

Документ подписан простой электронной подписью
Информация о владельце:
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Должность: Ректор
Дата подписания: 28.05.2024 11:42:00
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

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

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 GOALS

The goal of the course "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. REQUIREMENTS FOR LEARNING OUTCOMES

The course "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 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 manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	PC-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, 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 PC-4.2 Can determine the methods, equipment, technologies

Competence code	Competence descriptor	Competence formation indicators (within this course)
		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 PC-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
PC-6	Capable of applying the basic principles of rational use of natural resources and environmental protection	PC-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 PC-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 PC-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 production facilities

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

Competence code	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
PC-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	Machinery and equipment for field development and transportation of hydrocarbons; Modern aspects of geological and geophysical research in the oil and gas industry;	Pre-graduation Practical Training;

Competence code	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
PC-6	Capable of applying the basic principles of rational use of natural resources and environmental protection	<p><i>Advanced oil and gas processing equipment and product quality management**;</i></p> <p>Modern aspects of geological and geophysical research in the oil and gas industry;</p> <p><i>Modern stream in oil and gas processing in Russia**;</i></p> <p>Technologies for developing prospective hydrocarbon reserves;</p> <p>Technological practice (educational) / Технологическая практика (учебная);</p> <p>Technological practice (industrial) / Технологическая практика (производственная);</p>	Pre-graduation Practical Training;

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

4. COURSE WORKLOAD

The total workload of the course "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 5 credits.

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

Type of study work	TOTAL, acc.	Semester(s)
<i>Contact academic hours, acc .</i>	<i>54</i>	<i>54</i>
including:		
Lectures	18	18
Laboratory work		
Seminars (workshops/tutorials)	36	36
<i>Self-study (ies), academic hours</i>	<i>99</i>	<i>99</i>
<i>Evaluation and assessment (exam or pass/fail grading)</i>	<i>27</i>	<i>27</i>
The course total workload	acc.hrs.	180
	credits	5

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	Topic 1.1. Scheme and main elements of the installation	Lecture, Lab work

information about submersible pumping equipment	of a submersible centrifugal pump (ESP). Operating characteristic of a submersible centrifugal pump. Head, flow and speed coefficient of a vane pump.	
	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 pumping gas-liquid mixtures	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
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.	
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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. 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	
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. RESOURCES RECOMMENDED FOR COURSE

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 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"

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- 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 ""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 the development of the course ""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".

*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.

8. 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:

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

position, educational department

Yushin E.S.

name and surname

Head of Department:

Head of the Department of Mineral Developing
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Head of Educational Programme:

Professor of the Department of Mineral
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