

Документ подписан простой электронной подписью  
Информация о владельце:  
ФИО: Ястребов Олег Александрович  
Должность: Ректор  
Дата подписания: 25.05.2026 15:07:49  
Уникальный программный ключ:  
ca953a0120d891083f939673078ef1a989dae18a

**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**

**Innovative technologies for the development of hydrocarbon deposits /  
Инновационные технологии разработки месторождений 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 «Innovative technologies for the development of hydrocarbon deposits / Инновационные технологии разработки месторождений углеводородов» is included in the curriculum of the master's program "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 3rd semester of master 2. The discipline is delivered by the Department of Mineral Developing and Oil & Gas Engineering. It consists of 3 sections and 13 topics and is aimed at enabling students to acquire theoretical knowledge and practical skills for solving complex issues related to the use of software and equipment for well operation and efficient field development; training students to identify problems and select intelligent and technical solutions for the conditions of various fields; providing general knowledge on the application of state-of-the-art technologies and developments in the field of data collection and processing; as well as adjusting and changing operating modes during well operation and field development as a whole.

The goal of the course is to provide students with knowledge, skills, competencies, and practical experience in studying the methodology for identifying problems in field development and well operation; examining existing intelligent Russian and foreign technologies; acquiring skills in selecting specific equipment; and mastering the methodology for calculating equipment characteristics.

## 2. REQUIREMENTS FOR LEARNING OUTCOMES

The course "Innovative technologies for the development of hydrocarbon deposits / Инновационные технологии разработки месторождений 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)
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	<b>PC-3.1.</b> 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>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><b>PC-3.2.</b> 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><b>PC-3.3.</b> 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>
<b>PC-4</b>	<p>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</p>	<p><b>PC-4.1.</b> 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.</p> <p><b>PC-4.2.</b> Can draw up and prepare 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.</p> <p><b>PC-4.3.</b> Has the methodology for preparing primary reporting, including work schedules, instructions, plans, estimates, applications for materials, equipment according to approved forms.</p>
<b>PC-6</b>	<p>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</p>	<p><b>PC-6.1.</b> 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</p>

Competence code	Competence descriptor	Competence formation indicators (within this course)
	processing of oil and gas	<p>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.</p> <p><b>PC-6.2.</b> 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 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>

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p><b>PC-6.3.</b> 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.</p>

### 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*
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	Machinery and equipment for field development and transportation of hydrocarbons; Fundamentals of construction and operation of pipeline transport; Methods for oil production intensification and enhanced oil recovery; Advanced oil and gas	Pre-graduation Practical Training; State Exam; Graduate Qualification Work

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
		processing equipment and product quality management; Innovative technologies for the transportation and storage of hydrocarbons; Technological practice (educational); Technological practice (industrial)	
<b>PC-4</b>	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	Modern aspects of geological and geophysical research in the oil and gas industry; Technologies for developing prospective hydrocarbon reserves; Well repair and water breakthrough control technologies; Modern stream in oil and gas processing in Russia; Advanced oil and gas processing equipment and product quality management; Innovative technologies for the transportation and storage of hydrocarbons; Technological practice (educational); Technological practice (industrial)	Pre-graduation Practical Training; State Exam; Graduate Qualification Work
<b>PC-6</b>	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	Modern aspects of geological and geophysical research in the oil and gas industry; Machinery and equipment for field development and transportation of hydrocarbons; Current development of the production of unconventional hydrocarbon resources in the world; Methods for oil production intensification and enhanced oil recovery;	Pre-graduation Practical Training; State Exam; Graduate Qualification Work

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
		Well repair and water breakthrough control technologies	

\* 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 "Innovative technologies for the development of hydrocarbon deposits / Инновационные технологии разработки месторождений углеводородов" is 5 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)
		3
<i>Contact academic hours, acc .</i>	36	36
including:	18	18
Lectures		
Laboratory work		
Seminars (workshops/tutorials)	36	36
<i>Self-study (ies), academic hours</i>	99	99
<i>Evaluation and assessment (exam or pass/fail grading)</i>	27	27
<b>The course total workload</b>	acc.hrs.	<b>180</b>
	Credits	<b>5</b>

#### 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. Overview of Intelligent Wells	1.1	Concept of an intelligent well. Main components and operating principle of an intelligent well.	LC, S
	1.2	History and evolution of intelligent technologies in oil and gas production.	LC, S
	1.4	Economic efficiency and barriers to the implementation of intelligent wells.	LC, S

		1.5	Architecture of an intelligent well: surface and downhole levels.	Downhole level: sensors (PVT, flow meters), inflow control valves (ICV), telemetry systems. Surface level: controllers, SCADA systems, software for data analysis and decision-making.	LC, S
2	Section 2. Intelligent Automation Systems in Oil and Gas Production Operations	2.1	Downhole sensors and real-time monitoring systems.	Pressure and temperature sensors, distributed temperature (DTS) and distributed acoustic (DAS) fiber-optic systems. Phase flow rate measurement (oil, gas, water). Data transmission via hydraulic, electrical, and optical cables.	LC, S
		2.2	Technical solutions of intelligent control systems for mechanized oil production. Inflow control devices.	Control devices: interval control valves (ICV) and completion couplings: hydraulically or electrically actuated ICVs. Multi-position and variable (stepless) control valves. Completion couplings for plug installation. Zone isolation and flow redistribution.	LC, S
		2.3	Intelligent multizone well completions.	Division of the horizontal wellbore into isolated zones (packers + ICV). Interval-specific inflow/injection control. Capability for selective shut-off of water-flooded or gas-saturated intervals without well intervention.	LC, S
		2.4	Telemetry and data transmission systems.	Hydraulic telemetry (pressure pulses). Electrical (via armored cable). Optical (via fiber optics – highest speed). Wireless systems (electromagnetic, acoustic). Bandwidth, range, reliability.	LC, S
		2.5	Surface equipment and software for intelligent well control.	SCADA systems, controllers (RTU, PLC), operator panels. Simulation software (current and forecast flow rates), decision support systems, integration with reservoir digital twins.	LC, S
3	Section 3. Experience in Implementing Intelligent Technologies	3.1	Intelligent technologies and their implementation at Russian oil fields.	Application in fields with hard-to-recover reserves (Bazhenov Formation, Achimov deposits). Examples: Sakhalin-1 (simultaneous separate production), Talakanskoye, Vankorskoye fields. Role of Gazprom Neft and Rosneft. Interval-specific water injection control. Sweep front equalization,	LC, S

			prevention of premature water breakthroughs. Implementation examples in Western Siberian fields (Samotlor, Priobskoye).	
	3.2	Foreign experience in implementing intelligent technologies.	Analysis of programs by leading companies: Manara intelligent well production management system (Schlumberger). WellWatcher FLUX intelligent completion system (Schlumberger), Shell (Smart Fields), BP (Field of the Future), Chevron (iField), Equinor (Integrated Operations), TotalEnergies (Integrated Field). Key projects: Shenzi (Gulf of Mexico), Troll (Norway), Saudi Arabia (Saudi Aramco), Abu Dhabi (ADNOC RoboWell). Results: 20–30% OPEX reduction, 10–40% production increase, reduction in the number of interventions.	LC, S
	3.3	Prospects for the development of high-tech "smart" fields in Russia and abroad.	Integration of all wells, pads, and reservoir pressure maintenance into a unified digital environment. Closed-loop optimization of well operating modes. Application of machine learning for failure prediction. Examples: Shell Smart Fields, BP Field of the Future, Total Integrated Field.	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.	

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
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. Bolsunovskaya L.M. [and others] Petroleum Engineering. course book = Oil and gas engineering . Book for students: textbook / ed. L.M. Bolsunovskaya, R.N. Abramova, I.A. Matveenکو. — Electron . Dan. - Tomsk: TPU, 2014. - 742 p.

<https://e.lanbook.com/book/62912>

2. Tetelmin V.V. Oil and gas engineering . Textbook / V.V. Tetelmin , V.A. Yazev. - 2nd ed ; Dolgoprudny: Publishing House "Intellect", 2014. - 800 p.

<http://lib.rudn.ru>

3. Tetelmin V.V. Oil and Gas Drilling Fundamentals: Study Guide / - 3rd ed. - Dolgoprudny: Intellect, 2014. - 296 p.

<http://znanium.com/catalog/product/478822>

### *Additional(optional) reading (sources):*

1. Saifullin I.Sh., Tetelmin V.V., Yazev V.A. Physical foundations of oil production: Textbook / - Dolgoprudny: Intellect, 2013. - 328 p.

<http://znanium.com/catalog/product/423812>

2. Arbuzov, V.N. Collection of tasks on the technology of oil and gas production in complicated conditions: workshop: study guide / V.N. Arbuzov, E.V. Kurganov. - Electron . Dan. - Tomsk: TPU, 2014. - 68 p.

<https://e.lanbook.com/book/82862>

### *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](http://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/>
- 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 Innovative technologies for the development of hydrocarbon deposits / Инновационные технологии разработки месторождений углеводородов.

2. Guidelines for students on the development of the course Innovative technologies for the development of hydrocarbon deposits / Инновационные технологии разработки месторождений 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:**

Associate Professor of the Department of Mineral  
Developing and Oil&Gas Engineering

Tcharo H.

---

position, department

name and surname

**HEAD OF EDUCATIONAL DEPARTMENT:**

Mineral Developing and Oil&Gas Engineering

Kotelnikov A.E.

---

name of department

name and surname

**HEAD****OF HIGHER EDUCATION PROGRAMME:**

Professor of the Department of Mineral Developing and  
Oil&Gas Engineering

Kapustin V.M.

---

position, department

name and surname