations.

The laboratory experiments evaluate the acquired technical skills and expertise required to apply these methods to practical signal processing tasks.

Bibliography

Basic

1. Numerical Methods for Scientists and Engineers by Richard Hamming

2. Numerical Methods for Engineers: With Software and Programming Applications by Steven C. Chapra, Raymond P. Canale

3. Numerical Methods That Work by Forman S. Acton Precise Numerical Methods Using C++ by Oliver Aberth

4. Numerical Methods for Chemical Engineers with MATLAB Applications by Alkis Constantinides, Navid Mostoufi

5. An Introduction to Numerical Methods: A MATLAB Approach by Abdelwahab Kharab, Ronald B. Guenther

6. www.kstio.com/nm

Additional

1. Numerical Methods Using MathCAD(R) by Laurene V. Fausett

2. Problem Solving in Chemical Engineering with Numerical Methods by Michael B. Cutlip (Preface), Michael B. Cutlip (Preface), Mordechai Shacham

Schaum's Outline of Linear Algebra by Seymour, Phd Lipschutz, Marc Lars, Phd Lipson

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	31	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	44	1,0

[1] delete or add other activities as appropriate