Cracow University of Technology

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies in the academic year 2022/2023

Information on the course

Name of the course in Polish	Mechanika płynów
Name of the course in English	Fluid mechanics
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Choosable
Field of education	Engineering and technology
Discipline of education	Mechanical engineering
Person responsible for the course Contact	Prof. Piotr Duda, *doctor habilitatus* piotr.duda@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical classes	Laboratory	Computer Lab	Project Class	Seminar
2, 3, 4, 5	G	15	0	0	0	0	0

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	Introduction to the methods of fluid flow description.
Objective 2	Acquiring the ability to solve selected flow problems.

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUD DS	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student is familiar with the methods of fluid motion research.	E_W01, E_W02	Involvement in class activities, a presentation
EUW2	The doctoral student knows Helmholtz's theorem (first and second)	E_W01, E_W02	Involvement in class activities, a presentation
OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student is able to describe the general equation of behavior and provide its specific cases.	E_U01	A presentation, discussion.

EUU2	The doctoral student is able to provide the most known methods of solving and discretization of fluid mechanics equations.	E_U01	Discussion.
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is able to refer to the methods of fluid flow analysis known in the subject literature and occurring in the issue related to the implementation of the doctoral dissertation. The doctoral student is able to justify the models they use or the lack of the need to use them.	E_K01, E_K03	Discussion.

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	Fluid motion research methods. Concepts and theorems of fluid mechanics. Lagrange and Euler method. Fluid element path and streamline. Local fluid movement. Helmholtz's first theorem. Vortex fluid flow. Swirling fluid motion. Helmholtz's second theorem.	EUW1, EUW2	5
W2	The principle of conservation of chemical components, mass, momentum and energy. Discussion. Basic equation of motion of an ideal fluid. Applications of the Bernoulli equation. Application of the conservation of momentum and angular momentum principle. Dynamics of viscous fluids. Navier-Stokes equation. Fundamentals of the boundary layer theory.	EUW1, EUU1	5
W3	Elements of the theory of turbulent flow. Flux of a solid body with a fluid. Methods of solving and discretization of fluid mechanics equations. Taylor expansion. Variational formulation. Weighted residual method. Finite volume method.	EUW1, EUU1, EUU2, EUK1	5

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH AN ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF AN ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, a report, a project, a presentation, a discussion	4
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

Preliminary requirements

No.	Requirements
1	Knowledge of differential and integral calculus.
2	Knowledge of the English language.

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	Conversation on the issues presented in the class.
METHOD OF THE FINAL GRADE CALCULATION	
Weighted average grade for the presentation and the conversation.	

Additional information

None specified.

The course reading list

1	Patankar S.V., *Numerical Heat Transfer and Fluid Flow*, 1980, Taylor & Francis Inc.
2	Gryboś R., *Podstawy mechaniki płynów. Cz. 1, Kinematyka, dynamika cieczy i gazów, hydrostatyka*, Warszawa, 1988, Wydawnictwo Naukowe PWN.
3	Gryboś R., *Podstawy mechaniki płynów. Cz. 2, Turbulencja, metody numeryczne, zastosowania techniczne*, Warszawa, 1988, Wydawnictwo Naukowe PWN.
4	Prosnak W.J., *Mechanika płynów. T. 1, Statyka płynów i dynamika cieczy*, Warszawa, 1971, PWN.