Cryogenic systems and applied sperconductivity

Faculty of	**Mechanical and Power Engineering**
Name in English	**Cryogenic systems and applied sperconductivity**
Name in Polish	**Systemy kriogeniczne i nadprzewodnictwo stosowane**
Main field of study	**Power Engineering**
Specialization	**-**
Level of studies	**II level**
Form of studies	**full-time**
Kind of subject	**optional-specialization**
Subject code	**W09ENG-SM2366**
Group of courses	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	50			30	
Form of crediting	Zaliczenie			Zaliczenie	
For group of courses mark final course with (X)					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BU) classes	1,28				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.	Knowledge of issues concerning thermodynamics basis of cryogenics and low temperature physics
2.	Knowledge of the basics of heat transfer and fluid mechanics
3.	Knowledge of the basics of electricity and magnetism
4.	Knowledge of the basics of mechanical design
5.	Knowledge on the technical drawing
6.	Ability to use the 2D and 3D CAD software
7.	Ability to work and cooperate in heterogeneous groups

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
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 LEARNING OUTCOMES

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 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	can selects the necessary auxiliary equipment and safety devices
PEU_U03	can develop technical design documentations
relating to social competences:	
PEU_K01	is able to active listening
PEU_K02	is able to work in group

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Wy1	Definition and classification of cryogenic systems and system components	2
Wy2	Cryogenic materials	2
Wy3	Cryogenic system components – part 1	2
Wy4	Cryogenic system components – part 2	2
Wy5	Cryogenic system components – part 3	2
Wy6	Cryogenic Instrumentation – part 1	2
Wy7	Cryogenic Instrumentation – part 2	2
Wy8	Introduction to superconductivity	2
Wy9	Theory of superconductivity	2
Wy10	Energy losses in superconductors	2
Wy11	Superconducting devices design and production –part 1	2
Wy12	Superconducting devices design and production –part 2	2
Wy13	Cryo-stabilization of low-temperature and high-temperature superconductors	2
Wy14	Helium distribution systems for large superconducting devices	2
Wy15	Test	2
Suma godzin		30

project		Number of hours
Pr1	Presentation of project subjects	2
Pr2	Selection of the working fluid type and its consumption for selected device	2
Pr3	Transfer line sizing and modularization, selection of the cryogenic vessel capacity and design pressure	2
Pr4	Design of transfer line module female and male bayonet connections, selection of the process pipe thermal compensation element and determination of the inner support system	2
Pr5	Determination of the heat losses to the process pipe	2
Pr6	Selection of the safety and axillary equipment	2
Pr7	Preparation of the project report, manufacturing drawings and assembly procedure	2
Pr8	Acceptance of the students' projects	1
Suma godzin		15

TEACHING TOOLS USED	
N1	Information lecture
N2	Multimedia presentation
N3	Self-work, self-studies and preparation for the final test
N4	Individual discussion with students and consultancies
N5	Project results presentation

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_W08 PEU_K01	Final test
Project C	PEU_U01- PEU_U03	Project defense

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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