COURSE DESCRIPTION CARD - SYLLABUS

Course name
High vacuum technology

Course

Field of study
Technical and IT Education

Year/Semester
3/5

Area of study (specialization)

Profile of study
practical

Level of study
First-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
20	30	
Tutorials	Projects/seminars	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Prerequisites

Basic knowledge on: physics, thermodynamics and chemistry, including: gas definition, interactions of molecules, concepts of ideal and real gas, gas transformations, pressure. Technical drawings preparation - including software support, analytical skills, using the Internet to obtain the necessary information. Ability to work in a group, active attitude to solve problems..

Course objective

1. . In terms of knowledge: presentation to students the knowledge defined by the course content,
2. In terms of skills: mastering the basics of high vacuum techniques and the ability to design, operation and use vacuum measurement systems.
3. In terms of social competences: developing teamwork skills

Course-related learning outcomes

Knowledge

The student will be able to:
1. Explain vacuum systems constructing principles, including identification and selection of materials used in the discussed techniques - [K_W12, K_W19],
2. Explain the principles of operation of: pumps, gauges and other vacuumdevices, and standard ways of connecting elements - [K_W01],
3. Explain the laws concerning the gas properties of under reduced pressure and thermodynamics - [K_W09].

Skills

The student will acquire the following skills:
1. Identify typical defects of selected devices, including their diagnostics and indicatation of their advatages - [K_U20 K_U23],
2. Independent design of systems for selected technological processes, properly apply, install and operate vacuum devices - [K_U01 K_U03 K_U09],
3. Use professional vocabulary and work with catalogs of vacuum companies, correctly describe the standard assembly elements system - [U10 K_U16 K_U24].

Social competences

The student will acquire the following social competences:
1. Express and justify a critical assessment of specific design solutions based on the acquired knowledge and skills. - [K_K01, K_K05],
2. Develop the ability to cooperate in a team. - [K_K01, K_K05]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:
Formative assessment:
a) In the scope of the project, on the basis of:
(1) the current tricks of the project implementation
(2) assessment of preparation for classes
b) In the scope of the lecture, on the basis of:
(1) answers to questions about the material discussed in previous lectures

Summative assessment:
a) In the scope of the project, on the basis of:
(1) the correctness and form of the prepared project
(2) public presentation of the completed project
(3) discussion after both self-presentation and others
b) Within the scope of the lecture, on the basis of the written exam under written test with open questions consists of 7 -10 questions. The rating is based on the number of points scored (0-50% - rating 2.0; 50,1-60% - rating 3,0; 60,1-70% - rating 3,5; 70,1-80% - rating 4,0; 80,1-90% - rating 4,5; 90,1-100% - rating 5,0)

Programme content

Lecture:
1. Fundamentals of the kinetic theory of gases and thermodynamics
2. Viscous and molecular conditions
3. Phenomena of viscosity, effect, diffusion and thermal conductivity of gases under reduced pressure
4. Description and mechanisms of gas flow
5. Physical and chemical phenomena occurring on the surface of a solid at reduced pressure: sorption, desorption and adsorption
6. Basics of vacuum technology
7.Methods of obtaining a vacuum and its control
8. Classification and operation of vacuum pumps
9. Criteria for the selection of pumps
10. Basics of vacuum measurement
11. Division and principle of operation of pressure gauges
12. Mass spectrometry
13. Leaks in vacuum systems and their detection
14. Basics of cryogenics, basic definitions
15. Properties of liquid gases and materials at low temperatures
16. Application of the vacuum technique and cryogenics

Laboratory:
1. Performing calculations in the field of thermodynamics, properties of gases under reduced pressure
2. Methods of measuring pressure,
3. Presentation of vacuum systems for various applications
4. Getting acquainted with the terminology and catalogs of vacuum elements
5. Schematic representation of vacuum systems
6. Designing the vacuum system (in groups of two) design assumptions randomly selected by students. The project consists in designing a system that implements individual design assumptions, including:
- designing the vacuum chamber, designation
- selection of the pumping and measuring system

- determination of pumping speed in viscous and molecular conditions for the proposed solution
- selection of additional elements such as: windows, culverts
7. Presentation of completed projects and discussion

Teaching methods

1. Lecture: multimedia presentation, discussion.
2. Laboratory exercises: practical exercises, team work, development of individual vacuum system designs.

Bibliography

Basic

1. Catalogs and manuals for manufacturers of vacuum devices
2. Technika Próżni, A. Hałas, OWPW, Wrocław, 2017
3. Technika wysokiej próżni, J. Groszkowski, PWN, Warszawa, 1978
4. Technika doświadczalna w fizyce niskich temperatur, G. K. White, PWN, Warszawa, 1965
5. Vacuum Technology Know How dostępny na stronie:
http://www.pfeiffer-vacuum.com/downloads/container, w formacie pd

Additional

1. Technologia wysokiej próżni, A. Hałas, PWN, Warszawa, 1980
2. Urządzenia próżniowe, J. Groszkowski, WSiP, Warszawa, 1982
3. Experimental techniques in Low-Temperature Physics, G. K. White, P. J. Meeson, Clarendon Press, Oxford, 2002
4. Matter and Methods at Low Temperatures, F. Pobell, Springer, Berlin, 1996

Breakdown of average student's workload

	Hours	ECTS
Total workload	160	4,0
Classes requiring direct contact with the teacher	75	3,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	45	1,0

[1] delete or add other activities as appropriate