RTU Course "Hydro- and Gas Dynamics"

15016 Siltumenerģētisko sistēmu katedra

General data

Code	MSE305
Course title	Hydro- and Gas Dynamics
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	Rusovs Dmitrijs
Academic staff	Smirnovs Sergejs
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Maximum auditorium capacity	50
Maximum number of students per semester	50
Abstract	The subject contains consideration of properties of liquids and gases, hydrostatic forces, pressure definition. The Fluid Dynamics course is based on motion equations of liquids and gases. Real flows described in terms of border layer equations and turbulence length. Non dimensional methods used for process modeling. Heat losses and flow types are analyzed. Methods of pipe, valve, pump and fan selection. Flow parameters described in nozzles, channels, around the body.
Goals and objectives of the course in terms of competences and skills	To gain knowledge about properties of liquids and gases, hydrostatics, real flow description, border layer and turbulence definition, heat loss calculation and non dimension analysis. To develop understanding about flow equipment selection based on life cycle analysis. To be able to calculate heat losses for various flows.
Structure and tasks of independent studies	Elaboration of report about properties of liquids and gases. Two home tasks: calculation of hydrostatics forces and heat losses. Six experiments, analysis of results, calculation of properties, presentation and development of conclusions. Pipe heat loss simulation with the software PipeCalc.
Recommended literature	1. V.Dirba, J.Uiska, V.Zars. Hidraulika un hidrauliskās mašīnas. Rīga, Zvaigzne, 1980, 456.lpp. 2. P.Lielpēters, R.Dorošenko, Ē.Geriņš. Fluidtehnika. Rīga, 2005, 183.lpp. 3. D.Rusovs. Metodiskie norādījumi. Hidro un gāzu dinamika.RTU, Rīga, 2007. 35.lpp. 4. P.Lielpeters,E.Gerinsh,R.Doroshenko. Calculation of Pneumatic Conduits. Rīga, 2007, 118.lpp. 5. Cengel Y.A., Turner R.H. Fundamentals of Thermal-Fluid Science. McGraw-Hill,N.Y, 2005
Course prerequisites	Physics.

Course outline

Theme	Hours
Liquid and gas properties. Newtonian and non-Newtonian liquids. Surface stress. Hydrostatics. Forces and pressure.	3
Euler equation. Hydrostatic equation. Pressure measurement. Pressure epirusses.	3
Pressure profile on flat and bent surface. Pascal's Law and Archimedes Principle.	3
Hydrodynamics, terminology and parameters of flow. Continuity equation. Euler differential equations.	3
Bernoulli equation. Hydraulic pressure losses. Navier-Stokes equation.	3
Hydrodynamic similarity and its criteria. Similarity theory and modeling of flows.	3
Two types of flow in real liquids. Laminar liquid flow in circular and non-circular pipes.	3
The characterization of turbulent flow. Hydraulic resistance.	3
Wall roughness. Nikuradze graph. Murin graph.	3
Local hydraulic losses. Valves and pipe accessories. Equivalent length. Shezi equation.	3
Hydraulic calculus of pipe grid. The calculation of a parallel and series connection of pipes.	3
The definition of optimal velocity. Calculus of liquid and gas supply units. Supply of liquids via pumps. Fans.	3
Liquid flow through small and big holes. Flow through nozzles.	3
The calculus of a flow without pressure. Water jet.	3
Active and reactive pressure. Pressure on a moving surface.	3
Non-stationary flow in closed pipes. Fluid hammer. Movement of gasses in pipe grids under pressure.	3
Work in the laboratory.	16

Learning outcomes and assessment

Learning outcomes	Assessment methods

To be able to analyze the properties of liquids and gases.	Examination: home work, exam, report. Assessment criteria: Able to identify, calculate and evaluate the influence of properties of liquids and gases.
To be able to apply hydrostatic equations and laws.	Examination: home work, exam, report. Assessment criteria: Able to identify, calculate and evaluate the influence of properties of liquids and gases.
To be able to apply laws and equations of fluid dynamics.	Examination: Home work, exam. Assessment criteria: is able to calculate pressure on a surface, including arcuated.
To be able to perform flow analysis and make flow equipment selection.	Examination: Home work, laboratory/practical work, exam. Assessment criteria: ability to carry out the analysis of movement: impact, flow in a nozzle, flow in channel, by using knowledge obtained during the course.

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		*	