



Syllabus Course Program



Machines and equipment for drilling oil and gas wells

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

Optional (profile)

Semester

6

Language of instruction

English, Ukrainian

Lecturers and course developers



Nataliia Shevchenko

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

Author and co-author of more than 60 scientific and educational works.

Courses: "Fundamentals of underground hydraulics and the theory of filtration", "Mechanics of viscous fluids and drilling fluids", "Machines and equipment for drilling oil and gas wells", "Machines and equipment for the extraction of oil and other types of hydrocarbon raw materials", "Increasing efficiency of 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"

General information

Summary

Machines and equipment for drilling wells for oil and gas is one of the leading directions in the field of mechanical engineering. The process of drilling wells is very expensive and therefore requires careful planning and consideration of many geological, technical and technological factors. The future inflow of

oil and gas and, accordingly, the profit from the development of a hydrocarbon field depends on the quality of drilling operations.

Course objectives and goals

To form and develop in students a scientific and practical outlook, modern forms of theoretical thinking, the ability to analyze work processes that occur when drilling wells for oil and gas; to acquaint students with the main directions of development of domestic and foreign well drilling technology; to teach students to understand the regularities of the work process of oil and gas equipment, their construction; to be able to independently choose drilling equipment for the conditions of its effective use.

Format of classes

Lectures, practical classes, consultations, self-study, course work. Final control is in the form of an exam.

Competencies

ZK2. Ability to apply knowledge in practical situations.

FK3. The ability to evaluate and ensure the quality of the work performed.

SK-15. Ability to use knowledge to select construction materials, equipment, processes.

SK-16. Ability to demonstrate understanding of engineering requirements to ensure rapid and sustainable development.

Learning outcomes

RN-1. The ability to demonstrate knowledge and understanding of the fundamentals of fundamental and engineering sciences that underlie industrial mechanical engineering.

PH-2. The ability to demonstrate knowledge of mechanics and mechanical engineering and outline the prospects for their development.

PH-4. The ability to set and solve engineering tasks of industrial mechanical engineering using appropriate calculation and experimental methods

PH-5. The ability to use the acquired knowledge in the analysis of engineering objects, processes and methods.

Student workload

The total volume of the course is 150 hours (5 ECTS credits): lectures - 48 hours, practical classes – 24 hours, self-study - 78 hours.

Course prerequisites

The study of this discipline is directly based on general physics, hydraulic and pneumatic drives, mechanics of viscous fluids and drilling mud, underground hydraulics and the basics of filtration.

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

Lectures are conducted interactively using multimedia technologies. In practical classes, a project approach to learning, game methods are used. Study materials are available to students through OneNote Class Notebook and an electronic course on the educational platform of NTU "KhPI"
<https://dlc.kpi.kharkov.ua/course/view.php?id=532>.

Program of the course

Topics of the lectures

Topic 1. Trends and directions of development of drilling equipment. Drilling rigs. Classification and main parameters of drilling rigs. Modern models of drilling rigs. Methods of drilling. Inflow of VU to the well. Pressure, productivity of wells.

Topic 2. Selection of well design. Casing columns. Selection of casing pipe diameter when constructing wells. Casing column calculation methodology. Equipment for cementing wells.

Topic 3. A destructive tool. Classification. Terms of use. Design features. The choice of PRI to the conditions of HTN. Technical means for core drilling. Drill bits for special work.

Topic 4. Design and operation of drill strings. Calculation of static strength and endurance. Normative coefficients of safety margins. Materials used in drilling and casing strings. Classification by strength groups and chemical composition. Heat treatment.

Topic 5. Composition of BU and typical kinematic schemes. Selection of the method and mode of drilling for given conditions. BU drives and transmissions. Types of drives, their characteristics. Layout of power drives and transmissions.

Topic 6. The lowering and lifting complex of the drilling rig. Rules of operation, safety equipment. Tackle ropes. Crown blocks, hooks, hook blocks. Drilling winches. Basic requirements, classification. Kinematic diagrams, structural features, basic technical data. Equipment for mechanization and automation of technological processes when drilling wells.

Topic 7. Equipment for tying and sealing the wellhead. General Information. Working conditions, classification, basic requirements and parameters. Rules of operation, safety equipment.

Preventers. Classification. Principle of operation, design. Calculations of the main parameters

Topic 8. Rotors. Constructive performance. Features of operation. Basic requirements for parameters. Calculation of the kinematic scheme.

Topic 9. Well flushing technology (direct and reverse schemes). Drilling mud (BR). Main functions, composition and parameters of BR. Hydraulic calculation of well flushing for given geological conditions. Determination of the mode of operation of the drilling pump.

Topic 10. Drilling pump. Classification. Kinematics, construction. Adjustment of work modes. Strength calculations. Terms of use.

Topic 11. Swivels. General information, working conditions, basic requirements, appointment. Constructive performance. Calculation of swivel bearings.

Topic 12. Circulation system for supply, preparation and cleaning of drilling fluid. Vibrant Hydro cyclones. Degassers. Centrifuges. Classification. Terms of use. Specifications. Calculations of the main parameters of the CS for the given conditions of the HTN.

Topic 13. Drilling inclined wells. Terms, requirements and parameters. Control when drilling wells. Technique and technology of drilling inclined wells.

Topic 14. Methods of development of marine deposits. Marine platforms. Floating drilling rigs. Classification. Basic equipment. Rules of operation, safety equipment

Topics of the workshops

1. Designing the structure of the well and casing strings for the given conditions of the HTN.
2. Selection of the type of flights. Selection of the drilling method and drilling mode for given conditions.
3. Design of the drill pipe column and MBT. Strength calculations.
4. Calculation of the carrying capacity of the BU for the given conditions of the HTN. Selection of a drilling rig for given conditions.
5. Selection and calculations of elements of SPK BU.
6. Analysis of the selected kinematic scheme of the BU.
7. Selection of typical wellhead casing equipment for given conditions
8. Hydraulic calculation of well flushing parameters. Selection of a drilling pump.
9. Selection of the rotor, swivel, preventer for the given conditions. Construction.
10. Examples of calculations on the strength of BU equipment.

Topics of the laboratory classes

There are no laboratory classes

Self-study

The course involves performing computational and graphic work. Drawing of typical rig equipment. Compilation of specifications. The results of calculations and drawings are drawn up in a written report. Students are also recommended additional materials (videos, manuals) for independent study and analysis. An electronic course on the educational platform of KhPI National Technical University <https://dlc.kpi.kharkov.ua/course/view?id=532> is recommended

Course materials and recommended reading

1. Orlovsky V. M., Biletskyi V. S., Vitryk V. G., Sirenko V. I. Drilling and technological equipment. Kharkiv: KhNUMG, NTU "KhPI", LLC NTP "Burova tehnika", Lviv, Publishing House "New World - 2000", 2021. - 358 p. <http://library.kpi.kharkov.ua>
2. Myronov Y.B., Romanishyn L.I Workshop on the course "Machines and equipment for drilling oil and gas wells". // Yu.B. Mironov, L. I. Romanyshin - Ivano-Frankivsk DTU "Oil and Gas", 2002. - 120 p. <https://dlc.kpi.kharkov.ua/course/view.php?id=532>
3. Shevchenko N.G. Methodical instructions for coursework and practical tasks on the topic: "Hydraulic calculation of well flushing during oil and gas drilling" from the disciplines "Viscous fluid and drilling fluid mechanics", "Machines and equipment for drilling oil and gas wells" / H.G. Shevchenko. - Kharkiv: NTU "KhPI", 2010. - 30 p. <https://dlc.kpi.kharkov.ua/course/view.php?id=532>
4. Shevchenko N.G., Fateeva N.M. Methodical instructions for performing the calculation work "Selection and calculations of parameters of drilling equipment for drilling oil and gas wells" from the educational discipline "Machines and equipment for drilling oil and gas wells" // N.G. Shevchenko. - Kharkiv: NTU "Khpy", 2019. <https://dlc.kpi.kharkov.ua/course/view.php?id=532>
5. Vyrvinsky P.P. Drilling technology. / P.P. Vyrvinskyi, Yu.L. Kuzin, V.L. D. Khomenko: National Mining University, 2014. <http://library.kpi.kharkov.ua>

Assessment and grading

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

100% of the final grade consists of assessment results in the form of an exam (40%) and ongoing assessment (60%).

Exam: written assignment (2 theory questions + problem solving) and oral presentation.

Current assessment: 2 online tests and calculation tasks.

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

30.06.2023

Head of the department
Andrii ROGOVYI

30.06.2023

Guarantor of the educational program
Iryna TYNIANOVA

