COURSE DESCRIPTION CARD - SYLLABUS

Course name
Heat engineering in building [S1BZ1E>TCwB]

Course

Field of study
Sustainable Building Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

prof. dr hab. inż. Janusz Wojtkowiak
janusz.wojtkowiak@put.poznan.pl

Lecturers

Prerequisites

Mathematics: basic algebra, functions, equations and inequalities, trigonometry, analitycal geometry, systems of equations, fundamentals of differential and integral calculus. Analysis and solving of equations and systems of equations, mathematical formulation of engineering problems, solving of simple differential equations, aplication of integral calculus in heat engineering. Physics: laws of conservation in physics.

Course objective

Gain by students basic knowledge and calculation skills in heat engineering necessary of solving fundamental and simple problems they can meet in buildings and built environment.

Course-related learning outcomes

Knowledge:
1. Student knows physical properties characterizing gazes, liquids and solids, and understands their behaviour 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 civil engineering

4. Student knows basic rules concerning energy balances and knows definitions of energy efficiency, heat effects and heat losses concerning buildings and equipment in civil engineering
5. Student knows and understands the tendencies and development directions concerning heat equipment in civil engineering

Skills:
1. Student is able to find and apply appropriate thermal properties necessary for thermal calculations
2. Student can find the needed relationships describing thermal problems in buildings
3. Student can recognize and solve simple design and operation problems concerning heat equipment of buildings
4. Student can assess the design solution and find a correct way to achieve appropriate performance conditions for thermal equipment
5. Student can determine an accuracy of calculation results
6. Student can develop a general energy balance and determine thermal efficiency and heat losses of analysed equipment

Social competences:
1. Student is aware of the ranges and limits of the used relationships and methods in solving heat engineering problems
2. Student is convinced of the need of examine and verification of the applied methods of calculation
3. Student is aware of the importance of team cooperation in solving engineering problems and the need to constantly develop their own professional skills

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lectures:
The final exam consists of two parts. Part 1: Test of skills and competencies involving the solution of 2 problems of heat engineering. Part 2: Test for understanding the basics of heat engineering involving answering 4 questions.
In some cases the oral examination is used. Also the activity of students during lectures and tutorials is taken into account.
To pass each of the two parts of the exam (as well as to pass the tutorials) there is necessary to obtain at least 50% of the maximum points (max=20 points). The exam is passed if both part 1 and part 2 are passed. Corrected (Improved) is only this part which was failed.
Grading system: 0-9 points = 2,0 (failed); 10-12 points = 3,0 (sufficient); 13-14 points = 3,5 (sufficient plus); 15-16 points = 4,0 (good); 17-18 points = 4,5 (good plus); 19-20 points = 5,0 (very good)
Tutorials:
One 45 minute written test at the end of the semester. Continuous assessment of student activity (rewarding activity).

Programme content

The module program covers the following topics:
1. air and water as the basic working fluids in building installations,
2. ideal gas model and its application,
3. liquid water and steam,
4. humid air,
5. first law of thermodynamics - energy balances, enthalpy,
6. second law of thermodynamics – entropy,
7. fuels and combustion,
8. thermodynamic processes,
9. thermodynamic cycles,
10. heat exchange in steady-state conditions - conduction, convection, radiation,
11. heat exchange in transient conditions - heating and cooling of solids,
12. heat exchangers.

Course topics

The lecture program covers the following topics:
1. application of heat engineering in civil engineering,
2. equation of thermal state of gas, ideal and real gas, gas mixtures,
3. principle of conservation of mass and energy, 1st law of thermodynamics, energy of the system, specific heat, internal energy and enthalpy, energy of flowing fluid,
4. typical thermodynamic processes, work and heat of process,
5. irreversible processes, 2nd law of thermodynamics, entropy, isentropic efficiency,
6. properties of water and water vapor,
7. thermodynamic cycles, left-hand (working) and right-hand (engine) Carnot cycle, coefficient of performance of refrigeration equipment and heat pumps,
8. moist gases, moist gas parameters, dew point temperature, Molière's diagram for moist air,
9. combustion and fuels, heat of combustion, calorific value, stoichiometric equations, air demand, excess air coefficient, composition and amount of exhaust gases,
10. heat transfer through a multi-layer flat and cylindrical wall, thermal resistance,
11. unsteady heat conduction, cooling and heating of well-conducting bodies, Biot and Fourier number,
12. heat convection in internal and external flows, similarity numbers (Nusselt, Prandtl, Reynolds, Grashof, Rayleigh),
13. thermal radiation, solar radiation,
14. heat exchangers, average logarithmic temperature difference, efficiency of heat exchangers.

The tutorials program covers the following topics:
1. application of the perfect state equation,
2. application of the first law of thermodynamics, preparation of energy balances of machines and devices,
3. calculations of left- and right-hand thermodynamic cycles,
4. determination of humid air parameters,
5. calculation of the determined heat conduction through flat walls,
6. calculation of the determined heat conduction through cylindrical walls,
7. calculations of heat exchangers,
8. combustion - calculation of air demand, composition and temperature of exhaust gases.

Teaching methods

Classical lecture with elements of conversation
Tutorials: solving problems method

Bibliography

Basic
1. SCHMIDT P., BAKER D., EZEKOYE O., HOWELL J., Thermodynamics. An Integrating Learning System. International Edition., John Wiley and Sons, Inc., U S A, 2006
2. SONNTAG R.E., BORGNAKKE C., Introduction to Engineering Thermodynamics, 2nd Edition, John Wiley
and Sons, Inc., U S A, 2007
3. CENGEL Y.A., BOLES M.A., Thermodynamics. An Engineering Approach. 6 Edition (SI Units), McGraw-Hill Higher Education, 2007
Additional
4. SZARGUT J., Termodynamika techniczna. Wyd. Politechniki Śląskiej, Gliwice 2000
5. SZARGUT J., GUZIK A., GÓRNIAK H., Zadania z termodynamiki technicznej. Wyd. Politechniki Śląskiej, Gliwice 2008

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,00
Classes requiring direct contact with the teacher	50	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00