COURSE DESCRIPTION CARD - SYLLABUS

Course name
Heat Engineering [S1IŚrod2>TC]

Course

Field of study
Environmental Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

dr inż. Ilona Rzeźnik
ilona.rzeznik@put.poznan.pl

Lecturers

Prerequisites

Mathematics: basic algebra, functions, equations and inequalities, trigonometry, analitycal geometry, systems of equations, fundamentals of differential and integral calculus of one variable. 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. Awareness of the need of permanent updating and supplementing knowledge and engineering skills.

Course objective

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

Course-related learning outcomes

Knowledge:
1. Student knows physical properties characterizing gazes, liquids and solids, and understands their behaviour and knows their units.
2. Has a general knowledge concerning heat engineering and heat flow.
3. Knows basic methods needed for solving basic problems concerning processes and equipment

occuring in environmetal engineering.
4. Knows basic rules concerning energy balances and knows definitions of energy efficiency, heat effects and heat losses concerning equipment in environmental engineering.
5. 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. Can find the needed relationships describing the discussed thermal problems.
3. Can recognized and solve simple design and operation problems conc. eat equipment.
4. Can assess the design solution and find a build and operated thermal equipment.
5. Can plan and realize a simple operating tests.
6. Can determine an accuracy of calculation and measurement results.
7. Can develop a general energy balance and determine thermal efficiency and heat losses of analysed equipment.
8. Can find and estimate literature data conc. analysed processes and equipment.
9. Is able to obtain and evaluate information available in the literature, the Internet and catalogs on technologies and devices in environmental.

Social competences:
1. Student is aware of the ranges and limits of the used relationships and methods in solving heat engineering problems.
2. Is convinced of the need of examine and verification of the applied methods, calculation and experimental results.
3. Is aware of the significance of team cooperation during solving theoretical and operating problems.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
Exam in the form of questions (and/or): open, calculation, drawing, test questions of various types.
Grading scale: 0-49% = 2,0; 50%-59% = 3,0; 60%-69% = 3,5; 70%-79% = 4,0; 80%-89% = 4,5; 90%-100% =
5,0
Tutorials:
Two written credit colloquia with calculation tasks.
Grading scale: 0-49% = 2,0; 50%-59% = 3,0; 60%-69% = 3,5; 70%-79% = 4,0; 80%-89% = 4,5; 90%-100% =
5,0
Laboratories:
Before starting the classes, there is a conversation with the teacher to verify the preparation for the classes.
In the case of a negative verification, it is not possible to carry out the exercise in a given class and you have to apply again at a different date.
Each exercise ends with the preparation of a report by the group, which is subject to evaluation.
At the end of each cycle of exercises, there is a test of theoretical and practical knowledge.
The credit is based on the grades from the tests and reports.
Both tests must be passed with a passing grade. At the end of the semester there is a cumulative improvement from both tests.
The final grade is the weighted average of the grades from tests (0.7) and reports (0.3).

Programme content

Lectures:
1. Introduction, subject contents. Application of the heat engineering and heat transfer.
2. Thermodynamic system and control volume, thermodynamic parameters. Ideal gas equation of thermal state. Ideal gas. Amount of substance.
3. Ideal gas mixtures.
4. Principle of mass and energy conservation. System energy balance.
5. Heat specific. Internal energy and enthalpy.

6.Typical thermodynamic processes.
7. Work and heat of the typical thermodynamic process of ideal gas.
8. First law of thermodynamics. Reversible processes.
9. Second law of thermodynamics. Entropy.
10. Properties of liquid and vapour water.
11. Carnot thermodynamic cycle.
12. Clausius-Rankine cycle.
13. Linde cycle - left hand drive cicle of heat pomp. Refrigeration and heat pump coefficient of performance (COP).
14. Humid air, psychrometric chard, dew point temperature.
15. Introduction to heat transfer. Heat flux by conduction, convection and radiation under established conditions.
16. Stady overall heat transfer.
17. Steady heat conduction.
18. Basic of radiation theory and heat exchangers.
Tutorials:
1. Energy balances. First law of thermodynamics. The right warmth.
2. Thermal equation of state of gas. Ruthless, technical and useful work.
3. Characteristic transformations of ideal gases.
4. Second law of thermodynamics, entropy, cycles of ideal gases.
5. Steam.
6. Cycle of the steam power plant.
7. Mixtures of ideal gases.
8. Humid air.
9. Steady state heat conduction through flat and cylindrical walls.
10. Thermal radiation.
11. Heat transfer - basic theory of heat exchangers.
Laboratories:
1. Calibration of thermometers.
2. Calibration of manometers.
3. Testing of selected heat exchangers.
4. Determination of air specific heat.

Course topics

none

Teaching methods

Lectures:
Informative lecture with elements of a conversational lecture; Multimedia presentation; Exercise elements
Tutorials:
Problem method; Solving tasks
Laboratories:
Experiment method; Practical exercises

Bibliography

Basic:
[1] KALINOWSKI E., Termodynamika. Skrypt Politechniki Wrocławskiej, Wrocław 1994
[2] GÓRNIAK H., SZYMCZYK J., Podstawy termodynamiki. Wyd. Politechniki Śląskiej, Wyd. III, Gliwice, Cz.
1, 1997, Cz. 2, 1999
[3] SMUDSZ R., WILK J., WOLAŃCZYK F., Termodynamika. Repetytorium. Oficyna Wyd. Politechniki Rzeszowskiej, Wyd. III, stron 115, Rzeszów, 2009
[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
[6] Pomiary cieplne, T. 1 i T. 2, Praca zb. (Red. T.R. Fodemski), WNT, Warszawa 2001

[7] WIŚNIEWSKI St., WIŚNIEWSKI T.S., Wymiana ciepła. WNT, Warszawa, 1997
[8] OLEŚKOWICZ-POPIEL C., WOJTKOWIAK J., Eksperymenty w wymianie ciepła. Wyd. II, Wyd. Polit. Poznańskiej, Poznań, 2007
[9] OLEŚKOWICZ-POPIEL C., WOJTKOWIAK J., Właściwości termofizyczne powietrza i wody- przeznaczone
do obliczeń przepływów i wymiany ciepła. Wyd. Polit. Poznańskiej, Poznań, 2010
[10] OLEŚKOWICZ-POPIEL C., AMANOWICZ Ł., Eksperymenty w technice cieplnej, Wyd. Polit. Poznańskiej, Poznań, 2016

Additional:
[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

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	75	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00