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

2025

1. COURSE GOALS

The goal of the course "Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов" is to familiarize students with the device, block diagram, design of equipment used in the development of oil and gas fields, as well as in the transport and storage of oil and gas.

The aims of the course are:

- study of the purpose of a complex of machines and equipment for drilling wells, production, well repair, oil and gas transportation through main pipelines;
- study of the design of machines and equipment for drilling wells, production, well repair, oil and gas transportation through main pipelines;
- studying the issues of installation, operation, maintenance and repair of machines and equipment for drilling wells, production, well repair, oil and gas transportation through main pipelines.

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	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.
		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.
		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 in modern PCs, using new methods and software packages.
SPC-4	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	SPC-4.1 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,

Competence code	Competence descriptor	Competence formation indicators (within this course)
		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
		SPC-4.2 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
		SPC-4.3 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
SPC-6	Capable of applying the basic principles of rational use of natural resources and environmental protection	SPC-6.1 Knows the legal and methodological framework of the procedure for conducting environmental impact assessment EIA and environmental expert activities for use in 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
		SPC-6.2 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
		SPC-6.3 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		production facilities
SPC-7	Able to organize, manage, and carry out quality control of the main types of work in the development of oil and gas fields, transportation and processing of oil and gas	SPC-7.1 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 and processing 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 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
		SPC-7.2 Can: Organize and conduct quality control 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 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		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
		SPC-7.3 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, 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 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
SPC-8	Able to manage the work on the diagnostic examination of the main oil pipelines (MOP) and the main oil product pipelines (MOPP) facilities	SPC-8.1 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 The procedure for the formation of long-term development plans in the field of diagnostic work at the facilities of MOP and MOPP The 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		SPC-8.2 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
		SPC-8.3 Has: Skills in planning work on diagnosing MOP and MOPP objects Skills in managing work on processing the results of diagnosing objects of MOP 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

1. ACADEMIC 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 that contribute to the achievement of the expected learning outcomes as the course results

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
GPC-2	Able to design oil and gas production facilities	Disciplines of the previous level of education	
SPC-4	Able to manage the system for monitoring the technical	Disciplines of the previous level of	*Diagnostics of oil and petroleum products main pipeline*

Competence code	Competence descriptor	Previous courses/modules, internships*	Subsequent courses/modules, internships*
	condition and technical diagnostics at the facilities and structures of the oil and gas complex	education	*facilities***; *Innovative technologies for the transportation and storage of hydrocarbons***; Methods of oil production intensification; Pre-graduation Practical Training;
SPC-6	Able to apply the basic principles of sustainable use of natural resources and environmental protection	Disciplines of the previous level of education	*Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons***; *Innovative technologies for the development of hydrocarbon deposits***; *Methods of oil production intensification;* *Pre-graduation Practical Training;*
SPC-4	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	Disciplines of the previous level of education	*Diagnostics of oil and petroleum products main pipeline facilities***; *Pre-graduation Practical Training;*
SPC-8	Able to manage work on the diagnostic examination of objects of main oil pipelines (MN) and main oil product pipelines (MNPP)	Disciplines of the previous level of education	*Current development of the production of unconventional hydrocarbon resources in the world;* *Methods of oil production intensification;*

* - filled in in accordance with the matrix of competencies and the Higher Education Programme

4. COURSE WORKLOAD

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.	Semester(s)	
		1	2
Contact academic hours, acc .	*70*	*36*	*34*
Lectures	35	18	17
Laboratory work	-	-	-
Seminars (workshops/tutorials)	35	18	17
Self-study (ies), academic hours	*164*	*81*	*83*
Evaluation and assessment (exam or pass/fail grading)	*54*	*27*	*27*

Type of study work		TOTAL, acc.	Semester(s)	
			1	2
The course total workload	acc.hrs.	**288**	**144**	**144**
	credits	**8**	**4**	**4**

5.COURSE MODULE and CONTENTS

Table 5.1. The content of the discipline (module) by type of educational work

Name of the discipline section	Contents of the section (topic)	Type of study work
Module 1. Machinery and equipment for the development of oil and gas fields	Topic 1: Overview of machines and equipment for drilling oil and gas wells. Drilling rig traveling block. Purpose and composition. Winches. Brake devices. Drilling rotors. Drill wrenches. Drilling swivels. Top drive system. Power transmission equipment. Couplings. Drilling rig circulation system. Blowout prevention equipment. Hydraulic control units. Drilling string. Drilling structures. Fundamentals of calculation of drilling operation. Hydraulic downhole motors. Turbodrills. Downhole screw motors. Electric downhole motor. Pumping and cementing equipment. Wellhead system. Casing heads	Lecture, seminar
	Topic 2: Tubing. Fundamentals of tubing calculation. Flowing well equipment. Flowing well shut-off and control valves. Gas-lift well equipment. Artificial lift equipment. Sucker-rod and rodless pumping units. Ground driven and submersible electric pumps. Centrifugal electric pumps. Artificial lift equipment. Ground driven and submersible electric pumps. Electric screw and diaphragm pumps. Jet pumps.	Lecture, seminar
	Topic 3: Water-alternating-gas and simultaneous water-alternating-gas injection equipment. Annular isolation equipment. Packers. Sub-surface safety valve. Equipment for dehydration, desalination of oil and oil emulsion control. Separators, furnaces, electric dehydrators. Field natural gas and condensate treatment system. Adsorbers, absorbers. Well servicing. Well servicing equipment classification.	Lecture, seminar
	Topic 4: Tripping operations equipment. Tools. Means of mechanization. Lifting equipment. Technological operations equipment. Surface equipment. Technological operations equipment. Equipment and tools lowered into the well. Equipment for the transportation of oil and gas at pumping and compressor stations.	Lecture, seminar
Module 2: Machinery and equipment for transportation of oil and gas	Topic 1: Overview of transportation and petroleum products. Pipeline transportation. Pipeline route and its profile. Oil and gas transportation equipment at pumping and compressor stations, its purpose and composition, as well as main technical characteristics.	Lecture, seminar
	Topic 2: Oil and petroleum products storage tanks. Storage tank accessories. Classification and composition of natural and artificial gases. Gas pipeline compressor stations. Removal of impurities from gas. Gas odorization.	Lecture, seminar

6.CLASSROOM EQUIPMENT and TECHNOLOGY SUPPORT REQUIREMENTS

- *Table 6.1. Classroom Equipment and Technology Support Requirements*

Classroom for Academic Activity Type	**Classroom equipment**	**Specialized educational / laboratory equipment, software and materials for mastering the discipline** (if necessary)
Lecture	Training room for conducting lecture-type classes: room. No. 2030 A set of specialized furniture; interactive panel	
Seminar	Computer class No. 2033 Set of specialized furniture; PC, telepanel	
For self-study	Classroom for conducting seminar-type classes: room. No. 2037 Set of specialized furniture; chalkboard; projector, laptop	
Laboratory of Rational Subsurface Use	Laboratory of Rational Subsurface Use No. 2035	Computer with pre-installed licensed software "ARMARIS" Intel Core 15 processor; "Wellhead equipment" - mock-up bench; 32" LED TV 3D on a rack; Layout - controller "Electon-09 1" from SU " Electon 05-250 » in compact design
Laboratory of Rational Subsurface Use	Laboratory of Rational subsurface use No. 2039 A set of specialized furniture; training stand for experimental determination of pump characteristics, training stand, drilling rig	
Seminar	Computer class No. 457 Set of specialized furniture; PC, projector, laptop	Virtual Reality Class for Oil and Gas Production Process Management

7. RESOURCES RECOMMENDED FOR COURSE

Main reading(sources):

1. Sharifullin, A.V. Structures and equipment for storage, transportation and distribution of petroleum products: study guide / A.V. Sharifullin, L.R. Baibekova, S.G. Smerdova; 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. : illustrations, tables, schemes. - Bibliography. in book. - ISBN 978-5-7882-0973-9;
http://biblioclub.ru/index.php?page=book&id=270290

2. Verzhbitsky, V.V. Fundamentals of the construction of oil and gas transport facilities: study guide / V.V. Verzhbitsky, Yu.N. Prachev; Ministry of Education and Science of the Russian Federation, Federal State Autonomous Educational Institution of Higher Professional Education "North Caucasian Federal University". - Stavropol: NCFU, 2014. - 154 p.
http://biblioclub.ru/index.php?page=book&id=457777

Additional(optional) reading (sources):

1. Reservoirs for receiving, storing and dispensing petroleum products: study guide / Yu.N. Bezborodov, V.G. Shram, E.G. Kravtsova and others; Ministry of Education and Science of the Russian Federation, Siberian Federal University. - Krasnoyarsk: Siberian Federal University, 2015. - 110 p.
http://biblioclub.ru/index.php?page=book&id=435609
2. Technological equipment for gas stations and oil depots: study guide: At 2 hours / Yu.N. Bezborodov, O.N. Petrov, A.N. Sokolnikov, A.L. Feldman; Ministry of Education and Science of the Russian Federation, Siberian Federal University. - Krasnoyarsk: Siberian Federal University, 2015. - Part 2. Equipment for storing, receiving and dispensing petroleum products at oil depots and gas stations. - 172 p. :
http://biblioclub.ru/index.php?page=book&id=435655

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/
- EL "Trinity Bridge"

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/
- EL "Trinity Bridge"

Learning toolkits for self- studies:

1. A course 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 independent work of students in the course "Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов."
3. Guidelines for the implementation and execution of a term paper / project in 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.

3. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS COURSE RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course results are specified in the Appendix to the course syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Senior lecturer of the Department of Mineral Developing and Oil&Gas Engineering	Tcharo H.
position, educational department	name and surname

Head of Department:

Head of the Department of Mineral Developing and Oil&Gas Engineering	Kotelnikov A.E.
position, educational department	name and surname

Head of Educational Programme:

Professor of the Department of Mineral Developing and Oil&Gas Engineering	Kapustin V.M.
position, educational department	name and surname