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**Federal State Autonomous Educational Institution of Higher Education
Peoples' Friendship University of Russia named after Patrice Lumumba
RUDN University**

Academy of Engineering

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

**Machinery and equipment for field development and transportation of
hydrocarbons / Машины и оборудование для разработки месторождений и
транспорта углеводородов**

course title

Recommended by the Didactic Council for the Education Field of:

21.04.01 Oil and Gas Engineering

field of studies / speciality code and title

**The course instruction is implemented within the professional education programme of
higher education:**

Oil and Gas Engineering / Технологии добычи и транспортировки нефти и газа

higher education programme profile/specialisation title

1. COURSE GOAL(s)

The discipline «Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов» is included in the curriculum of the master's programme "Oil and Gas Engineering / Технологии добычи и транспортировки нефти и газа" within the field of study 21.04.01 "Oil and Gas Engineering" and is studied in the 1-2 semesters of master 1. The discipline is delivered by the Department of Mineral Developing and Oil & Gas Engineering. It consists of 2 sections and 7 topics and is aimed at and is aimed at studying the use of sets of machinery and equipment for drilling wells, producing hydrocarbons, repairing wells, and transporting oil and gas via main pipelines; studying the design of machinery and equipment for drilling wells, producing hydrocarbons, repairing wells, and transporting oil and gas via main pipelines; and studying the challenges related to the installation, operation, maintenance, and repair of machinery and equipment for drilling wells, producing hydrocarbons, repairing wells, and transporting oil and gas via main pipelines.

The goal of the course is to provide students with knowledge, skills, competencies, and practical experience in the field of familiarization with the design, block diagram, and construction of equipment used in the development of oil and gas fields, as well as in the transport and storage of oil and gas.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course "Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов" is designed for students to acquire following competences (competences in part):

Table 2.1. List of competences that students acquire during the course

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-2	Able to design oil and gas production facilities	<p>GPC-2.1. Knows the normative legal documents regulating the requirements for professional activity; algorithm for organizing work in the process of designing oil and gas production facilities; aspects of working in contact with the supervisor.</p> <p>GPC-2.2. Can apply the methods and technology of designing the main and additional processes of oil and gas production; formulate goals for the performance of work and propose ways to achieve them; own the methodology and technology for designing oil and gas production facilities; apply an activity approach to design problems in the field of oil and gas production; evaluate the convergence of the results of calculations obtained by various methods.</p> <p>GPC-2.3. Has the principles and techniques of designing oil and gas production facilities; methods for developing a scientific and methodological approach to the design of oil and gas production processes; has the skills to promptly fulfill the requirements of the working project; the skills to work</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		in modern PCs, using new methods and software packages.
PC-3	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	<p>PC-3.1. Knows the principles, physical foundations, technical support of technical control and diagnostic methods, modern developments in the field of strength of materials, fracture mechanics, materials technology and materials science; design features, manufacturing technology, operation and repair of the control object, types and types of defects, probable zones of their formation, taking into account the loads acting on the object and other factors, principles, physical foundations, technical support for the types and methods of technical control and diagnostics; principles of construction, functional diagrams and rules for operating equipment for a given method of control, rules for selecting and checking the quality of used consumable flaw detection materials; control systems used to check objects (products) of a certain type; metrological support; standards, calculation methods and other applicable regulatory documents and rules for assessing the technical condition; harmful environmental factors of this control method and ways to prevent their impact on the environment and humans; principles of planning and organization of work of technical control and diagnostic units, current state and prospects for the development of technical control and diagnostic methods; rules for electrical safety and fire safety, rules for the construction and safe operation of facilities.</p> <p>PC-3.2. Can determine the methods, equipment, technologies and techniques to be used for specific types of objects; perform control operations, evaluate and identify the results of control and testing, issue conclusions on the results of technical control and diagnostics; organize, conduct and manage calculations and experimental work to assess the technical condition.</p> <p>PC-3.3. Has the skills to perform verification calculations, taking into account the identified defects; assessment of the mutual influence of various defects on the technical condition of the control object; determining the need for additional research in order to clarify the determining parameters of the technical condition; development of measures to reduce operational risks based on risk analysis, minimization of operational risks.</p>
PC-5	Capable of applying the basic principles of rational use of natural resources and environmental protection	PC-5.1. Knows the legal and methodological framework of the procedure for conducting environmental impact assessment EIA and environmental expert activities for use in

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>professional activities; fundamentals of the theory and normative legal acts of the integrated development and rational use of natural resources and environmental protection; the procedure for conducting a geological examination of projects, regulatory documents for compiling an environmental passport.</p> <p>PC-5.2. Can assess the state of the environment when conducting complex geological and geographical studies; use mechanisms for the rational use of natural resources and environmental protection; apply regulatory and methodological documents to assess and prevent environmental damage at production facilities.</p> <p>PC-5.3. Has the methodology of rational use of natural resources and environmental protection; a system of methods (EIA) and conducting state environmental expertise for successful research and production activities; skills and knowledge to assess environmental damage at production facilities, modern methods for eliminating the consequences and preventing environmental damage at production facilities.</p>
PC-6	Able to organize, manage, and carry out quality control of the main types of work in the development of oil and gas fields, transportation of oil and gas	<p>PC-6.1. Knows: the main types of applied systems for assessing the quality of geological types of work in the development of oil and gas fields, transportation of oil and gas; ISO-9001 quality system, GKZ regulations and classification of oil and gas reserves; requirements of regulatory legal acts of the Russian Federation, local regulations, administrative documents and technical documentation in the field of hydrocarbon production; technological processes of hydrocarbon production; purpose, device and principle of operation of equipment for the extraction of hydrocarbon raw materials; physical and chemical properties of hydrocarbon raw materials, chemical reagents, the procedure and rules for their disposal; technological modes, well operation parameters; standards for technological losses of hydrocarbon raw materials during production in accordance with the accepted scheme and development technology; the influence of various processes occurring in the reservoir on the productivity factor of a production well; the procedure for measuring the productivity factor of a production well; methods for calculating the productivity factor and skin effect according to well surveys with recording the pressure recovery curve; purpose, device and principle of operation of equipment for mechanized production of</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>hydrocarbon raw materials; standards, specifications, guidelines for the development and execution of technical documentation; types of emergencies during well operation, their causes and methods of prevention and elimination; structure, interaction of means of an automated process control system, telemechanics, automatic control systems for hydrocarbon production equipment, ways to control them; requirements for labor protection, industrial, fire and environmental safety.</p> <p>PC-6.2. Can: organize and conduct quality control of work in the development of oil and gas fields, transportation of oil and gas at different stages of the study of specific objects; evaluate the residual life of hydrocarbon production equipment; analyze inflow characteristics in a vertical, horizontal or multilateral well; predict the change in the inflow characteristics from the reservoir to the well, taking into account the reservoir operation mode; develop operating instructions for hydrocarbon production equipment; control the operation of equipment for artificial lift of hydrocarbons; identify wells operating with deviations from the planned regime; conduct emergency drills with subordinate personnel according to the action plan for localization and elimination of accidents and incidents at hydrocarbon production facilities.</p> <p>PC-6.3. Has: the methodology for assessing the quality of all types of work in the development of oil and gas fields, transportation and processing of oil and gas at different stages of the study of specific objects; skills for organizing and monitoring the implementation of plans and tasks for the extraction of hydrocarbons; skills for operational management of production and monitoring compliance with hydrocarbon production technology; skills for monitoring compliance with the specified operating mode of well equipment, piping, oil and gas field pipelines, prefabricated pipelines, gas pipelines, inhibitor pipelines in accordance with the requirements of the technological regulations of the installation, operating instructions and passports of equipment manufacturers; skills to analyze the dynamics of hydrocarbon production. Organization of providing jobs with up-to-date technological documentation; skills in organizing monitoring and control of the operation of the field and wells; skills of control and management of work on the preparation and maintenance of technical documentation of the unit; skills of control and</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		management in the direction of compliance with the requirements of labor protection, industrial, fire and environmental safety in the unit; skills to control and manage the preparation of reports on the production of hydrocarbons.
PC-7	Able to manage the work on the diagnostic examination of the main oil pipelines (MOP) and the main oil product pipelines (MOPP) facilities	<p>PC-7.1. Knows: methods for organizing work on in-line diagnostic inspection of the MOP and MOPP using in-line inspection devices; organizational and administrative documents, regulatory and methodological materials in the field of quality control of work on the diagnostic examination of the MOP and MOPP; list of scientific and technical documentation, the use of which is associated with the performance of work on the diagnosis of MOP and MOPP objects; procedure for the formation of long-term development plans in the field of diagnostic work at the facilities of MOP and MOPP; procedure for the development of design, executive and operational documentation for the direction of activity; rules for working with specialized software systems; requirements for labor protection, industrial, fire and environmental safety.</p> <p>PC-7.2. Can: determine the scope and procedure for performing work on the diagnostic examination of the MOP and MOPP; assess the compliance of work performance with the requirements of the technological process for diagnosing objects of MOP and MOPP; determine the composition and sequence of preparatory work for non-destructive quality control of structural elements of objects and structures of MOP and MOPP, mechano-technological equipment and metal structures of MOP and MOPP tanks, technical devices, materials, products, parts, assemblies, welded joints; ensure the prevention and elimination of violations of the production process of diagnosing objects of MOP and MOPP by NDT methods; determine the procedure for performing work to identify defects based on the results of additional flaw detection control of MOP and MOPP objects, including internal ones, measurement and refinement of their parameters; analyze advanced domestic and foreign experience in the field of diagnosing MOP and MOPP objects; use specialized software products in the field of activity; comply with the requirements of industrial safety and labor protection at the facilities of MOP and MOPP.</p> <p>PC-7.3. Has: skills in planning work on diagnosing MOP and MOPP objects; skills in managing work on processing the results of diagnosing objects of MOP</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		and MOPP; skills for verification and approval of production documentation for the diagnosis and control of MOP and MOPP facilities; skills to control the regulatory and technical support of work on diagnosing objects of MOP and MOPP; skills to control data entry into specialized software systems, and their verification.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the variable component of (B1) block of the higher educational programme curriculum.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
GPC-2	Able to design oil and gas production facilities	—	Technological practice (educational); Technological practice (industrial); State Exam; Graduate Qualification Work
PC-3	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	Diagnostics of oil and petroleum products main pipeline facilities; Innovative technologies for the transportation and storage of hydrocarbons; Methods for oil production intensification and enhanced oil recovery	Pre-graduation Practical Training; State Exam; Graduate Qualification Work
PC-5	Capable of applying the basic principles of rational use of natural resources and environmental protection	Methods for oil production intensification and enhanced oil recovery	State Exam; Graduate Qualification Work
PC-6	Able to organize, manage, and carry out quality control of the main types of work in the development of oil and gas fields, transportation of oil and gas	Current development of the production of unconventional hydrocarbon resources in the world; Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons; Innovative technologies	Pre-graduation Practical Training; State Exam; Graduate Qualification Work

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
		for the development of hydrocarbon deposits; Well repair and water breakthrough control technologies; Methods for oil production intensification and enhanced oil recovery	
PC-7	Able to manage the work on the diagnostic examination of the main oil pipelines (MOP) and the main oil product pipelines (MOPP) facilities	Diagnostics of oil and petroleum products main pipeline facilities; Well repair and water breakthrough control technologies	Pre-graduation Practical Training; State Exam; Graduate Qualification Work

* To be filled in according to the competence matrix of the higher education programme

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов" is 8 credits.

Table 4.1 Types of academic activities during the period of the HE programme mastering

Type of study work	TOTAL, acc.hrs.	Semester(s)	
		1	2
<i>Contact academic hours, acc .</i>	70	36	34
including:	35	18	17
Lectures			
Laboratory work			
Seminars (workshops/tutorials)	35	18	17
<i>Self-study (ies), academic hours</i>	99	81	83
<i>Evaluation and assessment (exam or pass/fail grading)</i>	27	27	27
The course total workload	acc.hrs.	288	144
	Credits	8	4

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course topic title	Course module contents (topics)	Academic activities types
1 Section 1. Machinery and Equipment for the Development of Oil and Gas Fields	1.1 Overview of machinery and equipment for drilling oil and gas wells.	Classification of wells (by purpose, depth, wellbore profile). Main drilling methods (percussion, rotary, combined). Overview of a drilling rig: surface and subsurface equipment. Brief description of main components. Concept of drilling parameters. Drilling rig classes by lifting capacity. Main stages of well construction.	LC, S
	1.2 Drilling rig equipment and fundamentals of its	Drilling structures. Fundamentals of derrick calculation. Traveling block system.	LC, S

			calculation.	Purpose and composition. Drawworks. Braking systems of drawworks. Drilling rig drive. Power transmissions. Couplings. Rotary tables. Tongs. Swivel. Drill string. Downhole hydraulic motors. Turbodrills. Positive displacement motors (PDM). Electric drills. Drilling fluid circulation system. Pumping and cementing equipment. Blowout prevention equipment. Hydraulic control units. Casing string head equipment. Casing heads.	
		1.3	Equipment for well operation.	Tubing (Tubing). Fundamentals of tubing calculation. Equipment for flowing oil and gas wells. Shut-off and control devices on Christmas trees. Equipment for gas lift wells. Equipment for mechanized well operation: rod and rodless downhole pumping units. Electric pumps with surface and submersible drives. Centrifugal electric pumps. Screw and diaphragm electric pumps. Jet pumps.	LC, S
		1.4	Technologies for separate operation, oil and gas treatment, and workover.	Equipment for isolating zones in the production casing. Packers. Downhole shut-off valves. Equipment for separate and dual string production. Equipment for dehydration, desalting of oil, and combating oil emulsions. Separators, heaters, electro-dehydrators. Field natural gas and condensate treatment system. Adsorbers, absorbers. Well workover. Classification of workover equipment.	LC, S
		1.5	Equipment and mechanization means for repair and hydrocarbon transport.	Hoisting equipment. Equipment for trip operations. Mechanization means. Surface equipment for technological operations. Downhole equipment and tools. Equipment for oil and gas transport at pumping stations and compressor stations.	LC, S
2	Section 2. Machinery and Equipment for Oil and Gas Transport	2.1	Transport and storage of oil, gas, and petroleum products.	General information on the transport of oil, gas, and petroleum products. Modes of transport (pipeline, rail, road, water). Pipeline route and its profile. Pumping and compressor stations. Equipment for loading and unloading operations.	LC, S
		2.2	Storage of petroleum products and gas treatment prior to transport.	Tanks for storage of oil and petroleum products. Tank equipment. Classification and composition of natural and manufactured gases. Removal of impurities from gas. Gas odorization.	LC, S

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Lecture	A lecture hall for lecture-type classes, equipped with a set of specialised furniture; board (screen) and technical means of multimedia presentations.	
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and technical means for multimedia presentations.	
Computer Lab	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (in the amount of 12 pcs), a board (screen) and technical means of multimedia presentations.	Virtual Reality Class for Oil and Gas Production Process Management
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment.	

* The premises for students' self-studies are subject to **MANDATORY** mention

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

1. Sharifullin, A. V., Baibekova, L. R., Smerdova, S. G. Facilities and equipment for storage, transportation and dispensing of oil products: textbook / Ministry of Education and Science of the Russian Federation, State Educational Institution of Higher Professional Education "Kazan State Technological University". – Kazan: KSTU, 2011. – 135 p.
2. Snarev, A. I. Selection and calculation of equipment for oil production: textbook. – Moscow; Vologda: Infra-Engineering, 2019. – 217 p.
3. Verzhbitsky, V. V., Prachev, Yu. N. Fundamentals of construction of oil and gas transport facilities: textbook / Ministry of Education and Science of the Russian Federation, Federal State Autonomous Educational Institution of Higher Professional Education "North Caucasus Federal University". – Stavropol: NCFU, 2014. – 154 p.

Additional(optional) reading (sources):

4. Bezborodov, Yu. N., Shram, V. G., Kravtsova, E. G., et al. Tanks for receiving, storing and dispensing oil products: textbook / Ministry of Education and Science of the Russian Federation, Siberian Federal University. – Krasnoyarsk: Siberian Federal University, 2015. – 110 p.
5. Bezborodov, Yu. N., Petrov, O. N., Sokolnikov, A. N., Feldman, A. L. Technological equipment for filling stations and oil depots: textbook: in 2 parts / Ministry of Education and Science of the Russian Federation, Siberian Federal University. – Krasnoyarsk: Siberian Federal University, 2015. – Part 2. Equipment for storage, reception and dispensing of oil products at oil depots and filling stations. – 172 p.

Internet sources

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" <http://e.lanbook.com/>

2. Databases and search engines:

- electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>

- Yandex search engine [https:// www .yandex.ru/](https://www.yandex.ru/)
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

*Training toolkit for self- studies to master the course *:*

1. The set of lectures on the course Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов.

2. Guidelines for students on the development of the course Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов.

*The training toolkit and guidelines for the course are placed on the course page in the university telecommunication training and information system under the set procedure.

DEVELOPERS:

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name and surname

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