Załącznik nr 6 do ZW 121/2020

FACULTY OF MECHANICAL AND POWER ENGINEERING

SUBJECT CARD

Name of subject in Polish:	Sprężarkowe systemy ziębnicze
Name of subject in English:	Vapor-compression refrigeration systems
Main field of study (if applicable):	POWER ENGINEERING
Specialization (if applicable):	Refrigeration and Cryogenics
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	optional
Subject code:	W09ENG-SM0075
Group of courses:	NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	30	
Number of hours of total student workload (CNPS)	120		60	60	
Form of crediting	Exam		crediting with grade	crediting with grade	
For group of courses mark final course with (X)					
Number of ECTS points	**2**		2	2	
including number of ECTS points for practical (P) classes	0		2	2	
including number of ECTS points for direct teacher-student contact (BU) classes	2		2	2	

*niepotrzebne skreślić

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamental knowledge of thermodynamics, fluid mechanics and heat transfer.
2. Knowledge of technical drawing and construction rules
3. Ability to construct using graphic programs

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SUBJECT OBJECTIVES

C1 Transfer of basic knowledge, taking into account the application aspects of compressor refrigeration

C2. Transfer of knowledge regarding the calculation of heat exchangers and the selection of fittings and refrigeration automation.

C3. To develop skills in qualitative understanding, interpretation and quantitative analysis - based on dependencies describing cold cycles

C4. Developing students' skills to characterize processes in refrigeration equipment

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01 - knows the basics of cooling system implementation and the differences between theoretical and actual cooling system.
PEK_W02 - have knowledge of the design of refrigeration compressor installations
PEK_W03 - knows the mathematical model describing heat exchangers and principles of fitting selection

relating to skils:

PEK_U01 - can determine the basic parameters of the refrigeration cycle and indicate the differences between the theoretical and actual refrigeration cycle.
PEK_U02 - can conclude from the measurements of refrigeration plant operating parameters
PEK_U03 - can use mathematical models to calculate heat exchangers
PEK_U04 - can choose the necessary fittings from catalogs
PEK_U05 - can design the vapor compressor refrigeration system

PROGRAM CONTENT		
Lectures		**Number of hours**
Lec 1	Refrigeration industry history and construction of the lgp-h chart. Natural methods of achieving the cooling effect	2
Lec 2	Determining the basic parameters characterizing the cooling cycle. The theoretical and real refrigeration cycle and its representation on lg p -h.	2
Lec 3	Self-regulation of the cooling cycle. The problems caused by self-regulation effects	2
Lec 4	Opportunities to ensure a higher COP	2
Lec 5	Division of refrigeration compressors, construction, principle of operation, mathematical model.	2
Lec 6	Oil function in the refrigeration system. Oil selection. Mathematical model of cooling pipeline diameters.	2
Lec 7	Rules of construction of the refrigeration system discharge line	2
Lec 8	Rules of construction of a liquid refrigeration plant line.	2
Lec 9	Condensers in compressor refrigeration installations. Mathematical model	2
Lec 10	Condensation pressure control	2
Lec 11	Rules of construction of compressor rack systems	2
Lec 12	Rules of construction of the refrigeration suction line. Parallel connecting of evaporators.	2
Lec 13	Expansion elements in the refrigeration system	2
Lec 14	Evaporators in refrigeration installations Mathematical model	2
Lec 15	Heat recovery from refrigeration installations. Mathematical model	2
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Safety regulations in laboratory classroom	2
Lab 2	Getting a chilling effect with eutectic mixtures	2
Lab 3	Adiabatic cooling and it's representation on the i-x graph for humid air	2
Lab 4	Visualization of processes occurring in the cooling cycle based on the observation of the glass model of the household refrigerator	2

Lab 5	Measurements of work parameters of the household refrigerator and it's representation of its refrigeration cycle together with basic calculations of cycle. Cold room balance.	2
Lab6	Presentation of the basic service tools necessary for use for service of refrigeration installations. Refrigerant recognition based on measured pressure and temperature parameters.	2
Lab 7	Measurements of work parameters of the primary refrigeration system equipped with an air cooler. Representation of its refrigeration cycle together with basic calculations of cycle based on measurements and determination of actual performance and COP.	2
Lab 8	Self-regulation effect on the high pressure side of the system and it's influence on COP of the cycle	2
Lab 9	Self-regulation effect on the low pressure side of the system and it's influence on COP of the cycle	2
Lab 10	Calculation of the condenser performance based on measurements	2
Lab 11	Calculation of the air cooler performance based on measurements	2
Lab 12	Refrigerant load of the refrogeration plant and it's influence on COP	2
Lab 13	Operation of the thermostatic expansion valve, it's regulation and influence on COP.	2
Lab 14	Removal of filling from a refrigeration system by various refrigerant recovery methods.	2
Lab 15	Corrective and supplementary classes	2
	Total hours	30

Project		**Number of hours**
Proj 1	Project scope, crediting conditions, literature. Assigning individual project topics to students.	2
Proj 2	Discussion and approximation of issues raised in projects. Individual work of students on projects. Concept of the design	2
Proj 3	Individual work of students on projects. Determining the basic operating temperatures of the compressor refrigeration cycle. Identification of status points for individual design data.	2
Proj 4	Individual work of students on projects Selection of the refrigerant	2
Proj 5	Individual work of students on projects Selection of the cycle depending of the maximum COP factor and minimum volume flow of the compressor on the suction side	2
Proj 6	Individual work of students on projects Representation of the real cycle and corrections of the capacity of the compressor	2
Proj 7	Individual work of students on projects. Calculation of the needed diameters of the pipelines	2
Proj 8	Individual work of students on projects. Construction of the main pipelines	2
Proj 9	Individual work of students on projects. Calculation of the condenser	2
Proj 10	Individual work of students on projects. Calculation of the evaporator	2
Proj 11	Individual work of students on projects. Selection of the main elements in the main pipelines	2
Proj 12	Construction of the condensing unit	2
Proj 13	Logic of work of the refrigeration plant, selection of the regulator and safety devices.	2
Proj 14	Drawings for the designed installation. Preparation of the report. Preparation of project presentation.	2

Proj 15	Presentation and submission of ready projects by students.	2
	Total hours	30

TEACHING TOOLS USED
N1. Lecture with presentation N2. Laboratory – discussion of problems N3 Individual design presentation N4. Self-study – reading of supplementary materials. N5. Self-study – study and preparation for the final exam. N6. Office hours.

OCENA OSIĄGNIĘCIA PRZEDMIOTOWYCH EFEKTÓW KSZTAŁCENIA-WYKŁAD

Oceny (F – formująca (w trakcie semestru), P – podsumowująca (na koniec semestru)	Numer efektu kształcenia	Sposób oceny osiągnięcia efektu kształcenia
P	PEK_W01 ÷ PEK_W03;	Egzamin pisemny

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Learning outcomes number	Way of evaluating learning outcomes achievement
P1	PEK_W01 ÷ PEK_W03	Final exam containing questions based on the entire range of the lecture
F2	PEK_U01 ÷ PEK_U02	Reports from laboratory classes
P3	PEK_U03 ÷ PEK_U05	Final presentation of the design

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Rex Miller, Mark R. Miller, Air conditioning and refrigeration McGraw-Hill Professional Publishing,2006

[2] Risto Ciconkov Refrigeration - Solved examples, "St Kiril & Metodij" Faculty of Mechanical Engineering. Po. Box 464. 1000 Skopie Macedonia

[3] Handbook: refrigeration, American Society of Heating, Refrigerating and Air-Conditioning ASHRAE 2006

[4] Wilbert F. Stoecker - Industrial refrigeration handbook McGraw-Hill 1998

SECONDARY LITERATURE:

[1] Technical bulletins of manufacturers of the refrigeration equipment

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

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