

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name in Polish	Technologie gazowe i kriogeniczne
Name in English	GAS AND CRYOGENIC TECHNOLOGIES
Main field of study	Power Engineering
Specialization	Refrigeration and Cryogenics
Profile:	Academic
Level and form of studies	2nd level, full-time
Kind of subject	optional-specialization
Subject code	W09ENG-SM0079
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in university (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	crediting with grade			crediting with grade	
For group of courses mark (X) final course					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes	0			2	
including number of ECTS points for direct teacher-student contact (BU) classes	1			1,5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the issues related to the designs of machines,
2. Knowledge of thermodynamics, heat transfer and fluid mechanics,
3. Knowledge of the basics of material strength,
4. Knowledge on the technical drawing,
5. Ability to use the 2D and 3D CAD software,
6. Ability to work and cooperate in heterogeneous groups.

SUBJECT OBJECTIVES

- C1 - providing information about the use of gas and cryogenic technologies in industry, food processing and medicine,
- C2 - providing information about vacuum technology.
- C3 - presenting of the design principles of cryogenic transfer lines.
- C4 - providing information about the technologies of liquefied hydrogen and liquefied natural gas.
- C5 - presenting the industrial technologies of gas mixture separations.
- C6 - preparing students for the realization of the projects of cryogenic equipment.
- C7 - developing the skills in the preparation and presentation of technical documentations.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 - has knowledge on the use of gas and cryogenic technologies in industry, food processing, and medicine,
 PEU_W02 - has knowledge on vacuum technologies,
 PEU_W03 - describes the design principles of cryogenic transfer lines,
 PEU_W04 - has knowledge on the technologies of liquefied natural gas,
 PEU_W05 - has knowledge about hydrogen technologies.
 PEU_W06 - has knowledge on the gas mixture separations.

relating to skills:

PEU_U01 - can design the selected equipment and components of the installation applied in gas and cryogenic technologies in accordance with selected design codes and standards,
 PEU_U02 - selects the necessary auxiliary equipment and safety devices,
 PEU_U03 - can develop technical design documentations;

relating to social competences:

PEU_K01 is able to work and cooperate in heterogeneous groups,
 PEU_K02 is able to communicate effectively with others,
 PEU_K03 is able to active listening,
 PEU_K04 is able to leadership the group.

PROGRAMME CONTENT

Lecture		Number of hours
Lec 1	Introduction to the course.	1
Lec 2	Vacuum technologies. Leak tightness test techniques and equipment.	2
Lec 3	Gas and cryogenic technologies in the food processing and storage.	2
Lec 4	Gas and cryogenic technologies in metallurgy and steel treatment. Cryogenic methods of gas mixtures separation. Air separation.	2
Lec 5	Cryogenic grinding and recycling of polymers.	2
Lec 6	Gas and cryogenic technologies in medicine.	2
Lec 7	LNG and liquid hydrogen – liquefaction, storage, transfer and regasification.	2
Lec 8	Final test	2
Total hours		15
Project		Number of hours
Proj 1	Presentation of project subjects.	2
Proj 2	Description of the client device, setting of the process requirements	2
Proj 3	Selection of the working fluid type and its consumption for selected device	2
Proj 4	Transfer line modularization, selection of the cryogenic vessel capacity and design pressure	2
Proj 5	Determination of the transfer line's process and vacuum pipe diameter	2
Proj 6	Design of transfer line module female and male bayonet connection	2
Proj 7	Selection of the process pipe thermal compensation element and determination of the inner support system	2
Proj 8	Determination of the heat conduction to the process pipe through inner support system	2
Proj 9	Determination of the thermal insulation for process pipe	2

Proj 10	Selection of the safety and axillary equipment	2
Proj 11- Proj 14	Preparation of the project report, manufacturing drawings and assembly procedure.	8
Proj15	Acceptance of the students' projects.	2
	Total hours	30

TEACHING TOOLS USED
N1. Traditional lecture with multimedia presentations, N2. Presentation of project, N3. Individual discussion with students and consultancies, N4. Student individual work.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT- lecture

Evaluation (F– forming (during semester), C– concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
C	PEU_W01-PEU_W06	Test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT- project

Evaluation (F– forming (during semester), C– concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
C	PEU_U01-PEU_U03 PEU_K01-PEU_K04	Project defense

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

- [1] J.G. Weisend II, *Handbook of Cryogenic Engineering*, Taylor&Francis, USA, 1998
- [2] A.R. Jha, *Cryogenic Technology and Applications*, Elsevier, USA, 2008
- [3] Chorowski M., *Kriogenika, podstawy i zastosowania*, IPPU MASTA, Gdańsk 2007
- [4] Thomas M. Flynn, *Cryogenic Engineering*, Marcel Dekker, USA.2005
- [5] S. Mokhatab et al. *Handbook of Liquefied Natural Gas*, Gulf Professional Publishing, 2014, ISBN 9780124045859, <https://doi.org/10.1016/B978-0-12-404585-9.11001-3>
- [6] Zohuri, B. (2019). *Cryogenics and Liquid Hydrogen Storage*. In: *Hydrogen Energy*. Springer, Cham. https://doi.org/10.1007/978-3-319-93461-7_4

SECONDARY LITERATURE:

- [1] R.C. Scurlock, *Low-Loss Storage and Handling of Cryogenic Liquids: The Application of Cryogenic Fluid Dynamics*, Kryos Publications, United Kingdom, 2006
- [2] A.M. Arkharow, I.V. Marfenina, Ye.I. Mikulin, *Cryogenic systems*, Bauman Moscow State University Press, Moscow, 2000

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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