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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

Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением

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 " Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением " 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 4th semester of master 2. The discipline is delivered by the Department of Mineral Developing and Oil & Gas Engineering. It consists of 5 sections and 13 topics and is aimed at studying field experience in the application of various well repair technologies and methods, as well as technologies for performing repair and isolation work (RIW) in wells in order to isolate sources of formation, foreign, and injected water influx; acquiring practical skills in solving problems related to selecting problematic wells and technologies for combating premature water breakthrough.

The goal of the discipline is to obtain knowledge, skills, and experience in the field of modern well repair methods aimed at restoring oil flow rates and eliminating excessive water cut of well production, as well as technologies for implementing these methods, which characterize the stages of competency formation and ensure the achievement of the planned learning outcomes of the educational program.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course "Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением / Технологические процессы трубопроводного транспорта" 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)
PC-4	Able to draw up technical documentation for the implementation of the technological process (work schedules, instructions, plans, estimates, requests for materials, equipment, etc.), make an economic assessment of oil and gas fields in accordance with approved forms	PC-4.1 Knows the requirements and GOSTs for the preparation of technical documentation, basic methods of geological and industrial assessment of oil and gas fields; methods of geological-industrial and geological-economic assessment (GEO) of new geological exploration projects, taking into account all the uncertainties and risks of their implementation PC-4.2 Can draw up and draw up technical documentation for the implementation of technological processes in the field of oil and gas field development, transportation and processing of oil and oil products; apply new methods of geological and industrial evaluation of oil and gas fields; determine the geological resources and the probability of finding a deposit, its production potential; carry out planning and evaluation of infrastructure solutions; determination of costs for the discovery and development of a field PC-4.3 Has the methodology for preparing primary reporting, including work schedules, instructions, plans, estimates, applications for materials, equipment according to approved forms
PC-6	Able to organize, manage, and carry out quality control of the main types of work in the	PC-6.1 Knows: The main types of applied systems for assessing the quality of geological types of work in the development of

Competence code	Competence descriptor	Competence formation indicators (within this course)
	development of oil and gas fields, transportation and processing of oil and gas	<p>oil and gas fields, transportation and processing of oil and gas; ISO-9001 quality system, GKZ regulations and classification of oil and gas reserves</p> <p>Requirements of regulatory legal acts of the Russian Federation, local regulations, administrative documents and technical documentation in the field of hydrocarbon production</p> <p>Technological processes of hydrocarbon production</p> <p>Purpose, device and principle of operation of equipment for the extraction of hydrocarbon raw materials</p> <p>Physical and chemical properties of hydrocarbon raw materials, chemical reagents, the procedure and rules for their disposal</p> <p>Technological modes, well operation parameters</p> <p>Standards for technological losses of hydrocarbon raw materials during production in accordance with the accepted scheme and development technology</p> <p>The influence of various processes occurring in the reservoir on the productivity factor of a production well</p> <p>The procedure for measuring the productivity factor of a production well</p> <p>Methods for calculating the productivity factor and skin effect according to well surveys with recording the pressure recovery curve</p> <p>Purpose, device and principle of operation of equipment for mechanized production of hydrocarbon raw materials</p> <p>Standards, specifications, guidelines for the development and execution of technical documentation</p> <p>Types of emergencies during well operation, their causes and methods of prevention and elimination</p> <p>Structure, interaction of means of an automated process control system, telemechanics, automatic control systems for hydrocarbon production equipment, ways to control them</p> <p>Requirements for labor protection, industrial, fire and environmental safety</p> <p>PC-6.2 Can:</p> <p>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</p> <p>Evaluate the residual life of hydrocarbon production equipment</p> <p>Analyze inflow characteristics in a vertical, horizontal or multilateral well</p> <p>Predict the change in the inflow characteristics from the reservoir to the well, taking into account the reservoir operation mode</p> <p>Develop operating instructions for hydrocarbon production equipment</p> <p>Control the operation of equipment for artificial lift of hydrocarbons</p> <p>Identify wells operating with deviations from the planned regime</p> <p>Conduct emergency drills with subordinate personnel</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>according to the action plan for localization and elimination of accidents and incidents at hydrocarbon production facilities</p> <p>PC-6.3 Has:</p> <p>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</p> <p>Skills for organizing and monitoring the implementation of plans and tasks for the extraction of hydrocarbons</p> <p>Skills for operational management of production and monitoring compliance with hydrocarbon production technology</p> <p>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</p> <p>Skills to analyze the dynamics of hydrocarbon production. Organization of providing jobs with up-to-date technological documentation</p> <p>Skills in organizing monitoring and control of the operation of the field and wells</p> <p>Skills of control and management of work on the preparation and maintenance of technical documentation of the unit</p> <p>Skills of control and management in the direction of compliance with the requirements of labor protection, industrial, fire and environmental safety in the unit</p> <p>Skills to control and manage the preparation of reports on the production of hydrocarbons</p>
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:</p> <p>Methods for organizing work on in-line diagnostic inspection of the MOP and MOPP using in-line inspection devices</p> <p>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</p> <p>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</p> <p>The procedure for the formation of long-term development plans in the field of diagnostic work at the facilities of MOP and MOPP</p> <p>The procedure for the development of design, executive and operational documentation for the direction of activity</p> <p>Rules for working with specialized software systems</p> <p>Requirements for labor protection, industrial, fire and environmental safety</p> <p>PC-7.2 Can:</p> <p>Determine the scope and procedure for performing work on the diagnostic examination of the MOP and MOPP</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>Assess the compliance of work performance with the requirements of the technological process for diagnosing objects of MOP and MOPP</p> <p>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</p> <p>Ensure the prevention and elimination of violations of the production process of diagnosing objects of MOP and MOPP by NDT methods</p> <p>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</p> <p>Analyze advanced domestic and foreign experience in the field of diagnosing MOP and MOPP objects</p> <p>Use specialized software products in the field of activity</p> <p>Comply with the requirements of industrial safety and labor protection at the facilities of MOP and MOPP</p> <p>PC-7.3 Has:</p> <p>Skills in planning work on diagnosing MOP and MOPP objects</p> <p>Skills in managing work on processing the results of diagnosing objects of MOP and MOPP</p> <p>Skills for verification and approval of production documentation for the diagnosis and control of MOP and MOPP facilities</p> <p>Skills to control the regulatory and technical support of work on diagnosing objects of MOP and MOPP</p> <p>Skills to control data entry into specialized software systems, and their verification</p>

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the elective 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*
PC-4	Able to draw up technical documentation for the implementation of the technological process (work schedules, instructions, plans, estimates, requests for materials, equipment, etc.), make an economic assessment of oil and gas fields in accordance with approved forms	Current development of the production of unconventional hydrocarbon resources in the world; Innovative technologies for the development of hydrocarbon deposits; Machinery and equipment for field development and	State Exam; Graduate Qualification Work

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
		transportation of hydrocarbons; Modern aspects of geological and geophysical research in the oil and gas industry; Methods for Oil Production Intensification and Enhanced Oil Recovery	
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 and processing of oil and gas	Advanced oil and gas processing equipment and product quality management; Innovative technologies for the development of hydrocarbon deposits; Innovative technologies for the transportation and storage of hydrocarbons; Modern aspects of geological and geophysical research in the oil and gas industry; Modern stream in oil and gas processing in Russia; Technologies for developing prospective hydrocarbon reserves; Technological practice (educational); Technological practice (industrial)	State Exam; Graduate Qualification Work
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	Fundamentals of construction and operation of pipeline transport; Machinery and equipment for field development and transportation of hydrocarbons; Technological processes of pipeline transport	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 "Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением / Технологические процессы трубопроводного транспорта" is 4 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) 4
<i>Contact academic hours, acc .</i>		32	32
including:			
Lectures		8	8
Laboratory work			
Seminars (workshops/tutorials)		24	24
<i>Self-study (ies), academic hours</i>		112	112
<i>Evaluation and assessment (exam or pass/fail grading)</i>			
The course total workload		acc.hrs.	144
		Credits	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	Equipment for Well Repair	1.1	Hoisting units for well repair.	Hoisting units used in workover (WO) and current repair (CR) of wells, their load capacity, tasks, and technological capabilities	LC, S
		1.2	Equipment for conducting hoisting operations during well repair	Mechanisms used for lifting worn-out submersible pumps and tubing strings from the well to the surface, as well as for running new downhole pumping equipment into the well	LC, S
		1.3	Equipment for fishing operations in wells and methods of its use	Tools used for catching and lifting to the surface fallen downhole equipment, and methods for conducting fishing operations depending on the nature and causes of the accident	LC, S
2	Technologies for Well Preparation for Workover (WO) or Current Repair (CR), and for Conducting Hoisting Operations	2.1	Well killing technologies before workover (WO) and current repair (CR) in wells.	Well killing technologies before workover and current repair, kill fluids used, and methods of pumping them into the well depending on the production method and downhole pumping equipment installed	LC, S
		2.2	Technologies for conducting hoisting operations in wells	Technologies for lifting a worn-out submersible pump on a tubing string from the well, replacing it with a new one specified in the work plan, and running it into the well to the depth specified in the same document	LC, S
3	Classification of Well Repairs. Technologies for Transferring a Well to Another Development Object and Bringing Other	3.1	Classification of well repairs	Main types of repairs performed in wells, differences between workover and current repair, as well as differences between fishing operations and repair-isolation works or any others	LC, S
		3.2	Technologies for transferring a well to another	Technologies for transferring a well to produce another overlying or underlying development object, possible reasons and	LC, S

	Formations into Production		development object and bringing other formations into production	conditions for conducting such operations, as well as conditions and technologies for bringing other formations into production	
4	Tools and Materials for Performing Repair and Isolation Works (RIW) in Wells	4.1	Mechanical devices for performing RIW in wells and methods of their use	Mechanical devices for isolating sources of excessive water cut in production wells	LC, S
		4.2	Materials and reagents for performing RIW in wells	Materials and reagents used for eliminating water breakthrough sources in production wells by plugging. Their chemical nature and conditions for effective application	LC, S
5	Methods for Selecting Problematic Wells with Excessive Water Cut and Technologies for Performing RIW in Them	5.1	Methods for searching for problematic wells for performing RIW and criteria for their applicability	Methods for searching for wells with integrity loss in the well design causing excessive water cut. Criteria and methods for selecting such wells for RIW	LC, S
		5.2	Methods for eliminating behind-casing water flows in wells	Methods and technologies for eliminating integrity loss in the cement sheath of a well causing behind-casing flow, depending on the nature and extent of the flow	LC, S
		5.3	Methods for eliminating production casing integrity loss in a well	Methods and technologies for eliminating production casing integrity loss in a well causing excessive water cut, depending on the location of the integrity loss relative to the productive formation and its size	LC, S
		5.4	Methods for equalizing the injectivity profile of injection wells and the waterflood front in a permeability-heterogeneous oil reservoir	Various technologies for equalizing the injectivity profile of injection wells in order to isolate channels (fractures or super-permeable zones) in the productive formation causing premature breakthrough of injected water to oil wells, which results in excessive water cut, depending on the geological conditions of the productive reservoir	LC, S

*Key: **LK** – Lectures; **PC** – Practical/Seminar Classes (only for full-time study)

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.	
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. Yushin, E. S. Equipment and technologies for workover and repair of oil and gas wells: theory and calculation: textbook / E. S. Yushin. – Moscow; Vologda: Infra-Engineering, 2022. – 380 p. – ISBN 978-5-9729-0905-6. – Text: electronic. – URL: <https://znanium.com/catalog/product/190418>
2. Kleshchenko, I. I., Leontiev, D. S., Panikarovskiy, E. V. Technologies and materials for well repair: textbook / I. I. Kleshchenko, D. S. Leontiev, E. V. Panikarovskiy. – Moscow; Vologda: Infra-Engineering, 2023. – 348 p. – ISBN 978-5-9729-1403-6. – Text: electronic. – URL: <https://znanium.ru/catalog/product/2100432>
3. Ryabokon, S. A. Technological fluids for well completion and repair: monograph / S. A. Ryabokon. – Moscow: INFRA-M, 2018. – 384 p. – ISBN 978-5-16-107073-4. – Text: electronic. – URL: <https://znanium.ru/catalog/product/991855>

Additional(optional) reading (sources):

4. Dmitriev, A. Yu., Khorev, V. S. Repair of oil and gas wells: textbook / Tomsk Polytechnic University. – Tomsk: Tomsk Polytechnic University Publishing House, 2016. – 272 p. – ISBN 978-5-4387-0697-7. – Text: electronic. – URL: <https://znanium.com/catalog/product/1043936>
5. Vorobyev, A. E., Vorobyev, K. A. Modern technologies for increasing oil well productivity: monograph / A. E. Vorobyev, K. A. Vorobyev. – Moscow; Vologda: Infra-Engineering, 2025. – 276 p. – ISBN 978-5-9729-2560-5. – Text: electronic. – URL: <https://znanium.ru/catalog/product/2226114>

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 Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением.
2. Guidelines for students on the development of the course "Well repair and water breakthrough control technologies / Технологии ремонта скважин и борьбы с их опережающим обводнением".

*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.

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