POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name

THE FIRST LAW OF THERMODYNAMICS AND POWER CALCULATION OF TURBOMACHINERY [S5ISGIE>PZTIOMMW]

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

1. Knowledge: Mathematics: differential and integral calculus. Physics: fluid mechanics, thermal engineering. 2. Skills: Applying differential and integral calculus to describe physical phenomena. 3. Social Competencies: Awareness of the need to continually update knowledge and skills.

Course objective

Broadening and deepening knowledge and skills in the field of thermodynamics and turbomachinery necessary to solve complex problems in energy devices and systems.

Course-related learning outcomes

Knowledge
1. A doctoral student knows and understands the first law of thermodynamics and its application in the theory of turbomachinery (P8S_WG/SzD_W01).
2. A doctoral student has a structured and theoretically grounded knowledge of the operation of turbomachinery and the introduction of simplifications in the equations of conservation of mass, momentum, and energy in the theory of turbomachinery (P8S_WG/SzD_W01).
3. A doctoral student knows and understands the equations describing the operation of water, steam, gas, and wind turbines, as well as pumps, fans, blowers, and compressors (P8S_WG/SzD_W01).

4. A doctoral student knows the phenomena responsible for energy losses in turbomachines and has in-depth knowledge of methods for reducing these losses (P8S_WK/SzD_W05).

Skills:
1. A doctoral student is able to calculate the energy characteristics of various turbomachines (P8S_UW/SzD_U01).
2. A doctoral student is able to consciously apply simplifications in the equations describing the operation of turbomachinery and predict their consequences (P8S_UW/SzD_U02).

Social Competencies:
1. A doctoral student understands the need for teamwork in solving theoretical and practical problems (P8S_KK/SzD_K03).
2. A doctoral student recognizes the need to systematically deepen and expand their competencies (P8S_KK/SzD_K03).

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

A written final work of a computational and analytical nature.
The correctness of calculations, the validity of the simplifying assumptions made, the accuracy of the conclusions drawn, the level of calculation tools used, the method of presenting results, the structure and aesthetics of the work will be assessed.
The maximum score for the work is 20. A passing grade requires a minimum of 10 points. Grading scale:
0-9 points = 2.0
10-12 points = 3.0
13-14 points = 3.5
15-16 points = 4.0
17-18 points = 4.5
19-20 points = 5.0

Programme content

Turbomachinery – classification and figures.
Working fluids – selected thermophysical properties.
Power of turbomachinery – general equation and specific equations.
Energy balance for open thermodynamic system.
First law of thermodynamics – differential form.
Technical work and technical power.
Mass conservation low of the working fluid.
Isentropic (adiabatic reversable) thermodynamic process.
Power of selected turbomachines – derivation of equations.
Sample tasks, solutions and discussion.

Course topics

Working fluids and their properties.
Classification of turbomachinery.
Total, static, dynamic, and elevation pressure of an incompressible fluid (liquid).
Total, static, dynamic, and elevation enthalpy of a compressible fluid (gas).
Energy conservation law in the flow of incompressible and compressible fluids.
Adiabatic compression and expansion of a gas.
Isentropic efficiency of the gas compression and expansion process.
Power and efficiency of turbomachines from a thermodynamic perspective.
The first and second laws of thermodynamics - differential approach.
The principle of conservation of mass in turbomachinery.
Derivation of equations for the power of selected turbomachines.
Energy losses in turbomachinery.

Teaching methods

An informative lecture with elements of conversational instruction. A multimedia presentation illustrated with examples.

Bibliography

Basic
1. White F.M., Fluid Mechanics. McGrawHill Book Company. 5th Int. Ed. Boston 2003.
2. CENGEL Y.A., BOLES M.A., Thermodynamics. An Engineering Approach. 6 Edition (SI Units), McGraw-Hill Higher Education, 2007.

Additional
1. Munson B.R., Young D.F., Okiishi T.H., Fundamentals of Fluid Mechanics (4rd. Ed.). John Wiley and Sons Inc., New York 2002.
2. SONNTAG R.E., BORGNAKKE C., Introduction to Engineering Thermodynamics, 2nd Edition, John Wiley and Sons, Inc., USA, 2007.
3. SCHMIDT P., BAKER D., EZEKOYE O., HOWELL J., Thermodynamics. An Integrating Learning System. International Edition., John Wiley and Sons, Inc., USA, 2006.

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