Heat and mass transfer equipment in the power industry

(title)

Course Description:

The purpose of the discipline "Heat and mass transfer equipment in power industry" is to make students acquainted with modern solutions in the area of heat and mass transfer equipment design. The issues to be covered include heat exchangers of different types and their operation principles, calculation methods used for various heat exchangers, drying plants and optimization of their operational capacity. The course combines theory and practical classes (workshops and lab classes). The students are expected to work on their own projects and to participate in conferences held at either national or international level. Students will be acquainted with industrial heat installations needed for various applications and calculation methods used for these systems. We will also provide them with deeper understanding of thermodynamic laws, which form the foundation of heat and mass transfer processes.

Learning Objectives:

Upon completion of this course, students are expected to:

- be able to design the heat and mass transfer systems for various industrial applications under certain constraints;
- to able to choose heat exchange solution to meet the exact requirements of an industry; to calculate and determine heat transfer coefficient; to calculate and minimize heat dissipation;
- be able to test operate, maintain and optimize heat exchangers for various industrial applications;
- to able to develop heat exchangers of various designs
- be able to predict a heating system failure and to start predictive maintenance;
- be able to choose the most appropriate calculation method; to use mathematical algorithms for the design of heat and mass transfer systems; to be well –versed in the dependencies on which these calculations are based;
- to be able to prepare technical reports for maintenance and repair.

Scope of the discipline and types of instructional activities, the contents of the discipline

Total scope of the course is 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 experience.

Contents of the discipline, the types of instructional activities, workload

Section number	Name of sections, topics of the discipline	Workload according to the types of instructional activities (hours)			
		total	L	WS	LC

1	The main types of heat and mass transfer equipment for industrial enterprises. Basic concepts and definitions	4	4	0	0
2	Regenerative continuous and batch heat exchangers	28	12	8	8
3	Gas-liquid and liquid-liquid heat exchangers	28	12	8	8
4	Drying plants	4	4	0	0
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 heat and mass transfer equipment for industrial enterprises. Basic concepts and definitions	1 Classification of heat exchangers according to the purpose, principle of action, and by the type of mutual movement of coolants. 2 Periodic and continuous regenerative action. 3 Basic coolants, requirements for coolants, the types of coolants.
2	Regenerative continuous and batch heat exchangers	1 Purpose of recuperative heat exchangers, their classification. 2 Shell-and-tube, sectional heat exchangers, heat exchangers with finned tubes, plate. 3 The main structural elements of shell-and-tube heat exchangers.
3	Regenerative continuous and batch heat exchangers	1 Calculation methods for heat exchangers. 2 Relative movement of coolants. 3 Temperature distribution in pipes and channels of heat exchangers. 4 The efficiency of heat exchangers. 5 Heat exchange intensification methods.
4	Regenerative continuous and batch heat exchangers	1 Thermal design calculations. 2 Calculation methods for the heat exchangers with phase transitions of the coolant.
5	Gas-liquid and liquid-liquid mixing heat exchangers	1 Recuperative heat exchangers of periodic action.
6	Gas-liquid and liquid-liquid heat exchangers	1 Types of regenerative heat exchangers. 2 Advantages and disadvantages of regenerative heat exchangers.

		3 Design and principles of operation of regenerative heat exchangers.
7	Gas-liquid and liquid-liquid heat exchangers	1 Heat exchangers with fixed and movable nozzles. 2 Types of nozzles used. 3 Temperature change in the nozzle of a regenerative heat exchanger. 4 Nozzle accumulation coefficient.
8	Drying plants	1 The concept of the drying process. 2 Types of drying materials. 3 Dryers, their designs and principles of operation. 4 Drying agents. 5 Forms of moisture contact with the material. 6 Classification of wet materials and schematic diagrams of drying installations.

Contents of the workshops (WS)

Number of WS	Section number	Title and summary of the class	Workload (hours)
1	2	Thermal design calculations for respirators	4
2	2	Thermal design calculations for recuperators provided in a graphical form	4
3	3	Calculation methods for the heat exchangers used in metallurgy	4
4	3	Fluidized bed regenerator.	4

Contents of the laboratory practical classes (LC)

Number LC	Section number	Title and summary of the class	Workload (hours)
1	2	Project: Simulation of the heat exchanger operations at various costs, temperatures and patterns of coolants movement	8
2	3	Project: Simulation of the heat exchanger operations (different coolant types)	8