COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S2-ME-EM-214**
	part-time programme:	
Course title in Polish	**Chłodnictwo i klimatyzacja**	
Course title in English	**Refrigeration and Air Conditioning**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**second-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**Machine Operation and Maintenance**
Department responsible	**Department of Mechanics and Heat Transfer**
Course leader	**dr inż. Robert Kaniowski**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**specialism-related**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester II**
	part-time programme	**Semester II**
Pre-requisites		**Fluid Mechanics, Thermodynamics**
Examination required (YES/NO)		**NO**
ECTS value		**2**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**15**		**15**		
	part-time programme					

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	The student knows the methods of achieving low temperatures and the principles of operation of compression and sorption refrigeration devices.	MiBM2_W02 MiBM2_W03 MiBM2_W10
	W02	The student knows the basic principles of air processing. They understand the principles of operation of air conditioning systems.	MiBM2_W02 MiBM2_W04 MiBM2_W10
	W03	The student knows examples of refrigerants and their properties.	MiBM2_W04 MiBM2_W10
	W04	The student understands the principles of air flow in buildings and vehicles. The student is familiar with the structure of various ventilation systems.	MiBM2_W10
	W05	The student is familiar with current regulations and safety standards related to refrigeration devices and systems.	MiBM2_W10
Skills	U01	The student can draw a compression cycle and calculate its characteristic parameters, as well as select a suitable refrigerant.	MiBM2_U10 MiBM2_U11 MiBM2_U15
	U02	The student can use thermodynamic tables to calculate the parameters characterizing the compression cycle.	MiBM2_U10 MiBM2_U11 MiBM2_U15
	U03	The student can determine the parameters of humid air and the design parameters for outdoor air. They have basic knowledge of air parameter regulation.	MiBM2_U10 MiBM2_U11 MiBM2_U15
	U04	The student can determine the efficiency of a heat pump and the performance of a refrigeration compressor.	MiBM2_U10 MiBM2_U11 MiBM2_U15
Competence	K01	The student is aware of the importance of and understands the non-technical aspects and impacts of safety engineering activities in refrigeration and air conditioning, considering their environmental impact and the responsibility associated with decision-making.	MiBM2_K01 MiBM2_K04
	K02	Is able to work in a group, obeys the rules of teamwork; is able to present his/her position and defend it using factual arguments in the discussion.	MiBM2_K01 MiBM2_K04

COURSE CONTENT

Mode of instruction	Topics covered

lecture	Methods of obtaining low temperatures. Division of air conditioning systems. Air conditioning units. Refrigerators and heat pumps. Reverse Carnot cycle, Linde cycle. The actual left-hand cooling circuit. T-s and p-h charts. Steam compressor refrigeration circuits. Air compressor refrigeration equipment. Basics of operation of absorption devices. Zeotropic and azeotropic refrigerants and mixtures. Refrigerants in the light of environmental protection. Properties of factors, scope of applications. Humid air: physical and thermodynamic properties, psychrometric parameters. h-x diagram for humid air. Comfort air conditioning, thermal comfort, air parameters in rooms and motor vehicles, calculation parameters for outdoor air. The amount of air supplied. Designing the air treatment process on the Mollier i-x diagram. Regulation of air parameters in the room. Heat recovery methods in air conditioning devices. Basic knowledge about ventilation. Air quality. Indoor and outdoor air pollution. Ventilation of living spaces and motor vehicles. Air exchange in industrial and residential facilities.
laboratory	Measurement of relative air humidity, velocity, dew point and wet bulb temperatures. Determination of the characteristics of the ventilation duct. Energy efficiency ratio of a reversible heat pump. Testing of a compressor refrigerator. Analysis of the refrigeration cycle in the *p-h* system. Determination of the energy efficiency ratios of an air-air and water-air compressor refrigeration device.

ASSESSMENT METHODS

Outcome code	Methods of assessment					
	Oral examination	Written examination	Test	Project	Report	Other
W01			X			
W02			X			
W03			X			
W04			X			
W05			X			
U01			X		X	
U02			X		X	
U03			X		X	
U04			X		X	
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	Assessment in the form of an open test. The grade depends on the points obtained during the exam. A student receives a positive grade after exceeding 51 points.
laboratory	non-examination assessment	Obtaining at least 50% of points in colloquiums preceding laboratories and preparing reports

OVERALL STUDENT WORKLOAD

ECTS weighting			
No.	Activity type	Student workload	Unit

		full-time programme					part-time programme					
1.	Scheduled contact hours	L	C	Lb	P	S	L	C	Lb	P	S	h
		15		**15**								
2.	Other contact hours (office hours, examination)	**2**		**2**								h
3.	**Total number of contact hours**	**34**										h
4.	**Number of ECTS credits for contact hours**	**1,4**										ECTS
5.	**Number of independent study hours**	**16**										h
6.	**Number of ECTS credits for independent study hours**	**0,6**										ECTS
7.	**Number of practical hours**	**25**										h
8.	**Number of ECTS credits for practical hours**	**1,0**										ECTS
9.	**Total study time**	**50**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**2**										ECTS

READING LIST

1. SILBERSTEIN OBRZUT T., Refrigeration & Air Conditioning Technology, Cengage, 2020.
2. Diner Ibrahim, Refrigeration Systems and Applications, Wiley, 2017
3. Langley Billy, Air Conditioning and Refrigeration Troubleshooting Handbook, Prentice Hall, 2003