FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish:	Wybrane zagadnienia procesów cieplno-przepływowych
Name of subject in English:	Selected problems of thermal-flow processes
Main field of study (if applicable):	Power engineering
Specialization (if applicable):	
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	obligatory
Subject code:	W09ENG-SM0037
Group of courses:	NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark final course with (X)					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1		0.75		

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to create 3D geometry in engineering programs.
2. Knowledge of heat transfer and fluid mechanics.

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SUBJECT OBJECTIVES
C1 - transfer of knowledge about methods of simulation of thermal-flow phenomena C2 - transfer of knowledge on modeling methods for selected thermal and flow processes C3 - developing skills in selecting appropriate models of multiphase flows C4 - developing skills in performing numerical calculations for models with the implemented radiation model and FSI

SUBJECT LEARNING OUTCOMES
relating to knowledge: PEK_W01 - has knowledge of equations describing heat transfer and fluid movement PEK_W02 – has a view on the phenomenon of turbulence and its models PEK_W03 - has knowledge of methods of numerical solving of heat exchange issues PEK_W04 - be familiar with the methods of numerical solution of inverse problems PEK_W05 - has knowledge of multiphase processes such as condensation and evaporation PEK_W06 - can model radiation-related processes PEK_W07 - has a basic knowledge of the FSI method PEK_W08 – has knowledge of process analysis at high factor speeds relating to skills: PEK_U01 - can generate geometries and numerical grids PEK_U02 - has the ability to choose the appropriate flow model in multiphase flows PEK_U03 - can perform numerical calculations of steady and transient heat conduction PEK_U04 - can perform numerical calculations of mixing substances in mixers PEK_U05 - can model processes with speeds for which the Mach number is greater than 1

PROGRAM CONTENT

Lectures		Number of hours
Lec 1	Body heating with low thermal conductivity. Transient heat transfer in flat plate, cylinder and ball.	2
Lec 2	Unsteady heat transfer in a semi-infinite body. Heat conduction at transient boundary conditions	2
Lec 3	Numerical methods for solving heat conduction problems.	2
Lec 4	Methods for solving inverse problems.	2
Lec 5	Heat transfer in a volume filled with radiating gas.	2
Lec 6	Numerical methods for solving radiation heat transfer.	2
Lec 7	Multiphase flows - general information.	2
Lec 8	Modeling of discrete phase flows. Free surface flow.	2
Lec 9	Condensing heat transfer.	2
Lec 10	Boiling heat transfer.	2
Lec 11	Mass transfer modeling methods.	2
Lec 12	Numerical methods for solving mixing problems.	2
Lec 13	Impact of flow and mechanical structures - FSI.	2
Lec 14	Heat transfer during flows at high speeds	2
Lec 15	Final test.	2
	Total hours	30

aboratory		Number of hours
Lab 1	Organizational issues	1
Lab 2	Transient heat transfer.	2
Lab 3	Modeling of heat transfer by radiation.	2
Lab 4	Modeling of multiphase flows.	2
Lab 5	Modeling of condensation / boiling processes.	2
Lab 6	Modeling of flow containing solid particles.	2
Lab 7	Modeling of the mixing process in a mixer.	2
Lab 8	Modeling of turbine blade flow.	2
	Total hours	15

TEACHING TOOLS USED
N1. Multimedia presentation. N2. A program for generating geometry and numerical grids, among others ANSYS ICEM or SpaceClaim Geometry. N3. The program for conducting simulations, among others CFD ANSYS CFX. N4. Consultations

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT - Lecture

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P	PEK_W01- PEK_W08	Final test

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT - Laboratory

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
F1	PEK_U01- PEK_U03	Report from Lab 2
F2	PEK_U01- PEK_U03	Report from Lab 3
F3	PEK_U01- PEK_U04	Report from Lab 4
F4	PEK_U01- PEK_U04	Report from Lab 5
F5	PEK_U01- PEK_U04	Report from Lab 6
F6	PEK_U01- PEK_U04	Report from Lab 7
F7	PEK_U01- PEK_U04	Report from Lab 8
C=0,1F1+0,2F2+0,2F3+0,2F4+0,1F5+0,1F6+0,1F7		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Patankar S., Numerical Heat Transfer And Fluid Flow, McGraw-Hill, Book Company, 1980. [2] Versteeg H. K., Malalasekera W., An Introduction to Computational Fluid Dynamics. The Finite Volume Method, 2nd ed., Pearson Education Limited, 2007. [3] Anderson J. D., Computational Fluid Dynamics. The Basics with Applications., McGraw-Hill Book Company, 1995. **SECONDARY LITERATURE:** [1] Tannehill J. C., Anderson D. A., Pletcher R. H., Computational Fluid Mechanics And Heat Transfer, Taylor & Francis, 1997. [2] Ferziger J. H., Peric M., Computational Methods For Fluid Dynamics, 3rd ed., Springer, 2007. [3] Hoffmann K. A., Chiang S. T., Computational Fluid Dynamics, 4th edition, vol. I,II,III, Engineering Education System, 2000.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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