Sorption refrigeration

Faculty of	**Mechanical and Power Engineering**
Name in English	**Sorption refrigeration**
Name in Polish	**Chłodnictwo sorpcyjne**
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-SM2367**
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)	25	25			
Form of crediting	Zaliczenie	Zaliczenie			
For group of courses mark final course with (X)					
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	0,68	0,68			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1.	Basics of thermodynamics
2.	Basics of heat transfer
3.	Basics of fluid dynamics

SUBJECT OBJECTIVES

C1	Familiarize students with the construction and operation of sorption energy systems and the properties of working solutions.
C2	To familiarize students with the modeling of sorption systems processes by the graphical method and the use of a computer program.
C3	Familiarize students with the possibilities of using low-temperature heat sources and waste heat.

SUBJECT LEARNING OUTCOMES

relating to knowledge:	
PEU_W01	Has structured knowledge of the thermodynamic fundamentals, construction and operation of sorption energy systems.
PEU_W02	Has a structured knowledge of process energy balancing and thermal calculation of sorption apparatuses of energy systems.
relating to skills:	
PEU_U01	Knows how to identify and balance sorption circuit processes of energy systems.
PEU_U02	Knows how to calculate and select apparatuses of sorption energy systems.

relating to social competences:	
PEU_K01	Is able to concisely present the results of his work.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours
Wy1	Scope of the lecture, credit conditions, literature. Characterization of the basic concepts and definitions from the thermodynamics of solutions, needed for modeling the absorption cycle.	1
Wy2	The principle of operation of absorption equipment. Properties of working vapors and their influence on the design of absorption systems. Construction of the h-ksi diagram for aqueous ammonia solution. Construction of the h-ksi and lgp-t diagram for an aqueous solution of lithium bromide.	2
Wy3	Application of thermodynamic balancing principles to model the sorption cycle. Thermal balance of an ammonia sorption system on an h-ksi diagram. Substance and thermal balances of partial processes.	2
Wy4	Principles of operation and thermal and hydraulic calculations of absorbers, desorbers and rectifiers of water-ammonia sorption systems, overview of the design.	2
Wy5	Principles of operation and thermal and hydraulic calculations of absorbers, desorbers and rectifiers of water-lithiumbromide sorption systems.	2
Wy6	Adsorption and desorption processes in refrigeration systems - principle of operation of adsorption equipment.	2
Wy7	Adsorption and desorption processes in refrigeration systems - working pairs.	2
Wy8	Credit	2
Suma godzin		15

classes		Number of hours
Cw1	Principles of credit, analysis of potential heat sources	1
Cw2	Calculation of primary energy demand and environmental impact	2
Cw3	Heat recovery in an industrial plant	2
Cw4	Balancing of absorption apparatuses in NH3-H2O chillers	2
Cw5	Balancing of absorption apparatuses in LiBr-H2O refrigerators	2
Cw6	Heat transfer in LiBr-H2O and NH3-H2O solutions	2
Cw7	Comprehensive calculations of sorption systems	2
Cw8	Credit	2
Suma godzin		15

TEACHING TOOLS USED	
N1	Traditional lecture with the use of multimedia presentation
N2	Calculus exercises, discussion of solutions to tasks, use of computer program.
N3	Individual consultations

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
F1	PEU_K01	Presentation of own calculations
P1	PEU_W01	Colloquium
P2	PEU_W02	Colloquium
P3	PEU_U01	Colloquium
P4	PEU_U02	Colloquium

PRIMARY AND SECONDARY LITERATURE

Primary literature	
1	Herold K., Radermacher R., Sanford A. Klein – Absorption Chillers and Heat Pumps. CRC Press 1996
2	Ratlamwala I., Dincer T. A. H. – Integrated Absorption Refrigeration Systems, Springer International, 2016
3	Wang R., Wang L., Wu J. – Adsorption Refrigeration Technology: Theory and Application, Wiley, 2014
Secondary literaturę	
1	Nalepa B., Hałon T. – Recommendations for running a tandem of adsorption chillers connected in series and powered by low-temperature heat from district heating network. Energies. 2021, vol. 14, nr 16, art. 4791, s. 1-17.
2	Hałon T., Pelińska-Olko E., Szyc M., Zajączkowski B. – Predicting performance of a district heat powered adsorption chiller by means of an artificial neural network. Energies. 2019, vol. 12, nr 17, s. 1-11.

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

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