Syllabus
Course Program

Mechanics of Viscous Fluid and Drilling Fluids

Specialty
133 – Industrial machinery engineering

Institute
Educational-scientific Institute of Mechanical Engineering and Transport

Educational program
Industrial machinery engineering

Department
Hydraulic Machines (150)

Level of education
Bachelor's level

Course type
Optimal (profile)

Semester
4

Language of instruction
English, Ukrainian

Lecturers and course developers

Kseniia Riezva

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Candidate of Technical Sciences, Associate Professor of the Department of Hydraulic Machines of NTU "KhPI"

Work experience is 10 years.
Author and co-author of more than 60 scientific and educational works.

Courses: "Technical equipment and technology of well repair", "Introduction to the specialty. Introductory practice", "Hydrogasdynamics", "Hydraulics", "Basics of scientific research", "Fountain and gas safety in the oil and gas industry", "Machines and equipment for wells drilling, equipment for oil and gas production".

Yevhenii Krupa

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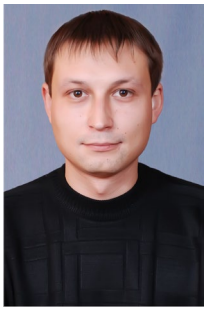
Candidate of Technical Sciences, Associate Professor of the Department of Hydraulic Machines named after G.F. Proscura of NTU "KhPI"

The author of more than 50 scientific and educational works (articles, manuals, monographs, patents on a useful model). Courses: "Fundamentals of bladed hydraulic machines theory", "Hydraulic turbines and reversible hydraulic machines", "Fundamentals of CAD for bladed hydraulic machines", "Design of bladed hydraulic machines"



Andrii Rogovyi

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Doctor of Technical Sciences, Professor, Head of the Department

Author of more than 200 scientific and educational works. Leading lecturer in the courses: "Modeling and calculation of viscous fluid flows", "Mathematical modeling of work processes in hydraulic machines", "Numerical study of spatial flow in hydraulic machine channels". He defended his dissertation on "Development of the theory and methods of calculation of vortex chamber superchargers".

General information

Summary

The course is aimed at studying the laws and rules by which processes occur in liquid media and their application in solving practical technical problems.

Course objectives and goals

Studying the laws of equilibrium and motion of ideal and real fluids as a continuous medium, getting to know the features of various models of continuous fluid media, as well as their properties in relation to solving private problems in industrial mechanical engineering.

Format of classes

Lectures, laboratory works, consultations, self-study, course work. Final control in the form of an exam.

Competencies

GS2. Ability to apply knowledge in practical situations.
SC1. Ability to apply typical analytical methods and computer software tools for solving engineering problems of industrial mechanical engineering, effective quantitative methods of mathematics, physics, engineering sciences, as well as appropriate computer software for solving engineering problems of industrial mechanical engineering.

Learning outcomes

LA4. Carry out engineering calculations to solve complex tasks and practical problems in industrial mechanical engineering.

Student workload

The total volume of the course is 180 hours (6 ECTS credits): lectures - 48 hours, laboratory works - 32, self-study - 100 hours.

Course prerequisites

To successfully complete the course, it is necessary to have knowledge and practical skills in the following subjects: Higher Mathematics, Physics.

Features of the course, teaching and learning methods, and technologies

In the lectures, various methods of oral presentation of information are used: maintaining attention for a long time, activating the listeners' thinking; techniques that ensure logical memorization: persuasion, argumentation, evidence, classification, systematization, generalization, etc.

The method of discussion of educational material and discussion is used in lectures. The discussion makes it possible to significantly deepen and systematize knowledge and understanding of a particular problem, to check the basis of the conclusions reached by students during the study of a specific topic. The discussion method develops students' ability to defend their views and beliefs. The discussion helps to identify, logically and critically consider different points of view, scientific concepts and approaches to the issues under consideration. The organization and support of the discussion is achieved by using the following methods: asking questions (main, additional, leading, etc.), discussing the answers and opinions of students, correcting the answers and formulating conclusions.
Visual and practical teaching methods. Among the visual methods of learning, illustration and demonstration are used. Illustration - showing students posters, maps, graphs, sketches on the board. During distance education, lecture material is presented in the form of presentations with pictures and videos.
The material is available on the Microsoft 365 resource and on the Moodle platform https://dlc.kpi.kharkov.ua/course/view.php?id=477.

Program of the course

Topics of the lectures

Topic 1. Introduction to the course. Physical properties of the liquid.
Subject of discipline. Hypothesis of continuity. Physical properties of liquids. Forces acting in liquids.
Topic 2. Hydrostatics.
Hydrostatic pressure and its properties. Pascal's principle. The main equation of equilibrium. Devices for measuring pressure. The relative equilibrium of the fluid. Fluid pressure force on flat walls and curved surfaces. Archimedes' principle.
Topic 3. Fluid kinematics.
The main concepts of kinematics. Equation of flow.
Topics 4. Fluid hydrodynamics.
Bernoulli's equation for an elementary stream of an ideal fluid. Bernoulli's equation of real fluid flow.
Topic 5. Fluid motion modes.
Laminar and turbulent modes of fluid motion. Hydraulic energy losses.
Topic 6. Liquid flow through holes and nozzles.
Fluid flow through a hole in a thin wall at constant and variable pressure. Fluid flow through a flooded hole. Fluid flow through nozzles.
Topic 7. Hydraulic calculation of the pipeline.
Calculation of a simple pipeline. Parallel and serial connection of pipelines. Siphon. Pipeline with pump supply.
Topic 8. Hydraulic drives and pneumatic drives.
Classification of volumetric hydraulic drives, purpose, principle of operation, main parts and hydraulic devices. Guiding and regulating hydraulic devices. Advantages and disadvantages of pneumatic drives. Volumetric pneumatic motors. Pneumatic devices.

Topics of the workshops

There are no practical classes.

Topics of the laboratory classes

1. Pressure measurement devices.
2. Study of the fluid flow in the variable section of the pipeline
3. Modes of fluid motion.
4. Linear head losses along the length of the pipe.
5. Local hydraulic losses.
6. Fluid flow through holes and nozzles.
7. Energy testing of the pump.
8. Energy testing of the compressor.

Self-study

The course provides for individual tasks. The results of calculations and research are made into a written report. Additional materials (videos, manuals, articles) are also recommended for students to study and analyze independently.

Course materials and recommended reading

1. Elger, D. F., LeBret, B. A., Crowe, C. T., & Roberson, J. A. (2020). Engineering fluid mechanics. John Wiley & Sons.
2. Nakayama, Y. (2018). Introduction to fluid mechanics. Butterworth-Heinemann.
3. Gerhart, A. L., Hochstein, J. I., & Gerhart, P. M. (2020). Munson, Young and Okiishi's fundamentals of fluid mechanics. John Wiley & Sons.
4. Graebel, W. (2018). Engineering fluid mechanics. CRC Press.
5. Completions Hydraulic Handbook: Handbook. Schlumberger, 2000. – 392 p.
6. Miller R., Miller M.R., Stewart H.L. Pumps and Hydraulics: Wiley Publishing, Inc., Indianapolis, Indiana, 2004. – 577 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

Description of the final score structure:
Exam (2 theoretical questions+ problem solving) - 30 points
Laboratory works - 40 points
Course work - 30 points

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	Date, signature	Head of the department Andrii ROGOVYI
	Date, signature	Guarantor of the educational program Iryna TYNYANOVA