GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Fluid Mechanics, PG_00050282		
Field of study	Mechanical Engineering, Mechanical Engineering		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2021/2022
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	English -
Semester of study	4	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Energy and Industrial Apparatus -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Krzysztof Tesch	
	Teachers	dr inż. Marzena Banaszek prof. dr hab. inż. Krzysztof Tesch	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	0.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	8.0	57.0	125

Subject objectives

Objective of the subject is to supply the student with the theoretical and practical knowledge, enabling him to solve engineering computational and experimental problems related to fluid mechanics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W09	The student has basic knowledge in the field of thermodynamics and fluid mechanics, construction and operation of thermal energy devices, process equipment, including renewable energy sources as well as refrigeration and air conditioning	[SW1] Assessment of factual knowledge
K6_U06	The student is able to use mathematical and physical models to analyze the processes and phenomena occurring in mechanical devices in the field of material strength, thermodynamics and fluid mechanics	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

LECTURES Introduction and basic definitions. Properties of fluids. Models of fluids. Fluids in equilibrium. Determination of hydrostatic forces. Archimedes" law. Methods of fluid flow description. General motion of fluid. Deformation of fluid element. Vortex motion of fluid. Principles of conservation of mass, momentum and energy. Balance of entropy. Navier-Stokes equation. Bernoulli equation. Similarity of flow phenomena. Potential flows. Principles of gas dynamics - subsonic and supersonic flows. PRACTICAL EXERCISES Kinematics of flows. Laminar and turbulent flows in pipes - averaging of flow parameters.Practical applications of Bernoulli equation. Determination of forces acting on channel walls and on surfaces of bodies moving in fluids. LABORATORY EXERCISES Visualization of flows. Outflow from orifices. Measurements of flow intensity in open channels and pipes. Characteristics of water turbine. Research of flow around lifting foils. Modelling of gas flow by hydrodynamic analogy.

Prerequisites and co-requisites

Konowledge of differential and integral calculus, differential and integral equations and principles of vector calculus. Knowledge of principles of classical mechanics of solids.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	40.0%
Laboratory experiments reports	100.0%	30.0%
Two practical exercises tests	50.0%	30.0%

Recommended reading	Basic literature	Tesch K.: Mechanika płynów, Wyd. Politechniki Gdańskiej, Gdańsk 2008 G. K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, New York, 2000
	Supplementary literature	Puzyrewski R., Sawicki J.: Podstawy mechaniki płynów i hydrauliki, PWN Warszawa 1998
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Provide the definition of stream lines and surfaces as well as lines and vortex lines and surfaces. What are the differential equation? 2. Give the formula for the substantial derivative. What do the individual symbols mean and what is the physical interpretation of the individual terms? 3. What components does the velocity of any fluid element consist of? Give the pattern with the drawing and explain the meaning of the individual symbols and their physical interpretation. 4. What types of deformations are distinguished and what components of individual tensors are associated with them? Introduce both tensors. 5. Provide (formula and drawing) and explain the content of Helmholtz's first theorem on vorticity. 6. Give the differential form of the mass conservation equation. What do the individual symbols mean? How can this equation be simplified in stationary, incompressible and potential cases? 7. Provide the Cauchy relationship between the tensor and the stress vector. What types of forces are there? 8. Give the differential form of the momentum conservation equation. What do the individual symbols mean? What is the physical interpretation of the entire equation and individual terms? 9. Provide Newton's hypothesis for compressible fluid. What do the individual symbols mean? Why is it being introduced? 10. Provide any non-Newtonian fluid model together with the flow curve. What do the individual symbols mean? 11. Provide the first and second law of thermodynamics for continuous media. What do the individual symbols mean? 12. Provide the form of the Navier-Stokes equation depending on the density and viscosity coefficient. 13. Provide a closed system of equations for incompressible flow at a constant viscosity coefficient. What do the individual symbols mean? 14. Provide a closed system of equations for incompressible flow with a variable viscosity coefficient. What do the individual symbols mean? 15. Provide a closed system of equations for compressible flow at constant viscosity coefficient and specific heat. What do the individual symbols mean? 16. Provide a closed system of equations for compressible flow with variable viscosity coefficients and specific heat. What do the individual symbols mean? 17. Give and explain Pascal's law. 18. What is the difference between thrust and buoyancy. Give formulas and explain the meaning of symbols. 19. Provide and explain Archimedes' law. 20. Give and explain Buckham's theorem. 21. Give the Bernoulli equation. Under what assumptions is it correct? 22. Give the Lagrange integral. Under what assumptions is it correct?	
Work placement	Not applicable	