COURSE DESCRIPTION CARD - SYLLABUS

Course name

Modeling of thermal processes [N1Energ2>MPC]

Course

Field of study
Power Engineering

Year/Semester
5/9

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
20

Laboratory classes
10

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr inż. Joanna Jójka
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Lecturers

Prerequisites

Has advanced, grounded and in-depth knowledge of thermodynamics, mathematics and fluid mechanics, necessary to describe and analyse the operation of energy elements and systems, as well as physical and chemical processes related to energy generation, storage and supply [K1_W01]. Is able to use the known analytical, simulation and experimental methods as well as mathematical models and computer simulations to analyse and evaluate the operation of energy components and systems [K1_U07]. Is aware of a critical assessment of the knowledge he/she possesses, recognises its importance in solving cognitive and practical problems, as well as in decision-making in processes related to energy generation, storage and supply [K1_K01].

Course objective

The aim of the course is to use numerical based software tools to solve problems related to thermodynamics and fluid mechanics. Students gain knowledge and skills in modelling energy conversion processes and determining the differences between simplified analytical calculation results and the numerical solution in the field of heat, momentum and mass transfer, including combustion processes.

Course-related learning outcomes

Knowledge:
Has a structured and theoretically supported knowledge of the use of thermodynamics, fluid mechanics, heat transfer elements for modelling basic energy conversion technologies [K1_W06].
Has advanced and well-established knowledge of the construction, operation and diagnostics of energy devices, machines, installations and networks, and is familiar with computational methods and computer tools necessary for the analysis of experimental results [K1_W10].
Has a well-established and theoretically supported knowledge of energy generation and supply [K1_W12].

Skills:
Is able to select numerical models and perform numerical analysis for a combined heat and flow system; is able to critically analyse how existing engineering solutions function and evaluate these solutions [K1_U14].
Is able to design simple combined heat and flow systems for a variety of applications, and is able to make an initial assessment of proposed solutions and engineering actions taken [K1_U18].

Social competences:
Is aware of the need to initiate changes related to the implementation of new technologies and technical and organisational solutions in the power industry [K1_K04].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - written test. Pass mark: 50%. There is a possibility to supplement the written assessment in verbal form in order to increase the obtained mark.
Laboratory - evaluation of current progress in the form of a report on the completed exercise and answer to questions asked verbally. Final report is submitted in written form. Pass mark: 50%.

Programme content

Theoretical and practical introduction to numerical computations, including geometry modeling, discretization methods, and selection of appropriate numerical models for the analyzed heat and flow phenomena.

Course topics

1. Introductory workshop. Conduction in a solid body.
2. Air flow modelling. Modelling of free and forced convection.
3. Modelling of heat transfer in a water/exhaust gas heat exchanger. Modelling transportation of species using flue gases as an example.
4. Coupled CHT heat transfer.
5. Mixing systems. Modelling the turbulent fuel-air mixing process.
6. Modelling fuel combustion process for natural gas and selected alternative fuel.

Teaching methods

Lecture - whiteboard lecture and/or a multimedia presentation and case study demonstration.
Laboratory - case study demonstration with explanation and instruction, followed by completion of a given laboratory/design exercise by students individually.

Bibliography

Basic:
Ansys Fluent User/Theory Guide
Maciej Kryś, Mateusz Pawłucki, CFD dla inżynierów. Praktyczne ćwiczenia na przykładzie systemu ANSYS Fluent, 2020
S. Wiśniewski - Wymiana ciepła

Additional:
COMPUTATIONAL FLUID DYNAMICS. The Basics with Applications. J.D Anderson
Fundamentals of Heat and Mass Transfer. Frank P. Incropera, David P. DeWitt, Theodore L. Bergman,

Adrienne S. Lavine
Thermodynamics. RAO, Y. V. C. Rao

Breakdown of average student's workload

	Hours	ECTS
Total workload	85	3,00
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)	55	2,00