POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name

METHODS FOR MODELLING HEAT FLOW IN ENERGY DEVICES [S5ISGIE>MMPCUE]

Course

Proposed by Discipline

–

Year/Semester

3/5

Level of study

Doctoral School

Course offered in

English

Form of study

full-time

Requirements

elective

Number of hours

Lecture

4

Laboratory classes

0

Other

0

Tutorials

0

Projects/seminars

0

Number of credit points

1,00

Coordinators

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Lecturers

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Prerequisites

Knowledge: PhD student has basic knowledge in the field of thermodynamic, heat transfer and mathematics. PhD student knows the structure of basic energy devices. Skills: PhD student can use basic mathematical tools such as differential calculus, linear algebra and numerical analysis. Social competencies: doctoral student is able to consider opinions of other social groups in his/her deliberations and to conduct debates on various aspects related to the conducted research.

Course objective

To acquaint PhD students with the theoretical and practical problems related to modelining of heat transfer in energy devices.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:

1) global achievements, covering theoretical foundations as well as general and selected specific issues that are relevant to modeling of heat transfer, [P8S_WG/SzD_W01]

2) major development trends for modeling of heat transfer. [P8S_WG/SzD_W02]

Skills

A PhD student who graduated from doctoral school can:
1) critically analyze and assess scientific research results, work of experts and other creative activities in field of modeling of heat transfer in energy devices, [P8S_UW/SzD_U02]
2) communicate on specialized issues concerning heat transfer at a level that allows activeparticipation in the international scientific community. [P8S_UK/SzD_U04]

Social competencies
A PhD student who graduated from doctoral school is ready to:
1) critically evaluate their own contribution to development of modeling of heat transfer in energy devices, [P8S_KK/SzD_K02]
2) recognition of the importance of knowledge in solving cognitive and practical problems in heat transfer. [P8S_KK/SzD_K03].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

W01, W06; written final test covering the verification of theoretical knowledge, 7 questions from the material presented during the lectures;
number of points 7

U02, U04; final test and rewarding the knowledge necessary to solve scientific problems in the subject, solving one problem related to presented material; number of points 2

K02, K03; written test of social skills in the subject, one question;
number of points 1

Programme content

1) The basic forms of heat flow: conduction, convection and radiation.
2) Methods of modelling temperature fields.
3) Direct and inverse heat conduction problem (IHCP). Stability of the solution IHCP.
4) Heat transfer modeling in a thermo-chemical treatment furnace.

Course topics

Differential equations of heat transfer, boundary conditions, convection, radiation, heat transfer modelling methods; direct problem, inverse problem of heat transfer; boundary conditions on the surface of elements treated with thermochemical treatment.

Teaching methods

Lecture: multimedia presentation including illustrations, examples and a tutorial analysis.

Bibliography

Basic
1) F.P. INCROPERA, D. P. DEWITT, Fundamentals of Heat and Mass Transfer, SIXTH EDITION, John Wiley & Sons, 2007.
2) T. L. Bergman, A. S. Lavine, Fundamentals of Heat and Mass Transfer, Wiley, 2017.
3) F. Hecht, FreeFEM Documentation, Release 4.13, 2024.
4) D. Joachimiak, M. Joachimiak, A. Frąckowiak, Determination of boundary conditions from the solution of the inverse heat conduction problem in the gas nitriding process, Energy, vol. 300, pp. 131497-1-131497-10, 2024.

Additional
1) M. Joachimiak, D. Joachimiak, Stabilization of boundary conditions obtained from the solution of the inverse problem during the cooling process in a furnace for thermochemical treatment, International Journal of Heat and Mass Transfer, vol. 224, pp. 1-12, 2024.
2) D. Joachimiak, T. Borowczyk, M. Joachimiak, A model of the steam compression process in a piston reactor, Archives of Thermodynamics, vol. 44, no. 4, pp. 261-284, 2023.
3) D. Kincaid, W. Cheney, Numerical Analysis. Mathematics of Scientific Computing, California, 1991.

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,00
Classes requiring direct contact with the teacher	4	0,00
Doctoral student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)	21	1,00