COURSE DESCRIPTION CARD - SYLLABUS

Course name
Vacuum Technology and Leak Testing [S1MiTPM1>TPiTS]

Course

Field of study
Materials and technologies for automotive industry

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. inż. Wojciech Koczorowski prof. PP
wojciech.koczorowski@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge on: physics, thermodynamics and chemistry, including: gas definition, interactions of molecules, concepts of ideal and real gas, gas transformations, pressure. Basic information on general material properties. 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, in particular regarding the basics of vacuum technology and industrial leak testing, 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. Describe the basic phenomena occurring under reduced pressure conditions.
2. Explain the basic principles of designing vacuum systems, including recognizing and selecting

materials used in the vacuum techniques.
2. Explain the principles of operation of basic vacuum devices, including mass spectrometers and standard systems for connecting elements.
3. Explain the principles allowing to determining the leak tightness of elements using various methods, including mass spectrometry and helium techniques.

Skills:
The student will acquire the following skills:
1. Propose a method for determining the leak tightness of a closed element and interpret the intensity of leakage.
2. Independently design simple systems for selected leaks test processes.
3. Use professional vocabulary and work with catalogues of vacuum companies, correctly describe the assembly of elements within system connections.

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.
2. Develop the ability to cooperate in a team.

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 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:
I Introduction:
1. Basics of kinetic theory of gases and thermodynamics
2. Viscous and molecular conditions
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
II. Basics of vacuum technology
1. Materials used in low pressure technology, systems for connecting vacuum elements
2. Elements of vacuum installations, principles of design and occupational hygiene in vacuum technology
III. Methods of obtaining vacuum and its control
1. Division and principle of operation of vacuum pumps
2. Basics of vacuum measurement
3. Division and principle of operation of vacuum gauges
IV. Mass spectrometry
1. Leaks in vacuum systems and their detection
2. Mass spectrometers - operating principle, components and interpretation of results
V. Industrial leak detection techniques
1. Standard leak detection techniques
2. Helium leak detection techniques

VII Summary
Laboratories:
1. Calculations of leak rates, familiarization with the terminology and catalogs of vacuum components
2. Components of the basic test system, operating modes
3. Construction of the basic leak detection system
4. Pump systems of test systems
5. Measurement system in test systems
6. Presentation of completed projects and discussion

Course topics

1. Fundamentals of Gas Theory and Vacuum Technology
2. Introduction to Vacuum Technology
3. Basic Elements of Vacuum Systems
4. Mass Spectrometry
5. Leak Detection Methods
6. Helium Leak Detector

Teaching methods

1. Lecture: multimedia presentation, discussion.
2. Laboratories: practical exercises, teamwork, Oxford discussion, development of individual test 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 aviable:
http://www.pfeiffer-vacuum.com/downloads/container, pdf format

Additional:
1. Technologia wysokiej próżni, A. Hałas, PWN, Warszawa, 1980
2. Urządzenia próżniowe, J. Groszkowski, WSiP, Warszawa, 1982

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00