POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name

Computational fluid mechanics [S2EJ1>OBP]

Course

Field of study

Nuclear Power Engineering

Year/Semester

1/2

Area of study (specialization)

–

Profile of study

general academic

Level of study

second-cycle

Course offered in

Polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

30

Laboratory classes

30

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

5,00

Coordinators

dr inż. Bartosz Ziegler
bartosz.ziegler@put.poznan.pl

Lecturers

Prerequisites

The student should have basic knowledge and skills in mathematics especially in the areas of differential calculus of many variables, vector calculus, linear algebra and differential operators, in addition, thermodynamics in terms of heat flow and perfect gas transformations, fluid mechanics (both compressible and incompressible).

Course objective

To acquire knowledge and skills in performing numerical calculations and analysis of their results in terms of flow phenomena in components of machinery and power equipment that can be used in nuclear power engineering. To familiarize the student with algorithms and numerical methods used in CFD analysis including the problems of compressible flows, turbulence modeling and quality assessment of numerical analysis.

Course-related learning outcomes

Knowledge:

1 The student knows the basic equations of mass, momentum and energy transport, the theoretical basis and the strengths and weaknesses of the turbulence modeling approaches used, and the types of

boundary conditions adopted in the calculations.
2. The student knows the computational methods used to solve fluid mechanics and heat flow problems.
3. The student has knowledge of the convergence criteria of numerical calculations.

Skills:
1 The student is able to apply basic methods of algebraization of differential equations to solve thermal-fluid problems.
2. The student performs CFD calculations for thermal-fluid problems using commercial software.
3. The student consciously selects numerical algorithms for solving nonlinear equations describing problems of fluid mechanics including, in particular, discretization schemes for the convection members of these equations.

Social competences:
1. The student understands that by performing calculations and carrying out engineering activities, he/she has an impact on the environment.
2. The student understands the necessity of systematic learning. He/she is also able to inspire and organize the learning process of others.
3. The student is aware of the necessity to cooperate with others in order to realize difficult computational and technical problems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture
Written exam on the content presented in the lecture.
The list of issues will be made available to students at the beginning of the semester.
A positive grade will be given to students who score above 50%.
Laboratories
Completion of computational tasks during classes and completion of a small project.
The activity and independence of students during the performance of computational tasks in laboratories will be taken into account.

Programme content

Lectures
Basic concepts and equations describing problems of fluid mechanics and heat flow. Types of boundary conditions in thermal-fluid analyses. Methods of discretisation of differential equations. Triangulation, creation and types of computational grids. Interpolation and approximation methods. Numerical methods for solving nonlinear equations on the example of flow problems.
Laboratories
Conducting simple flow analyses for incompressible and compressible flows based on a perfect gas model on provided computational grids. Creating two-dimensional structured and unstructured grids.

Course topics

none

Teaching methods

Lectures: multimedia presentation supplemented by explanations given on the blackboard.
Laboratories: calculations performed using openlu available software tools and commercial CFD codes .

Bibliography

Basic:
1. Ansys Fluent users guide & theory guide
2. Björck A, Dahlquist G., Metody numeryczne, PWN, 1983.
3. Kincaid D., Cheney W., Analiza numeryczna, WNT, W-wa 2006.
4. Wiśniewski, S., Wiśniewski, T., Wymiana ciepła, WNT, 2002.

Additional:
1. White F. M., Fluid Mechanics, McGraw-Hill Education, New York 2016.
2. Incropera F., DeWitt D., Fundamentals of heat and mass transfer, Wiley, 2008
3. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Taylor & Francis, 1980.

Breakdown of average student's workload

	Hours	ECTS
Total workload	127	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50