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Информация о владельце:
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Должность: Ректор
Дата подписания: 25.05.2026 15:07:48
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

**Diagnostics of oil and petroleum products main pipeline facilities /
Диагностирование объектов магистральных трубопроводов нефти и
нефтепродуктов**

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 goal of the course "Diagnostics of oil and petroleum products main pipeline facilities / Диагностирование объектов магистральных трубопроводов нефти и нефтепродуктов" is to equip students with theoretical and practical knowledge in the field of technical diagnostics of oil pipeline equipment for the formation of the required level of professional competencies in the field of technological processes of pipeline transportation of hydrocarbons.

The aims of the course are:

- the study of scientific foundations, terms and concepts, as well as the main methods of diagnosing and determining the technical condition of pipelines and equipment;
- study of the organization of work on the conduct of technical diagnostics;
- formation of the ability to study the properties of welded joints and metal of pipes and equipment during technical diagnostics;
- formation of skills for calculating the residual life of pipelines,
- use normative documents on technical diagnostics, compilation of technological maps.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The course "Diagnostics of oil and petroleum products main pipeline facilities / Диагностирование объектов магистральных трубопроводов нефти и нефтепродуктов" 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	PC-3.1. 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>electrical safety and fire safety, rules for the construction and safe operation of facilities.</p> <p>PC-3.2. 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.</p> <p>PC-3.3. 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.</p>
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	<p>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.</p> <p>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.</p> <p>PC-4.3. Has the methodology for preparing primary reporting, including work schedules, instructions, plans, estimates, applications for materials, equipment according to approved forms.</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	PC-7.1. 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

Competence code	Competence descriptor	Competence formation indicators (within this course)
		<p>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.</p> <p>PC-7.2. 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.</p> <p>PC-7.3. 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.</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-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 / Машины и оборудование для разработки месторождений и транспорта углеводородов [англ.]; Fundamentals of construction and operation of pipeline transport / Основы строительства и эксплуатации трубопроводного транспорта [англ.]; Technological practice (educational) / Технологическая практика (учебная) [англ.]; Technological practice (industrial) / Технологическая практика (производственная) [англ.]	Pre-graduation Practical Training / Преддипломная практика [англ.]; State Exam / Государственный экзамен [англ.]; Graduate Qualification Work / Выпускная квалификационная работа [англ.]
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	Modern aspects of geological and geophysical research in the oil and gas industry / Современные аспекты геолого-промысловых и геофизических исследований в нефтегазовом деле [англ.]; Technologies for developing prospective hydrocarbon reserves / Технологии разработки перспективных запасов углеводородов [англ.]; Modern stream in oil and gas processing in Russia / Современные направления нефтегазопереработки в России [англ.]; Technological practice (educational) / Технологическая практика (учебная) [англ.]; Technological practice (industrial) / Технологическая практика (производственная) [англ.]	Pre-graduation Practical Training / Преддипломная практика [англ.]; State Exam / Государственный экзамен [англ.]; Graduate Qualification Work / Выпускная квалификационная работа [англ.]
PC-7	Able to manage the work on the diagnostic	Technological processes of pipeline transport / Технологические процессы	Pre-graduation Practical Training / Преддипломная

Competence code	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
	examination of the main oil pipelines (MOP) and the main oil product pipelines (MOPP) facilities	трубопроводного транспорта [англ.]; Machinery and equipment for field development and transportation of hydrocarbons / Машины и оборудование для разработки месторождений и транспорта углеводородов [англ.]; Fundamentals of construction and operation of pipeline transport / Основы строительства и эксплуатации трубопроводного транспорта [англ.]	практика [англ.]; State Exam / Государственный экзамен [англ.]; Graduate Qualification Work / Выпускная квалификационная работа [англ.]

* 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 "Diagnostics of oil and petroleum products main pipeline facilities / Диагностирование объектов магистральных трубопроводов нефти и нефтепродуктов" 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)
			4
<i>Contact academic hours, acc .</i>		<i>54</i>	<i>54</i>
including:			
Lectures		16	16
Laboratory work			
Seminars (workshops/tutorials)		24	24
<i>Self-study (ies), academic hours</i>		<i>113</i>	<i>113</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. 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	Main Tasks and Systems of Technical Diagnostics	1.1	Main factors influencing the choice of non-destructive testing methods	Concept – technical diagnostics. Defect. Location of possible defects on pipelines.	LC, S
		1.2	Diagnostics of equipment at oil pumping stations of main oil pipelines.	The technology for conducting technical diagnostics of equipment at oil pumping stations of main oil pipelines	LC, S

2	Non-Destructive Testing Methods	2.1	Visual and measurement testing, ultrasonic testing, magnetic particle testing, capillary testing (dye penetrant inspection), radiographic testing.	The technologies for conducting basic non-destructive testing methods during technical diagnostics of oil and gas facilities	LC, S
3	Vibration Diagnostic Method for Equipment Technical Condition Monitoring	3.1	Factors in the development of vibration diagnostics. Vibration diagnostics of facilities.	The technology for conducting vibration diagnostics of oil and gas facilities	LC, S
		3.2	Causes of vibrations in pipelines.	Concept – vibration. The causes of vibration occurrence in pipelines	LC, S
		3.3	Economic aspects of using vibration diagnostics during machinery operation.	Various aspects, including economic ones, of using vibration diagnostics during the operation of oil and gas equipment	LC, S
4	Diagnostic Methods and Technical Means	4.1	Devices for cleaning the internal cavity of pipelines.	The main types of devices for cleaning the internal cavity of pipelines. Concepts – effective diameter. Main criteria for pipeline cleaning.	LC, S
		4.2	Diagnostics of the linear part of a main gas pipeline.	In-line inspection tool (VIP). Procedure for launching the in-line inspection tool on main gas pipelines.	LC, S
		4.3	Procedure for performing work during external inspection of pipelines.	Technology for performing various types of work during external inspection of oil and gas facilities.	LC, S
		4.4	Diagnostics of tanks.	Technological map of tanks. Types of work during technical diagnostics of tanks.	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.	
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. Kryukov, O. V., Saushev, A. V., Sychev, M. N., et al. Intellectual diagnostics of electrical equipment and communication systems of main pipelines: monograph / edited by Dr. Tech. Sci. O. V. Kryukov and Dr. Tech. Sci. A. V. Saushev. – Moscow; Vologda: Infra-Engineering, 2022. – 276 p. – ISBN 978-5-9729-1044-1. – Text: electronic. – URL: <https://znanium.com/catalog/product/1904176>
2. Meshalkin, V. P., Butusov, O. B. Computer assessment of the environmental impact of main pipelines: textbook. – Moscow: INFRA-M, 2023. – 449 p. – (Higher Education). – ISBN 978-5-16-018615-3. – Text: electronic. – URL: <https://znanium.ru/catalog/product/2020516>
3. Prachev, Yu. N., Verzhbitsky, V. V. Construction and repair of the linear part of main pipelines: textbook / Ministry of Education and Science of the Russian Federation, Federal State Autonomous Educational Institution of Higher Professional Education "North Caucasus Federal University". – Stavropol: NCFU, 2014. – 238 p.
4. Bukleshev, D. O., Smolyakov, V. B., Melnikov, V. N., et al. Methods for assessing the corrosion rate of main pipelines: monograph. – Moscow; Vologda: Infra-Engineering, 2024. – 80 p. – ISBN 978-5-9729-1830-0. – Text: electronic. – URL: <https://znanium.ru/catalog/product/2170641>

Additional literature:

5. Khrenov, N. N. Fundamentals of complex diagnostics of northern pipelines. Field studies. – Moscow: Gazoil press, 2005. – 608 p.
6. Khrenov, N. N. Fundamentals of complex diagnostics of northern pipelines. Aerospace methods and processing of survey materials. – Moscow: Gazoil press, 2002. – 352 p.
7. Efimenko, L. A., Elagina, O. Yu., Vyshemirsky, E. M., et al. Traditional and advanced steels for the construction of main gas and oil pipelines: monograph. – Moscow: Logos, 2020. – 316 p. – ISBN 978-5-98704-573-2. – Text: electronic. – URL: <https://znanium.ru/catalog/product/1214446>
8. Khazhinsky, G. M. Criteria for fatigue and long-term strength of power equipment and pipelines: monograph. – Moscow; Vologda: Infra-Engineering, 2021. – 264 p. – ISBN 978-5-9729-0603-1. – Text: electronic. – URL: <https://znanium.com/catalog/product/1835988>

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 Diagnostics of oil and petroleum products main pipeline facilities / Диагностирование объектов магистральных трубопроводов нефти и нефтепродуктов.

2. Guidelines for students on the development of the course "Diagnostics of oil and petroleum products main pipeline facilities / Диагностирование объектов магистральных трубопроводов нефти и нефтепродуктов".

*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:

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Developing and Oil&Gas Engineering

Brusnik O.V.

position, department

name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

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