COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical Methods in Physic and Technology

Course

Field of study
Technical Physics

Year/Semester
1/1

Area of study (specialization)

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
20	15	
Tutorials	Projects/seminars	

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
Justyna Barańska

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Faculty of Materials Engineering and Technical Physics

Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Knowledge of physics, mathematics and computer science at the level after the first degree of education in the field of technical physics. Skill in analyzing simple physical systems from the point of view of the laws of physics governing their evolution. Understanding the role of physics in the process of creating new technologies. Skill in acquiring information from listed sources.

Course objective

1. Acquaintance of the students with the basic algorithms of numerical analysis with particular emphasis on the methods of interpolation and polynomial approximation, numerical integration and numerical solving of differential equations, including equations of motion.

2. Development of practical skills in independently developing programs that implement the known algorithms in the selected programming environment.

3. Team work ability development.

Course-related learning outcomes

Knowledge

1. Student, who has completed the course, is able to select and describe mathematical models for the description and analysis of physical processes and systems using vectors, matrices, systems of differential equations, non-linear differential equations [K2_W01]

2. Student, who has completed the course, is able to explaine the basic methods and principles of operation of numerical algorithms for solving systems of linear equations, numerical interpolation and approximation of experimental results and integration of differential equations, in particular equations of motion. [K2_W03]

Skills

1. Student, who has completed the course, is able to use mathematical knowledge to describe and create computer models of processes as well as physical and technical systems [K2_U01]

2. Student, who has completed the course, is able to formulate a complex physical / technical problem in the form of a mathematical model, propose a computer algorithm and a strategy for its solution [K2_U05]

Social competences

1. Student, who has completed the course, is able to to work responsibly on a designated multi-threaded task, independently and in a team, [K2_K01]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

W01, W03 : : Assessment of knowledge demonstrated in written work during the last lecture in semester on the grounds of scored points:

50.1%-70.0% (3)

70.1%-90.0% (4)

90.1%-100.0%(5)

U01, U05 , K01: Assessment of programming skills demonstrated in practice. Assessment of an individual oral presentation with the use of a computer program.

50.1%-70.0% (3)

70.1%-90.0% (4)

90.1%-100.0%(5)

Programme content

1. Numerical solution of systems of differential equations: Gauss elimination algorithm, Gauss-Jordan algorithm.

2. Polynomial interpolation: interpolation in Stevin monomial base, structure of the Lagrange polynomial, Lagrange polynomial generation algorithm, Newton's form of interpolation polynomial.

3. Interpolation by spline functions: structure of interpolating functions, interpolation algorithm

4. Polynomial approximation: linear approximation, approximation with higher order polynomials

5. Numerical integration algorithms: the method of rectangles and trapezoids, Newton-Cotes quadrature, 1/3 and 3/8 Simpson algorithms, simple and complex quadratures.

6. Numerical solution of differential equations: Euler's method, the intermediate point method, Heun's method, Runge-Kutta method of the fourth order, Verlet algorithm.

Teaching methods

1. Lectures: multimedia presentation, presentation illustrated with examples given on the blackboard.

2. Laboratory classes: practical exercises, conducting experiments, taking measurements, discussion, teamwork.

Bibliography

Basic

1. Z. Fortuna, B. Macukow, J. Wąsowski. “Metody numeryczne”, WNT, Warszawa.

2. J. i M. Jankowscy. ”Przegląd metod i algorytmów numerycznych”, WNT, Warszawa.

Additional

J. Stoer. “Wstęp do metod numerycznych” PWN, Warszawa, tom 1,2

Breakdown of average student's workload

	Hours	ECTS
Total workload	70	2,0
Classes requiring direct contact with the teacher	40	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	35	1,0

[1] delete or add other activities as appropriate