

FACULTY OF MECHANICAL AND POWER ENGINEERING**SUBJECT CARD**

Name in Polish	Podstawy termodynamiczne procesów niskotemperaturowych
Name in English	Thermodynamic Fundamentals of Refrigeration, Cryogenics and Low Temperature Physics
Main field of study	Mechanical Engineering and Machine Building
Specialization	Refrigeration and Cryogenics
Level and form of studies	2nd level, full-time
Kind of subject	optional-specialization
Subject code	W09ENG-SM0074
Group of courses	No

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in university (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				30
Form of crediting	crediting with grade				crediting with grade
For group of courses mark (X) final course					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BU) classes	0.75				0,75

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

good knowledge of thermodynamics, heat transfer, fluid mechanics, background in physics, mechanical engineering and material engineering

SUBJECT OBJECTIVES

- C1 – To familiarize the students with thermodynamic background of low temperature physics.
- C2 – To transfer knowledge concerning designing refrigeration and cryogenic processes
- C3 – To train students in balancing energy efficiency of cryogenic devices
- C4 – To train students in calculation of cryogenic cycles
- C5 – To train students in oral presentations reg. refrigeration and cryogenics

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 knows definition, terminology and applications of low temperature physics

PEK_W02 knows the processes of obtaining low temperatures in fluids and solids

PEK_W03 knows the flow diagrams of cryogenic refrigerators and liquefiers

PEK_W04 knows basic methods of reaching the ultralow temperatures (below 1 K)

PEK_W05 knows the methods of gas mixtures separation (including air)

relating to skills:

PEK_U01 is able to obtain information from literature, databases and other properly selected sources, either in English or another foreign language regarded as a language for international communication in the studied discipline ; is able to integrate obtained information, interpret and critically evaluate it, draw conclusions, formulate and justify opinions in full

PEK_U02 is able to communicate in their professional environment and other environments using various techniques, either in English or another foreign language regarded as a language for international communication in the studied discipline

PEK_U03 is able to prepare and give an oral presentation concerning detailed issues in the field of the studied discipline both in Polish and a foreign language

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Lec1	Introduction to laws of thermodynamics and low temperature physics. Unattainability of absolute zero temperature.	1
Lec2	Temperature as the manifestation of particles energy. Maxwell and Boltzmann distribution.	2
Lec3	General principle of obtaining low temperatures. Statistical definition of entropy.	2
Lec4	Temperature lowering processes part I. Isentropic expansion, isenthalpic throttling, free gas discharge.	2
Lec5	Temperature lowering processes part II. Adiabatic demagnetization, adiabatic de-electrisation, electron dilution, stress and tension relaxation.	2
Lec6	Comparison of energy forces and entropy forces. Impact of the type of force for the cooling effect.	2
Lec7	Thermodynamic basis of low temperature insulations and insulation systems.	2
Lec8	Final test	2
Total hours		15
Form of classes - seminar		Number of hours
Sem 1	Presentation and selection of topics	1
Sem 2-8	Oral presentations of chosen topics (min. 2 presentations per semester)	14
Total hours		15

TEACHING TOOLS USED

- N1. Traditional lecture with multimedia presentations
- N2. Traditional seminar with multimedia presentations
- N3. Individual 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	PEK W01÷PEK W05	Examination, written

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT- seminar

Evaluation (F– forming (during semester), C– concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK U01÷U03	Oral presentations
C Average grade from the presentations		

PRIMARY AND SECONDARY LITERATUREPRIMARY LITERATURE :

- [1] M. Chorowski, Cryogenics – fundamentals and applications, MASTA 2007 (translation)
- [2] Lecture scripts from www page
- [3] Classes tutorials
- [4] A. Piotrowska-Hajnus, J. Fydrych, J. Poliński, Cryogenic Engineering Laboratory Handbook, Wrocław University of Technology 2010

SECONDARY LITERATURE:

- [1] S. Van Sciver, Helium Cryogenics, Plenum Press
- [2] A. Arkharov, I. Marfenina, Ye. Mikulin, Cryogenic Systems.

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

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
**Thermodynamic Fundamentals of Refrigeration, Cryogenics and Low Temperature
 Physics**
 AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building
 AND SPECIALIZATION **Refrigeration and Cryogenics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study/ specialization	Subject objectives	Programme content	Teaching tool number
PEK_W01÷PEK_W05	S2RAC_W06	C1, C2 C5, C6	Lec1÷Lec15	N1, N4, N5
PEK_U01÷PEK_U03	S2RAC_U01	C5	Sem 1÷Sem 8	N2, N3, N4