COURSE DESCRIPTION CARD - SYLLABUS

Course name
Numerical methods [S2ZE1E>MN]

Course

Field of study
Green Energy

Year/Semester
1/1

Area of study (specialization)
–

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 (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Knowledge of linear algebra, differential and integral calculus of functions of one variable. Ability to do basic programming in Python language. Skills: Logical thinking and inference. Social competences: Logical thinking and inference.

Course objective

Knowledge of basic discretization methods used in modern software dedicated to numerical simulations and their practical application in methods of modeling of thermal-flow phenomena

Course-related learning outcomes

Knowledge:
1. The student has a thorough knowledge of mathematics and numerical methods applied in the description of thermodynamic processes and fluid mechanics
2. He/she has ordered and deepened knowledge in solving systems of linear equations, nonlinear equations, function approximation and numerical differentiation and integration
3. He/she has extended knowledge, necessary for understanding of the profile subjects and specialized knowledge of the construction of numerical algorithms

Skills:
1. He/she is able to use his knowledge and skills to apply appropriate methods to solve problems and perform tasks related to engineering activities
2. He/she is capable of solving research and engineering tasks requiring the use of mathematical concepts and algorithmic thinking
3. He/she can acquire information from literature, internet, databases and other sources. Can integrate obtained information, interpret and draw conclusions from it in order to optimize ped heat and energy transport phenomena.

Social competences:
1. He/she is ready to critically evaluate his/her knowledge and perceived content in the field of numerical algorithms
2. He/she is ready to acknowledge the importance of knowledge in solving cognitive and practical problems and to seek expert advice in case of difficulties in solving the problem independently
3. He/she understands the need for critical assessment of the possessed knowledge and continuous education

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Performing laboratory exercises and submitting a report from the exercise
Written examination
Pass test

Programme content

Numerical differentiation and integration.
Function approximation.
Iterative methods for solving equations and their systems.
Koncepcja równania transportu
Methods of dicretization used in computational fluid dynamics

Course topics

The concept of transport equation
Discretization of differential equations: difference, element and finite volume methods
Discretization methods for diffusion and convection terms in the equation of transport
Examples of application of discretization methods in practice (Python)
Case analysis of the numerical solution of a flow problem based on available numerical software (OpenFoam, Ansys Fluent)

Teaching methods

Blackboard lecture
Independent practical training
Computer labs

Bibliography

Basic:
Joe D. Hoffman, Numerical Methods for Engineers and Scientists, Marcel Dekker, Inc. 2001
Ferzeiger J.H. Ferziger, Computational methods for Fluid Dynamics, Springer, 2002

Additional:
Anderson J., Computational Fluid Dynamics: An Introduction, McGraw-Hill; International edition (January 1, 1995)
Guo Z, Shu C., Lattice Boltzmann Method and Its Applications in Engineering (Advances in Computational Fluid Dynamics), World Scientific, 2013

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