POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Computational Fluid Dynamics [S2MiBM2-IWP>NMP]

Course

Field of study
Mechanical Engineering

Year/Semester
2/3

Area of study (specialization)
Virtual Engineering Design

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Piotr Posadzy
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Lecturers

Prerequisites

KNOWLEDGE: Has basic knowledge of thermodynamics and fluid mechanics to the extent necessary to understand the principle of operation and calculations of thermodynamic and flow processes occurring in machines SKILLS: the student is able to integrate the obtained information, interpret it, draw conclusions, formulate and justify opinions Can use a popular numerical system to program a simple system simulation task with a small number of degrees of freedom SOCIAL COMPETENCES: the student understands the importance of self-education and broadening his knowledge

Course objective

Introduction to computational fluid mechanics in the field of conducting flow simulations for selected devices and machines. Acquiring practical knowledge and the ability to use specialized software.

Course-related learning outcomes

Knowledge:
Has basic, theoretically founded general knowledge covering key issues in the field of computational fluid mechanics.
Has knowledge of the classification of flows and the knowledge of how to model real flows.

Has knowledge of numerical methods used in computational fluid mechanics.
Has structured, theoretically based knowledge of modeling supporting machine design. Knows the concepts and practical application of modern methods of optimal design.
Has knowledge in creating detailed technical documentation. Has structured, theoretically based knowledge of the use of information systems in the design of machines and technological processes.

Skills:
Can model flows using selected commercial software and analyze and critically evaluate the obtained results.
Can use engineering methods and IT tools to formulate and solve tasks.
Has the ability to self-study.
Is able to formulate criteria for selecting the appropriate mathematical method to solve a given technical problem. Is able to use selected mathematical methods to solve a technical problem. Is able to use basic methods of statistical analysis to evaluate measurements of technical quantities.
Is able to apply the laws of mechanics in solving problems in the field of mechanics and machine construction. Is able to describe the dynamics of complex mechanical systems. Is able to integrate the information obtained, interpret it, draw conclusions and formulate and justify opinions.
Is able to use IT systems in the design of machines and technological processes relevant to mechanics and machine construction. Is able to use CAx systems to design machines and simulate engineering issues.

Social competences:
Can obtain information from literature, databases and other properly selected sources, also in English; is able to integrate the obtained information, interpret it and draw conclusions.
Understands the need for lifelong learning; can inspire and organize the learning process of other people.
Has the ability to self-study.
Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in the event of difficulties in solving the problem on its own.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Oral and written tests. Assessment of individually made projects.

Programme content

Introduction to computational fluid mechanics, discussion of the basic assumptions and methods of flow modeling. DNS and RANS models. Turbulence modelling. Overview of governing equations, formulation of FEM and FVM, discussion of variational methods (standard Galerkin method).
Boundary layer. The problem of generation and quality of computational flow meshes.
Drag and lift. Estimation of aerodynamic forces. Analysis and interpretation of simulation results.
Practical classes include the application of the discussed content from the lecture in selected commercial/open source software used in industry.

Course topics

Advantages and disadvantages of CFD
Flow classification
CFD reliability
Governing equations
Turbulence modeling
RANS model
Time patterns

Laboratory:
External flows
Internal flows (ventilator channel)
Heat exchanger
Meshing - ICEM

Teaching methods

Information / problem lecture, Case study, laboratory with elements of project.

Bibliography

Basic:
T. J. Chung: Computational Fluid Dynamics. Cambridge Unmivesity Press 2002

Additional:
O.C. Zienkiewicz: Metoda Elementów Skończonych. WNT Warszawa 1977

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	55	2,00