COURSE DESCRIPTION CARD - SYLLABUS

Course name
High vacuum and low temperature techniques

Course

Field of study
Technical Physics

Year/Semester
3/6

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	15	
Tutorials	Projects/seminars	

Number of credit points

5

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 fabrication methods of low temperatures, as well as 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 learn the knowledge of:
1. Explanation the laws concerning the properties of gases under reduced pressure, indicate the basic properties of cryogenic liquids and discuss the methods of obtaining low temperatures - [K1_W12],
2. Principles of operation of: pumps, gauges and other vacuum-cryogenic devices, and connecting elements systems- [K1_W12, K1_W13],
3. Principles of constructing vacuum systems, with the recognition and selection of materials used in the discussed techniques - [K1_W13, K1_W14].

Skills

The student will acquire the following skills:
1. Using of professional vocabulary, work with catalogs of vacuum companies, correctly describe the assembly of elements within system connections standards- [K1_U02, K1_U03, K1-U11],
2. Can independently design systems for selected technological processes, correctly apply, install and operate vacuum-cryogenic devices - [K1_U03],
3. Can perform diagnostics of selected devices, including identify typical faults and defects [K1_U14].

Social competences

The student will acquire the following social competences:
1. Can express and justify a critical assessment of specific design solutions based on the acquired knowledge and skills - [K1-K03].

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. Materials used in the low pressure technique, vacuum connection systems
8. Elements of vacuum installations, and the principles of design and hygiene of work in vacuum technology
9. Methods of obtaining a vacuum and its control
10. Classification and operation of vacuum pumps
11. Criteria for the selection of pumps
12. Basics of vacuum measurement
13. Division and principle of operation of pressure gauges
14. Mass spectrometry
15. Leaks in vacuum systems and their detection
16. Basics of cryogenics, basic definitions
17. Obtaining low temperatures and condensation of gases
18. Properties of liquid gases and materials at low temperatures
19. Application of vacuum technique and cryogenics

Lobolatory:
1. Identification of applications of various vacuum systems
2. Analysis of parameters of available elements and subassemblies based on catalogs of vacuum elements
3. Schematic representation of vacuum systems
4. Designing a vacuum system (in groups of two) design assumptions drawn by students. The project consists in designing a system that implements individual design assumptions, including:
• design of the vacuum chamber
• selection of the pumping and measuring system
• selection of additional elements such as: windows, culverts
5. Presentation of completed projects and discussions

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	125	5,0
Classes requiring direct contact with the teacher	65	3,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	45	2

[1] delete or add other activities as appropriate