COURSE DESCRIPTION CARD - SYLLABUS

Course name

Thermal Engineering

Course

Field of study

Environmental Engineering

Year/Semester

2/3

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

English

Form of study

full-time

Requirements

elective

Number of hours

Lecture

20

Laboratory classes

0

Other (e.g. online)

0

Tutorials

0

Projects/seminars

10

Number of credit points

6

Lecturers

Responsible for the course/lecturer:

prof. Janusz Wojtkowiak, Ph.D., Dr.SC. Eng.

Responsible for the course/lecturer:

Prerequisites

Mathematics: algebra, functions, equations and inequalities, trigonometry, analytic geometry, systems of equations, fundamentals of differential and integral calculus, ordinary and partial differential equations - basic information of solving methods. Physics: statics, kinematics, dynamics, conservation laws in physics, fundamentals of fluid mechanics. Knowledge about: solving of equations and systems of equations, simple differential equations, application of integral calculus, mathematical formulation of engineering problems

Course objective

Gain by students basic knowledge and calculation skills in thermal engineering necessary of solving fundamental and simple problems they can meet in the build and natural environment

Course-related learning outcomes

Knowledge

1. Student knows physical properties characterizing gazes, liquids and solids, and knows their units

2. Student has a general knowledge concerning heat engineering and heat flow

3. Student knows basic methods needed for solving basic problems concerning processes and equipment occuring in environmetal engineering

4. Student knows basic rules concerning energy balances and knows definitions of energy efficiency, heat effects and heat losses concerning equipment in environmental engineering

5. Student knows and understands the tendencies and development directions concerning heat equipment in environmental engineering

Skills

1. Student can apply determine thermal properties needed for calculations

2. Student can find the needed relationships describing the discussed thermal problems

3. Student can recognized and solve simple design and operation problems concerning heat equipment

4. Student can assess the design solution and find a build and operated thermal equipment

5. Student can develop a general energy balance and determine thermal efficiency and heat losses of analysed equipment

6. The student is able to find and evaluate literature data on the analyzed processes and devices.

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems

2. The student sees the need for systematic increasing his skills and competences

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Final exam: discussion about correctness of homework problem solutions; the student has to justify each of his decision and, in that way, confirm his knowledge and skills.

Programme content

Introduction, subject contents. Application of the heat engineering and heat transfer. Physical properties of working fluids. Physical quantities and their units. Thermodynamic system and control volume, thermodynamic parameters. Ideal gas equation of thermal state. Ideal and real gas. Amount of substance. Gas mixtures. Principle of mass and energy conservation. Energy of system. Internal energy and enthalpy. Energy of flowing fluid. Typical thermodynamic processes. Work and heat of the thermodynamic process. First law of thermodynamics. Irreversible processes. Second law of thermodynamics. Entropy. Efficiency of the compression and expansion processes. Ventilators, blowers and compressors. Properties of liquid water and steam. Thermodynamic cycles. Refrigeration and heat pump coefficient of performance (COP). Humid air, psychrometric chard, dew point. Fuels, combustion process, higher and lower heating value. Efficiency of combustion chamber. Introduction to heat transfer. Heat flux by conduction, convection and radiation. Overall heat transfer. Steady and transient heat conduction. Lumped capacitance method, Biot and Fourier numbers. Forced and natural convection, Nusselt number, Reynolds, Prandtl and Grashof numbers. Heat transfer by radiation, solar radiation. Heat exchangers.

Teaching methods

Lectures: classical lecture supported by multimedia projector with elements of conversation

Project/seminars: solving practical problems.

Bibliography

Basic

1. SCHMIDT P., BAKER D., EZEKOYE O., HOWELL J., Thermodynamics. An Integrating Learning System. International Edition., John Wiley and Sons, Inc, 2006.

2. SONNTAG R.E., BORGNAKKE C., Introduction to Engineering Thermodynamics, 2nd Ed., John Wiley and Sons, Inc., 2007.

Additional

3. CENGEL Y.A., BOLES M.A., Thermodynamics. An Engineering Approach. 6 Ed. (SI Units), McGraw-Hill Higher Education, 2007.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,0
Classes requiring direct contact with the teacher	35	1,5
Student's own work (literature studies, project realisation, problem solving - homework, preparation for exam [1]	115	4,5

[1] delete or add other activities as appropriate