

Low-temperature technologies

Faculty of	Mechanical and Power Engineering
Name in English	Low-temperature technologies
Name in Polish	Technologie chłodnicze
Main field of study	Power Engineering
Specialization	-
Level of studies	II level
Form of studies	full-time
Kind of subject	obligatory
Subject code	W09ENG-SM2338
Group of courses	NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	50				
Form of crediting	Egzamin		Zaliczenie		
For group of courses mark final course with (X)					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	1,44				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.	Basic knowledge of thermodynamics and low temperature physics
2.	Basic knowledge of fluid mechanics and heat transfer

SUBJECT OBJECTIVES

C1	Familiarizing the students with thermodynamic fundamentals of refrigeration and cryogenics
C2	Familiarizing the students with low temperature technologies in power engineering and energy storage
C3	Familiarizing the students with construction and operation principals of refrigeration and cryogenic devices
C4	Training in calculations of refrigeration and cryogenic cycles

SUBJECT LEARNING OUTCOMES

relating to knowledge:	
PEU_W01	knows the definitions, terminology and applications of refrigeration and cryogenics
PEU_W02	knows physics of low temperature processes
PEU_W03	knows processes of the vapor compression, sorption and cryogenic cycles
PEU_W04	knows refrigeration and cryogenic devices, systems and technologies
PEU_W05	knows basics of the magnetic cooling and space technologies
PEU_W06	knows gas mixture separation methods
relating to skills:	
PEU_U01	is able to calculate refrigeration and cryogenic cycles
PEU_U02	Is able to model simple refrigeration / cryogenic system in DWSIM simulator

relating to social competences:	
PEU_K01	is able to work and cooperate in groups
PEU_K02	is able to communicate effectively with others in foreign language

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Wy1	Introduction to refrigeration and cryogenics	2
Wy2	Thermodynamic backgrounds of low temperature technologies	2
Wy3	Entropy in low temperature cycles. Unavailability of absolute zero	2
Wy4	Introduction to refrigeration technologies - vapor compression cycles	2
Wy5	Sorption technologies in refrigeration and air conditioning	2
Wy6	Refrigeration technologies in power generation and conversion - trigeneration	2
Wy7	Processes used in cryogenics	2
Wy8	Liquefiers and refrigerators with recuperative heat exchangers	2
Wy9	Liquefiers and refrigerators with regenerators	2
Wy10	Liquid Natural Gas (LNG) technologies and applications	2
Wy11	Hydrogen technologies in energy storage and conversion processes	2
Wy12	Introduction to applied superconductivity and cooling systems	2
Wy13	Magnetic cooling in refrigeration and cryogenics	2
Wy14	Cryogenic gas separation, applications in power generation	2
Wy15	Novel technologies in cryogenics, cryogenics in space engineering	2
Suma godzin		30

classes		Number of hours
Cw1	Introduction to tutorial classes, thermodynamic laws in low temperature systems	1
Cw2	Refrigeration cycles 1	2
Cw3	Refrigeration cycles 2	2
Cw4	Introduction to DWSIM simulator, modelling of simple refrigeration system	2
Cw5	Cryogenic cycles 1	2
Cw6	Cryogenic cycles 2	2
Cw7	Modelling of simple cryogenic system (using DWSIM simulator)	2
Cw8	Written test	2
Suma godzin		15

TEACHING TOOLS USED	
N1	Traditional lecture / tutorial classes, presentations available for students
N2	Consultations during office hours
N3	Self-study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F- forming (during semester), C- concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
Lecture C	PEU_W01 - PEU_W06	Examination, written and oral
Tutorial classes C	PEU_U01 – PEU_U02	Test

PRIMARY AND SECONDARY LITERATURE

Primary literature	
1	A. Arkharov, I. Marfenina, Ye. Mikulin, Cryogenic Systems, Bauman Moscow, State Technical University Press, 2000
2	G/F. Hundy, Refrigeration, Air-Conditioning and Heat Pumps, Butterworth-Heinemann, 2016
3	Presentations (lecture and tutorial)
Secondary literature	
1	J. G. Weisend II, The Handbook of Cryogenic Engineering, Taylor & Francis, 1998
2	M.I. Anand, Basics of Refrigeration and Air-Conditioning, ABPL, Second Edition, 2013

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

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