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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 OF THE DISCIPLINE**

**Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья**

(name of discipline/module)

**Recommended by the Didactic Council for the Education Field:**

**21.04.01 Oil and gas engineering**

(code and name of the Higher Education Field)

**The development of the discipline is carried out within the framework of the implementation of the higher education program of higher education (Higher Education Program):**

**Oil and gas engineering / Технологии добычи и транспортировки нефти и газа**

(name (profile/specialization) of the Higher Education Program)

## 1. COURSE GOALS

The purpose of mastering the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья" is the acquisition by students of theoretical knowledge and practical skills in solving complex issues related to the use of equipment in the operation of oil wells. Teaching students about various complications that appear during the operation of the well. General information about submersible pumping units and complications during operation. Influence of product parameters (free gas, viscosity, etc.) on the characteristics of submersible centrifugal pumps.

The aims of the course are:

- study of schemes of equipment used in oil production;
- studying the characteristics of the equipment, acquiring the skills of choosing one or another equipment;
- mastering the methodology for calculating equipment characteristics, operating technology, as well as collecting and preparing well products for transport.

## 2. LEARNING OUTCOMES

Mastering the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья" is aimed at developing the following competencies (parts of competencies) among students:

*Table 2.1. The list of competencies formed by students in the course of mastering the discipline (the results of mastering the discipline)*

Competence code	Competence	Competence indicators (within this discipline)
SPC-3	Able to assess resources, calculate estimate and recalculate reestimate hydrocarbon reserves for the preparation of scientific and technological projects planning.	<p>SPC-3.1 Knows the current legislative, regulatory legal acts of the Russian Federation, norms and rules in the field of assessing reserves and managing reserves; regulations, provisions, instructions and standards of the organization reserve estimation counting and management; rules for compiling documentation for ongoing exploration programs; rules for compiling documentation for prospective exploration programs; rules for drawing up planning documentation; norms and rules for the development of project documentation; the quality policy of the organization in the field of geological exploration; technologies for conducting, processing and interpreting geological and geophysical works; features of geological exploration</p> <p>SPC-3.2 Can develop recommendations for further study of the deposit to clarify the geological structure and reserves; apply the requirements of regulatory documents in the assessment of hydrocarbon resources and reserves; prepare materials used in the development of exploration programs for the reserve estimation and management; draw up documentation for current and prospective exploration programs; analyze the quality of current exploration programs for reserve estimation and management; control the implementation and results of the development of current and prospective work programs for reserve estimation and management.</p>

Competence code	Competence	Competence indicators (within this discipline)
		SPC-3.3 Has the skills to analyze and evaluate the organization's resource base; skills in the development of current and prospective programs of geological exploration in order to clarify hydrocarbon reserves in the territory of the organization; the skills for high-quality and timely estimation (re-estimation) of reserves for individual objects; the skills for preparation in the established order of operational reporting
SPC-5	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>SPC-5.1 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</p> <p>SPC-5.2 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</p> <p>SPC-5.3 Has the methodology for preparing primary reporting, including work schedules, instructions, plans, estimates, applications for materials, equipment according to approved forms</p>
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	<p>SPC-7.1 Knows:</p> <p>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</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</p>

Competence code	Competence	Competence indicators (within this discipline)
		<p>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><b>SPC-7.2 Can:</b></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 according to the action plan for localization and elimination of accidents and incidents at hydrocarbon production facilities</p> <p><b>SPC-7.3 Has:</b></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.</p> <p>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>

Competence code	Competence	Competence indicators (within this discipline)
		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

### 3. ACADEMIC PROGRAM STRUCTURE

The discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья" refers to the University Disciplines Module of block B1 of the Higher Education Program.

As part of the Higher Education Program, students also master other disciplines and / or practices that contribute to the achievement of the planned results of mastering the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья".

*Table 3.1. List of Higher Education Program components / disciplines that contribute to expected learning/training outcomes*

Competence code	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
SPC-3	Able to assess resources, calculate estimate and recalculate reestimate hydrocarbon reserves for the preparation of scientific and technological projects planning.	-	Research work / Научно-исследовательская работа SFC
SPC-5	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	Technologies for the development of promising hydrocarbon reserves	Technological practice (production) / Технологическая практика (производственная) Pre-graduate practice / Преддипломная практика SFC
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	Modern aspects of geological field and geophysical research in the oil and gas engineering Machinery and equipment for field development and transport of hydrocarbons	Pre-graduate practice / Преддипломная практика SFC

\* - filled in in accordance with the matrix of competencies and the Higher Education Program.

### 4. COURSE WORKLOAD and ACADEMIC/TRAINING/LEARNING ACTIVITIES

The total total workload of the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности

процесса добычи и работы оборудования по добыче углеводородного сырья" is equal to 5 credits.

Table 4.1. Types of academic activities during the period of the HE program mastering

Type of study work		TOTAL, acc.	Semester(s) 3
<i>Contact academic hours, acc .</i>		54	54
including:			
Lectures		18	18
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>	<b>180</b>
	credits	<b>5</b>	<b>5</b>

## 5. CONTENT OF THE DISCIPLINE

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

Name of the section (topic) of the discipline	Contents of the section (topic)	Type of study work
Section 1. General information about submersible pumping equipment	Topic 1.1. Scheme and main elements of the installation of a submersible centrifugal pump (ESP). Operating characteristic of a submersible centrifugal pump. Head, flow and speed coefficient of a vane pump.	Lecture, Lab work
	Topic 1.2. Influence of the density and viscosity of the pumped liquid on the characteristics of the ESP. The main complicating factors in the operation of wells with submersible pumps. Prospects for the use of submersible pumping units.	Lecture, Lab work
Section 2. Effect of free gas and viscosity on the performance of submersible centrifugal pumps	Topic 2.1. Forms of the flow of gas-liquid mixture in the channels of the working bodies of a centrifugal pump. Parameters influencing the characteristics of submersible centrifugal pumps when pumping GZhS. Installation design, choice of model gas-liquid mixtures and methods of conducting experiments to study the effect of free gas on the characteristics of submersible centrifugal pumps. Study of the influence of gas on the characteristics of a submersible centrifugal pump when operating on model mixtures "water-gas", "water-surfactant-gas" and various intake pressures.	Lecture, Lab work
	Topic 2.2. The results of the study of the operation of submersible centrifugal pumps on viscous gas-liquid mixtures "oil-gas". Analysis of mean integral parameters of submersible centrifugal pumps operating on gas-liquid mixtures. Method for calculating the characteristics of submersible centrifugal pumps when pumping water and gas mixtures from wells.	Lecture, Lab work
Section 3. Non-separation methods for increasing the efficiency of ESP operation when	Topic 3.1. Deepening the pump under the dynamic level of the liquid in the well. Pouring degassed liquid into the annulus. Use of the "conical" scheme of pumps. Application of pumps with dispersants. Use of steps of special designs.	Lecture, Lab work

pumping gas-liquid mixtures		
Section 4. Application of gas separators and mechanical impurities to ESP	Topic 4.1. The main types of gas separators for ESPs. Field tests of MNG separators. The effect of supercavitation and its role in the working process of the gas separator to the ESP. Bench research and field tests of gas separators MN-GSL and MNG and separators of the company "REDA".	Lecture, Lab work
	Topic 4.2. Experimental studies of the characteristics of gas separators and gas separators-dispersants for ESPs at different shaft speeds. Development and field testing of a centrifugal separator of mechanical impurities at the inlet of a submersible pumping unit. Extraction of natural gas from flooded gas wells and methane from coal deposits using submersible pumping systems.	Lecture, Lab work
Section number 5. Use of pump-ejector systems for oil production	Topic 5.1. Scheme and principle of operation of the jet apparatus. Principal diagrams and main elements of pump-ejector systems. Characteristics of joint operation of submersible centrifugal pumps and ejectors. Results of field tests and industrial implementation of submersible pump-ejector systems "Tandem".	Lecture, Lab work
	Topic 5.2. Field studies of packer hydraulic jet pumping units at the Samotlor field. Development and field testing of a packerless layout of a hydraulic jet pump with a double-row lift. Possibilities for the development of a hydro-jet method of operation using power ground mini-stations.	

## 6. CLASSROOM EQUIPMENT and TECHNOLOGY SUPPORT REQUIREMENTS

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

<b>Classroom for Academic Activity Type</b>	<b>Classroom equipment</b>	<b>Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)</b>
Lecture	Training room for conducting lecture-type classes: room. No. 335 A set of specialized furniture; technical means: projection screen; multimedia projector SANYO PROxtraX; system block DEPO Neos 220	
Seminar	Classroom for conducting seminar-type classes: room. No. 356 A set of specialized furniture; chalk board; monitor NEC PLASMA MONITO MODEL PX-42XM1G; system block DEPO Neos 220	
Seminar	Laboratory of hydrodynamic processes of oil and gas production No. 341 Ejector; Bench desktop, instrumentation and shut-off and control valves; Tank; Stand layout of the pump-ejector system, left view; laser diode; Column with liquid; Air compressor; Gas supply system to the column; Gas meter; pressure gauge; Photodiode; digital oscilloscope	

Classroom for Academic Activity Type	Classroom equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
For self-study	Classroom for conducting seminar-type classes: room. No. 356 A set of specialized furniture; chalk board; monitor NEC PLASMA MONITO MODEL PX-42XM1G; system block DEPO Neos 220	

## 7. Recommended Sources for Course Studies

### *Main reading(sources):*

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. Matveenko. — 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-(based) sources:*

1. Electronic libraries with access for RUDN students:  
RUDN Electronic Library System - RUDN EBS <http://lib.rudn.ru/MegaPro/Web>  
- ELS "University Library Online" <http://www.biblioclub.ru>  
- EBS Yurayt <http://www.biblio-online.ru>  
- ELS "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)  
- EBS "Lan" <http://e.lanbook.com/>  
- EBS "Trinity Bridge"
2. Databases and search engines:  
- electronic fund 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/>  
- abstract database SCOPUS <http://www.elsevierscience.ru/products/scopus/>



*Learning toolkits for self- studies in the RUDN LMS TUIS:*

1. A course of lectures on the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья."

2. Guidelines for students on mastering the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья."

\* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the page of the discipline **in TUIS!**

### 8. ASSESSMENT AND EVALUATION TOOLKIT

Marking criteria (MC) and a 100-point (score) scale for assessing the level of competencies (part of competencies) based on the results of mastering the discipline "Improving the efficiency of the production process and operation of equipment for the extraction of hydrocarbons / Повышение эффективности процесса добычи и работы оборудования по добыче углеводородного сырья" are presented in the Appendix to this Work Program of the discipline.

\* - MC and the 100-point (score) are formed on the basis of the requirements of the relevant local normative act of the Peoples' Friendship University of Russia.

#### DEVELOPERS:

Associate Professor of the Department of Mineral  
Developing and Oil&Gas Engineering  
\_\_\_\_\_  
Position, Department



\_\_\_\_\_  
Signature

\_\_\_\_\_  
Yushin E. S.  
Full name

#### Head of Department:

Director of the Department of Mineral  
Developing and Oil&Gas Engineering  
\_\_\_\_\_  
Name of Department



\_\_\_\_\_  
Signature

\_\_\_\_\_  
Kotelnikov A.E.  
Full name

#### Head of Educational Programme:

Professor of the Department of Mineral  
Developing and Oil&Gas Engineering  
\_\_\_\_\_  
Position, Department



\_\_\_\_\_  
Signature

\_\_\_\_\_  
Kapustin V.M.  
Full name