



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Heat Engineering [N1|Środ1>TC]

### Course

Field of study

Environmental Engineering

Year/Semester

2/4

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

polish

Form of study

part-time

Requirements

compulsory

### Number of hours

Lecture

20

Laboratory classes

10

Other (e.g. online)

0

Tutorials

20

Projects/seminars

0

### Number of credit points

5,00

### Coordinators

dr inż. Wojciech Rzeźnik

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### Lecturers

### Prerequisites

Mathematics: basic algebra, functions, equations and inequalities, trigonometry, analytical 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, application 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 environment.

### Course-related learning outcomes

Knowledge:

1. Student knows physical properties characterizing gases, 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

occurring in environmental 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 recognize and solve simple design and operation problems conc. heat 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 cycle of heat pump. Refrigeration and heat pump coefficient of performance (COP).
14. Humid air, psychrometric chart, dew point temperature.
15. Introduction to heat transfer. Heat flux by conduction, convection and radiation under established conditions.
16. Steady 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.

## 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
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- [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

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- [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	50	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	75	3,00