Refrigeration and Cooling Systems

Course description

The course "Refrigeration and cooling systems" is worth 4 ECTS and is designed to prepare students for a career in refrigeration and cooling systems engineering. The topics to be covered include refrigeration technologies, refrigerants (properties, uses); instrumentation, refrigeration cycle, refrigeration capacity, refrigeration components, compressors selection. The purpose of the course is to teach students how to design refrigeration and cooling equipment. Our students will understand the underlying principles of operations in different refrigeration and cooling systems, will get acquainted with calculation methods for refrigeration systems, methods for optimization of these systems. The course is mandatory for trainings in heat power engineering. We will highlight the specifics of each calculation method applied for refrigeration and cooling systems and will give certain examples using case studies. Students will be able to improve their skills in our labs with real-life industrial equipment.

Learning Objectives

The main objectives of the discipline are to make students acquainted with the applied industrial refrigeration and cooling systems installed for various purposes; to provide students with deeper understanding of the thermodynamical processes in cooling equipment; to equip students with the ability to use calculation methods and mathematical algorithms when seeking for the best industrial solution on cooling and refrigeration units or when choosing the optimal operating mode; to form an understanding of issues related to the heat and mass transfer apparatus design,

Upon the completion of this course, a student will be able to:

- design the refrigeration and cooling systems to meet the desired requirements;
- test, install, operate and maintain refrigeration and cooling systems equipment; apply mathematical modeling for refrigeration/cooling equipment design
- predict a refrigeration/cooling system failure and start predictive maintenance;
- choose the most appropriate calculation method for refrigeration and cooling systems under the certain restrictions;
- choose the most appropriate parameters for a refrigeration/cooling system in compliance with the set norms and regulations;
- use mathematical algorithms for the design of heat and mass transfer systems; be well – versed in the dependencies on which the calculations are based;
- prepare technical reports for maintenance and repair.

Scope and types of study, the content of the discipline

The course is worth 4 ECTS credits or 144 hours which include 32 hours of lectures, 16 hours of the supervised laboratory practical classes, 16 hours of the supervised practical classes (workshops), 80 hours of self-study lab practice.

Contents, instructional activities, workload

Section number	Name of sections, topics of the discipline	Workload according to the types of instructional activities (hours)			
		total	L	WS (workshops)	LC (lab practice)
1	The main types and classification of industrial refrigeration and cooling equipment. Basic concepts and definitions.	13	10	3	0
2	Vapor compression refrigeration systems	19	6	5	8
3	Thermodynamic cycles of cooling machines	13	10	3	0
4	Multistage cooling and refrigeration machines	19	6	5	8
Total		64	32	16	16

Contents of the sections, topics of the discipline

Section number	Name of sections	Contents of sections
1	The main types and classification of industrial refrigeration and cooling equipment. Basic concepts and definitions	1 Classification of refrigeration and cooling systems. 2 Periodic and continuous action devices. 3 Basic coolants, requirements for coolants.
2	Thermodynamic cycles of cooling machines	1 Reversed Carnot cycle. 2 The cycle of vapor compression refrigeration machines. 3 The main structural elements of the cycle.
3	Compressors for vapor compression refrigeration machines	1 Types of compressors. 2 Methods of compressor selection. 3 Operation modes of compressors for vapor compression refrigeration machines. 4 The compressors efficiency.
4	Heat exchange equipment of vapor compression refrigeration machines	1. Condensers 2. Compressors 3. Evaporators 4. Expansion devices
5	Refrigerants	1 Types of refrigerants and their properties

6	Calculation methods used for cooling chamber	1 Cooling capacity calculation methods. 2 Heat insulation calculation methods.
7	Multistage vapor compression refrigeration machines	1 Principles of operations of multistage refrigeration machines 2 Equipment applied for multistage refrigeration machines
8	Efficiency analysis of cooling machine	1 Factors that influence the efficiency 2 The ways to improve cooling machines energy efficiency

Contents of the workshops

Number of WS	Section number	Title and summary of the lesson	Workload (hours)
1	2	Calculations of thermodynamic cycles for vapor compression refrigeration machines	4
2	2	Selection of vapor compression refrigeration machines: criteria of selection	4
3	3	Selection of vapor compression refrigeration machines compressor	4
4	3	Calculations for the heat exchange equipment for vapor compression refrigeration machines	4

Contents of the laboratory practical classes

Number LC	Section number	Title and summary of the laboratory work	Workload (hours)
1	2	The study of the operation of single stage vapor compression refrigeration machine	8
2	3	The study of the air cooler based on operational capacity of a single stage vapor compression refrigeration machine	8