Załącznik nr 6 do ZW 121/2020

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name in Polish	Systemy kriogeniczne i nadprzewodnictwo stosowane
Name in English	Cryogenic Systems and Applied Superconductivity
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-SM0078W
Group of courses	No

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues concerning thermodynamics basis of cryogenics and low temperature physics,
2. Knowledge of thermodynamics, fluid mechanics and cryogenics of basics,
3. Knowledge of cryogenic materials and fluids,
4. Knowledge of electricity and magnetism basis.

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SUBJECT OBJECTIVES

C1 – Make students acquainted with components, design and analysis of the cryogenic systems
C2 – Providing information about superconductivity phenomenon and its application in industry, energetics, medicine and science.
C3 – To familiarize students with chosen superconducting materials and with their physical properties.
C4 – Providing information about superconductors manufacture methods.
C5 – Providing information about methods of cryo-stabilization of low- and high-temperature superconducting composites.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 - possesses a knowledge in superconductivity and its application in industry, energetics, medicine and science.
PEU_W02 - names and characterizes some chosen low- and high-temperature superconductors.
PEU_W03 - has knowledge on the superconductors production technologies.
PEU_W04 - has knowledge on the cryostabilization of high-and low-temperature superconductors.
PEU_W05 – knowledge the cryogenic systems definition and classification
PEU_W06 – knowledge of cryogenic system components, understanding of the particular component role in the system, knowledge of the components sizing procedure as well as selection of the component type
PEU_W07 – knowledge of types of instrumentation for measurement and control of process variables in the cryogenic systems
PEU_W08 – knowledge and understanding of design rules of basic and complex cryogenic systems with liquid, superfluid and supercritical helium

relating to social competences:

PEU_K01 is able to active listening

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec1	Definition and classification of cryogenic systems and system components	2
Lec2 Lec3	Cryogenic system components	4
Lec4	Instrumentation for measurement and control of process variables in the cryogenic systems	2
Lec5	Introduction to superconductivity	2
Lec6	Basic properties and classification of superconductors	2
Lec7	Production technologies of superconductors	2
Lec8	Cryo-stabilization of low-temperature and high-temperature superconductors	2
Lec9	Applications of low-temperature and high-temperature superconductors	2
Lec10	Liquid helium production and cryogenic systems	2
Lec11	FAIR facility cryogenic system analysis	2
Lec12	Superfluid helium systems	2
Lec13	LHC and XFEL accelerators cryogenic system analysis	2
Lec14	Supercritical helium systems. ITER reactor cryogenic system analysis	2
Lec15	Test	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Information lecture
N2. Multimedia presentation
N3. Self-work, self-studies and preparation for the final test
N4. Consultations with teacher

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_W08 PEU_K01	Final test

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE :

[1] A.M. Arkharow, I.V. Marfenina, Ye.I. Mikulin, *Cryogenic systems*, Bauman Moscow State University Press, Moscow, 2000
[2] Thomas M. Flynn, *Cryogenic Engineering*, Marcel Dekker, USA.2005
[3] Chorowski M*., Kriogenika, podstawy i zastosowania*, IPPU MASTA, Gdańsk 2007
[4] J.G. Weisend II, *Handbook of Cryogenic Engineering*, Taylor&Francis, USA, 1998
[5] A.R. Jha, *Cryogenic Technology and Applications*, Elsevier, USA, 2008
[6] W. Buckel, R. Kleiner, *Superconductivity: Fundamentals and Applications*, Wiley-VCH, 2004
[7] P. J. Lee, *Engineering Superconductivity*, Wiley-IEEE Press; 1 edition, 2001

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] G. Ventura, L. Risegari, *The Art of Cryogenics*, Elsevier, USA, 2008
[3] Advances in Cryogenic Engineering, Transactions of the Cryogenic Engineering Conferences
[4] C.P. Poole., H.A. Farach, R.J. Creswick, R. Prozorov, *Superconductivity*, Academic Press, 2007
[5] V.L. Ginzburg, E.A. Andryushin, *Superconductivity*, World Scientific Publishing Company, 2004

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

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