RTU Course "Equipment for Refrigeration Plants"

31000 null

General data

Code	MSE384
Course title	Equipment for Refrigeration Plants
Course status in the programme	Compulsory/Courses of Limited Choice; Courses of Free Choice
Responsible instructor	Dmitrijs Rusovs
Academic staff	Ainārs Cars
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV, EN
Annotation	The study course covers the peculiarities of refrigerants and cooling media and the classification of refrigeration equipment, the practical aspects of their use and operation. Calculations of compressors, evaporators, condensers are considered. The study course describes the methods of equipment selection: gas and steam compressor refrigeration equipment, alternative cooling methods (absorption, steam ejection, thermoelectric cooling). The content of the study course includes lessons with the software for the calculation of refrigeration equipment https://www.ipu.dk/products/coolpack/ and the software for the selection of equipment https://www.bitzer.de/websoftware/. Within the study course, the choice of equipment is also considered from the point of view of energy efficiency and environmental protection, paying attention to the requirements of specific regulatory enactments and standards binding in the field.
Goals and objectives of the course in terms of competences and skills	The aim of the study course is to provide an understanding of the main types of refrigeration equipment of refrigeration plants, the peculiarities of refrigerants and cooling media and the skills of practical application of theoretical knowledge. The tasks of the study course are: 1. To develop skills to select refrigeration equipment (compressor, evaporator, condenser) with matching software (https://www.bitzer.de/websoftware/ and others) and evaluate them through life cycle analysis and ecodesign requirements. 2. To provide students with an understanding of the principles of selection of refrigerants and their differences, as well as their regulatory framework. 3. To develop skills in solving the given problem, providing justification of results, calculation of processes and equipment with the software https://www.ipu.dk/products/coolpack/.
Structure and tasks of independent studies	Task solving and reports, incl. schedule, preparation. Learning the software (process and equipment analysis) https://www.ipu.dk/products/coolpack/ and https://www.bitzer.de/websoftware (refrigeration equipment selection). Collection of data on equipment and materials for comparison and selection.
Recommended literature	Obligātā/Obligatory: 1. I.Reinikovs, E.Jurēvics. Aukstumtehnika. Rīga: „Zvaigzne”, 1972. 2. J.Nagla, P.Saveljevs, R.Ciemiņš. Siltumtehnikas pamati. R. „Zvaigzne”. 1981. 3. J.Nagla, P.Saveljevs, A.Cars. Siltumtehniskie aprēķini piemēros. R. „Zvaigzne”. 310 lpp. Papildu/Additional: 4. I. Dincer, Refrigeration systems and applications. 3rd Edition., John Wiley & Sons Ltd., 2017, 752 p. 5. Y.Cengel. Heat Transfer Heat Transfer: A Practical Approach., Mac Graw Hill, 2004. 908 p. 6. C.Johnson. heating, Ventilation, and Air Conditioning. A Residental and Light Commercial Text & Lab Book. New York: Thomson Delmar Learning, 2006. - 880 p. 7. C.Langley. Refrigeration. Principles, Practices and Performance. New York: Thomson Delmar Learning, 2008. - 415 p. 8. H.Herr. Tabellenbuch. Waerme, Kaelte, Klima. Haan-Gruiten: Europa Lehrmittel, 2007. – 495 S. 9. Recknagel, Sprenger, Hönmann. „Taschenbuch für Heizung und Klimatechnik”. München, Wien, 1987. 10. Refrigeration. Handbook. SI Edition, Atlanta: ASHRAE, 2014. - 314 p.
Course prerequisites	Thermodynamics. Heat Exchange.

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
The role of refrigeration technology in the economy and in achieving the goals of the Green Deal. Ecodesign and environmental protection requirements.	4	2	2	4
Ways of obtaining and using artificial cold.	4	4	2	6
Theoretical basis of refrigeration plants and technology.	2	2	2	2
Refrigerants and cooling media. Regulatory framework for F-gas and requirements for personnel and possessors.	6	4	4	6
Single - stage and multi - stage steam compressor cycle calculation. Class work No.1: Selection of refrigerant with software.	4	6	4	6
Refrigeration equipment compressors: selection, capacity calculation.	4	4	2	6
Multistage refrigeration machines. Laboratory work “Single stage steam compressor cycle”.	4	6	2	8

Heat exchangers for refrigeration systems: calculation and selection. Class work No.2: Calculation of heat exchangers for refrigeration systems.	4	6	2	8
Absorption refrigerators.	2	2	2	2
Steam exhauster and gas coolers.	4	4	2	6
Thermoelectric cooling. Development of cold accumulation technologies.	2	2	2	2
Types and applications of cold rooms and storage.	4	4	2	6
Cold storage: schemes, elements, constructions.	2	2	2	2
Calculations of cold storage volume and area.	4	4	2	6
Heat infiltration and determination of cold losses.	2	2	2	2
Selection of condensing units and other equipment. Class work No.3: Compressor selection, using software.	4	6	2	8
Consultation.	2	0	2	0
Exam.	2	0	2	0
Total:	60	60	40	80

Learning outcomes and assessment

Learning outcomes	Assessment methods
Able to select the inverse thermodynamic cycle and refrigerant to obtain and maintain a certain temperature regime, as well as to determine the appropriate properties and thermodynamic characteristics of the system working fluids.	Assessment methods: classwork No.2, exam. Criteria: able to find, calculate and evaluate the parameters of the refrigeration cycle, determine the cooling capacity, select the appropriate fluid for the stage of the refrigeration system and determine its thermodynamic parameters.
Able to use the requirements of industry-related regulations, standards and equipment manufacturers for the projection and calculation of refrigeration systems and their assemblies.	Assessment methods: classwork No.1, exam. Criteria: able to assess the compliance of the refrigeration system and its components and working fluid with the requirements of regulatory enactments and standards, to provide assembly and operation recommendations.
Able to choose refrigeration equipment using output parameters: purpose of use, load, potential losses.	Assessment methods: laboratory and practical works, exam. Criteria: able to determine the operating parameters and basic characteristics of the refrigeration equipment by measurements, able to select the refrigeration equipment with the help of calculations and software.
Able to identify damage to refrigeration equipment and systems and determine possible causes, as well as determine the optimal operating modes of equipment.	Assessment methods: classwork No.3, exam. Criteria: is able to find and calculate the compressor/condensing unit, determine the capacity, describe the typical damage to refrigeration equipment and systems, causes and consequences.

Evaluation criteria of study results

Criterion	%
Midterm tests (classwork) and practical works	35
Laboratory works	20
Exam	45
Total:	100

Study subject structure

Part	CP	Hours			Tests			Tests (free choice)		
		Lectures	Practical	Lab.	Test	Exam	Work	Test	Exam	Work
1.	4.5	2.0	1.0	0.0		*			*	