RTU Course "Technical Thermodynamics and Heat Exchange"

15016 Siltumenerģētisko sistēmu katedra

General data

Code	MSE304
Course title	Technical Thermodynamics and Heat Exchange
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Heat Engineering, Heat, Gas and Water Technology
Responsible instructor	Cars Ainārs
Academic staff	Turlajs Daniels Jaundālders Sigurds Soročins Aleksandrs
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU, DE
Possibility of distance learning	Planned
Maximum auditorium capacity	50
Maximum number of students per semester	50
Abstract	The subject`` Technical Thermodynamics and Heat Transfer`` deals with the problems of thermal processes in nature and technical equipment. Basic topics: thermodynamic systems - characteristics and parameters. Ideal and real gases. Basic laws of thermodynamics. Specific heat, internal energy, enthalpy, entropy, exergy. Thermodynamic processes and cycles. Water and water steam. Humid air. Gas and steam flows. Steam and gas cycles of thermal machines. Refrigerators and heat pumps. Mechanisms and heat transfer. Steady and unsteady heat conduction. Theory of similarity. Convective heat transfer. Thermal and velocity boundary layers. Complex heat transfer. Heat utilizing equipment. Design of heat exchangers.
Goals and objectives of the course in terms of competences and skills	To acquire the basic knowledge of technical thermodynamics and heat transfer theory. To get skills of calculus of thermal engineering. Be able to explain basic concepts and laws of thermodynamics and heat transfer of thermal processes, cycles and equipment. To know and be able to find the thermodynamical and thermophysical properties of heat carriers. To understand the heat power and heating utilizing equipment, working processes and design principles.
Structure and tasks of independent studies	Individual studies of special literature, lecture notes, home calculus tasks. The accomplishment of calculation works and tasks according given time schedule. Preparation before lectures and in-time giving in of practical works. Individual work with information sources and software for the calculus and analysis of thermodynamic and heat transfer. Preparation of reports of calculus and practical works.
Recommended literature	1.Nagla J., Saveļjevs P., Turlajs D. Siltumenerģētikas teorētiskie pamati. Rīga, RTU, 2008, 194 lpp. 2.J. Nagla, P. Saveļjevs, R.Ciemiņš. Siltumtehnikas pamati. Rīga, "Zvaigzne", 1981.-356 lpp. 3.J. Nagla, P. Saveļjevs, A. Cars. Siltumtehniskie aprēķini piemēros. Rīga, "Zvaigzne", 1982.-130 lpp. 4.Lienhard J.H.,IY, Lienhard J.H.,Y. A Heat Transfer Textbook, Phlogiston Press, 2006, 760 p. 5.Cengel Y., Boles M., Thermodynamics: An Engineering Approach. 6-th edition, McGraw-Hill, 2007, 960 p. 6.Cengel Y. Heat Transfer: A Practical Approach. McGraw Hill, 2004, 908 p. 7.Нащокин В.В. Техническая термодинамика и теплопередача. М., Высшая школа, 1980,469с. 8.Исаченко В.П., Осипова В. А., Сукомел А. С. Теплопередача. М.,Энергия, 1975, 488 с.
Course prerequisites	Physics

Course outline

Theme	Hours
Thermodynamic systems. Heat carriers. Thermodynamic parameters. Specific heat of matter.	4
Ideal and nonideal gases. Equations of state for gases. Mixtures of gases.	4
The first and second law of thermodynamics. Thermodynamic processes and cycles.	4
Real gases. Water and water steam, tables and diagrams.	4
Steam-gas mixtures. Humid air- properties and diagrams. Drying processes.	4
Differential equations of thermodynamics. Principles of chemical thermodynamics.	4
Gas and steam flows in nozzles, throttles, orifices. Cycles of gas and steam turbines.	4
Cycles of heat and power stations, cogeneration, trigeneration. District heating. Refrigerators and heat pumps.	4
Physical nature and mechanisms of heat transfer. Heat conduction. Fourier law, differential equation of conduction.	4
Heat conduction in plane walls and cylinders. Overall heat transfer ratio.	4
Similarity of physical processes. Theory and numbers of similarity. Dimensional analysis.	4
Differential equations of convective heat transfer. Boundary layer.	4

Free and forced convection heat transfer. Heat transfer in tubes and bundle jets.	4
Boiling and condensation heat transfer. Interaction of heat and mass transfer.	4
Radiative heat transfer laws. Heat exchange between bodies with radiation. Radiative emission of gases.	4
Complex heat transfer. Enhancement methods of heat exchange. Design methods of heat exchangers.	4

Learning outcomes and assessment

Learning outcomes	Assessment methods
Ability to explain and analyze the physical essence and regularity of thermodynamic processes in nature and technological equipment, to know thermodynamic terms and laws.	Assessment methods: Solving of exercises in class-room and home work, seminars, tests. Criteria: Knowledge of the thermodynamic systems, processes of heat transfer and heat exchanging equipment specifications-processes and cycles. The ability to use information sources.
Ability to explain and motivate thermodynamic, heat mass transfer processes in thermal engines, heat & power plants, refrigerators and heat pumps.	Assessment methods: Calculation home work, preparation of reports, tests. Criteria: Ability to explain the processes and phenomena of heat & power units and technological devices. Performing of practical work.
Ability to calculate and evaluate performance and effectiveness of thermal engines, technological equipment, thermal insulation and building constructions from the view point of theory thermodynamic and heat and mass transfer.	Assessment methods: calculation home work, tests, exam. Criteria: Ability to explain, analyze and calculate the principles of thermodynamic, heat and mass transfer processes of thermal engineering equipment and technologies. Quality of completed calculation work and tests.

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	4.5	3.0	1.0	0.0		*	