STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
High Vaccum and Low Temp. Techn.		**1010401261010410053**

Field of study	Profile of study (general academic, practical)	Year /Semester
TECHNICAL PHYSICS	**(brak)**	**3 / 6**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **2**	Classes: **-**	Laboratory: **1**	Project/seminars: **-**		**5**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**5 100%**

Responsible for subject / lecturer:

dr. ieng. Wojciech Koczorowski
email: wojciech.koczorowski@put.poznan.pl
tel. 061 665 31 95
Faculty of Technical Physics
ul. Nieszawska 13A 60-965 Poznań

Responsible for subject / lecturer:

dr. eng. Wojciech Koczorowski
email: wojciech.koczorowski@put.poznan.pl
tel. 061 665 31 95
Faculty of Technical Physics
ul. Nieszawska 13A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge of physics, thermodynamics and chemistry, such as the definition of the gas, the types of gas particles, particle interaction, the concept of an ideal gas, real gas, gas conversion, the pressure
2	**Skills**	Performing technical drawings, including use software, analytical skills, using the Internet to acquire the necessary information
3	**Social competencies**	Ability to work in a group, active attitude to problem solving

Assumptions and objectives of the course:

In terms of knowledge to provide students with the knowledge specified by the program,

In terms of mastering the basics skills of high-vacuum generation techniques and methods for obtaining low temperatures, and the ability to design, operation and maintenance of vacuum measurement systems.

In terms of social skills, teamwork skills.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Explain laws on the properties of gases under reduced pressure, and indicate the basic properties of cryogenic liquids and discuss the method of obtaining low temperatures - [[K_W12]]

2. Explain principles: pumps, meters and other equipment cryogenic vacuum, and connection standarts - [[K_W12, K_W13]]

3. Explain the principle of of construction of vacuum systems, including recognition and selecting of materials used in these techniques - [[K_W13]]

Skills:

1. 1. Use professional vocabulary and work with directories of companies producing components, vacuum properly describe the assembly of the components in the system connections - [K_U02, K_U03, K-U11]]

2. Self-designed systems for selected technological processes, applied correctly, instalation and support vacuum-cryogenic equipments - [[K_U03]]

3. Make simple diagnosis of selected devices, including Identify the typical flaws - [[K_U14]]

Social competencies:

1. 1. Express and substantiate a critical assessment on the specific design solutions based on acquired knowledge and skills - [[K-K03]

Assessment methods of study outcomes

Forming Score:

a) In terms of the project: on the basis of (1) the current implementation of design tricks and (2) assess the preparation for classes

b) In the lecture: on the basis of (1) answers to questions concerning the material discussed in the previous lectures

Summary score :

a) In terms of the project: on the basis of (1) the accuracy and the form of their project, (2) made ??a public presentation of the project, (3) discussions held both in their presentation and that of others

b) In the lecture: on the basis of an oral examination, preceded by a written exam, answers to questions scored on a scale 0-1, driving test after obtaining at least 55% of the points from the written test and the correct answers in the oral test. The exam can be applied after completing the course design, (2) discuss the results of the examination.

Course description

-Lecture:

Fundamentals of kinetic theory of gases and thermodynamics

Terms of viscous and molecular

Viscous effects, effusion, diffusion and thermal conductivity of gases under reduced pressure

Description and mechanisms of gas flow

The physical and chemical processes occurring on the surface of the solid under reduced pressure: sorption, desorption and adsorption

Fundamentals of vacuum technology

The materials used in the technology of low pressure, vacuum systems combine elements

Vacuum system components and design principles and health in vacuum technology

Methods of obtaining a vacuum and its control

Distribution and operation of vacuum pumps

Pump Selection Criteria

Fundamentals of vacuum metrology

Distribution and operation of vacuum gauges

Mass Spectrometry

Leaks in vacuum systems and detection

Basics of cryogenics, the basic definitions

Getting low-temperature gas liquefaction

Liquid and gas properties of materials at low temperatures

The use of vacuum technology and cryogenics

Project:

Identification of the various applications of vacuum.

Analysis of the parameters available parts and components based on vacuum components catalogs.

Schematic representation of vacuum

Design of the vacuum system (in groups of two) conceptual design drawn by the students. The project is to design a system implementing individual design assumptions, including:

- Design of the vacuum chamber
- Selection of the pumping system and the measuring
- Selection of additional components such as windows, culverts

Presentation and discussion of completed projects

Basic bibliography:

1. Comercial catalogues and manulas
2. Vacuum Technology Know How: http://www.pfeiffer-vacuum.com/downloads/container, w formacie pdf
3. Experimental techniques in Low-Temperature Physics, G. K. White, P. J. Meeson, Clarendon Press, Oxford, 2002
4. Technika wysokiej próżni, J. Groszkowski, PWN, Warszawa, 1978 - in Polish
5. Technologia wysokiej próżni, A. Hałas, PWN, Warszawa, 1980 - in Polish

Additional bibliography:

1. Urządzenia próżniowe, J. Groszkowski, WSiP, Warszawa, 1982
2. Matter and Methods at Low Temperatures, F. Pobell, Springer, Berlin, 1996

Result of average student's workload

Activity	Time (working hours)
1. Wykład	30
2. Projekt	15
3. Konsultacje projektów	14
4. Przygotowanie do projektu	30
5. Przygotowanie do egzaminu	30
6. Egzamin	4
7. Omówienie wyników egzaminu	2

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	125	5
Contact hours	65	3
Practical activities	45	1