Ministry of Science and Higher Education of the Russian Federation

Federal State Budgetary Educational Institution of Higher Education
Perm National Research Polytechnic University

APPROVED BY
Pro-rector for Academic Affairs
_____ N.V. Lobov
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ACADEMIC COURSE WORKING PROGRAM

Academic course: Petrophysics
(Name)

Form of education: Full-time
(Full-time /full-time – correspondence/correspondence)

Level of higher education: Bachelor's program
(Bachelor's program/specialist program/
Master's program)

Workload in hours (in credits): 180 (5)
(Hours (CU))

Training program (degree): 21.03.01 Oil and Gas Engineering
(Code and denomination of degree)

Direction: Oil and Gas Engineering
(Title of curriculum)

Perm 2021

1. GENERAL PROVISIONS

1.1. GOALS AND OBJECTIVES OF THE COURSE

The goal of the course is to form a complex of knowledge in the field of petrophysics, as a modern complex applied science about:

– properties of reservoir systems,

– peculiarities of molecular interaction in liquid and solid phases;

To form a scientific worldview based on knowledge of physical laws in complex natural systems;

To develop the skills of ecological culture in the development of Oil and Gas deposits.

Objectives:

1. To study the scientific fundamentals, terms and concepts, basic methods for determining the petrophysical properties of rocks;

2. To study the organization of laboratory work to determine the reservoir properties of rocks;

3 To form the skills during the study of filtration-capacitive properties of rocks.

4. To teach to carry out calculations, use regulatory documents.

1.2. STUDIED OBJECTS OF THE COURSE

Rock samples (core) of productive deposits. Reservoir fluid models. Laboratory equipment for studying the reservoir properties of reservoir rocks. Methods for studying the properties of rocks and fluids.

1.3. STARTING CONDITIONS

Unstipulated

2. PLANNED RESULTS OF THE COURSE TRAINING

Compe-tence	Indicator's Index	Planned Results of the Course Training (to know, to know how, to master)	Indicator of Attaining Competence which the planned results of training are correlated with	Means of Assessment
1	2	3	4	5
PC-3.1.	**IA-1$_{pc-3.1.}$**	**To know** laboratory and downhole methods for analyzing petrophysical information on technological processes of productive formations waterflooding in the development of deposits and artificial lift of oil and gas	**Knows** methods for analyzing information on technological processes and the operation of technical devices in the oil and gas industry	Exam

1	2	3	4	5
PC-3.1.	**IA-2$_{pc-3.1.}$**	**To be able to**: – to plan and carry out laboratory experiments for determining the reservoir-filtration, lithological-structural, physical and mechanical properties of the oil reservoir from the core material; – to process experimental data using modern applied software products; – to interpret the results and draw conclusions about the conditional properties of reservoir rocks.	**Is able to** plan and conduct the necessary experiments, process, including with the use of applied software products, interpret the results and do the appropriate; conclusions	Report practice work
PC-3.1.	**IA-3$_{pc-3.1.}$**	**To master the skills** of using graphic and statistical software packages to determine the capacitive, filtration, structural, mechanical and electrical properties of reservoir systems in the exploration, development and operation of oil and gas production facilities.	**Masters** the ability to use the physical and mathematical apparatus to solve computational and analytical problems arising in the course of professional activity	Protecting laboratory work

3. FULL TIME AND FORMS OF ACADEMIC WORK

Form of academic work	**Hours in all**	**Distribution in hours according to semesters**
		Number of semester
		3
1. Holding classes (including results monitoring) in the form: 1.1.Contact classwork, including:	72	72
– lectures (L)	34	34
– laboratory work (LW)	18	18
– practice, seminars and/or other seminar-type work (PW)	18	18
– control of self-work (CSW)	2	2
– test		
1.2. Students' self-work (SSW)	72	72
2. Intermediate attestation		
Exam	36	36
Grading test		
Test (Credit)		
Course Project (CP)		
Course Work (CW)		
Workload in hours	**180**	**180**

4. COURSE OUTLINE

Name of the units with the course outline	Full time of classroom activity in hours according to the forms			Full time of extracurricular work in hours according to the forms
	L	LW	PW	SSW
1	2	3	4	5
Semester 4				
Introduction The goal of the course objectives and its relationship with related disciplines (geology of oil and gas, industrial geology, reservoir physics). A brief historical outline of the development of wells in of fluid mechanics and well testing. Scope petroleum of wells in of fluid mechanics and well testing; when developing oil and gas fields.	2	0	0	2
Module 1. Petrophysical properties of rocks Topic 1. Technology of sampling and laboratory studies of the core. Core study in a modern core storage. Preparation of rock samples for laboratory analysis. Manufacturing and registration of samples. Extraction, vacuum saturation and storage of rock samples. Drying, evacuation and saturation of core samples. Saturation of rocks at overpressure. Topic 2. Mineralogical and granulometric composition of rocks. Classification of rocks by origin. Properties of sedimentary rocks. Erogenous and carbonate rocks. Mineralogical and granulometric composition of rocks. Sieve and sedimentation analysis of rocks. Classification of rocks by types of reservoirs. Types of rock cement. Particle shape and roundness. Signs of oil and gas reservoir rocks. Topic 3. Capacitive and filtration properties of reservoir rocks Porosity, cavern porosity and fracturing. Classification of reservoir rocks by the size of pore channels. Coefficients of total, open, effective and dynamic porosity. Rock permeability. Methods for determining the permeability of rocks. Instruments for determining absolute permeability. Vertical and horizontal permeability. Capillary properties and residual water saturation of rocks. Topic 4. Structural characteristics of reservoir rocks The structure of the void space. The tortuosity and flow of the pore channels. Structural coefficient. Effective diameter. Hydraulic radius of voids. The distribution of voids by size in the rock. Specific surface of rocks. Methods for studying the structure of reservoir rocks. Topic 5. Mechanical properties of rocks Strength. Hardness. Elasticity. Plastic. Compressibility. Swelling. Fluidity. Volumetric elasticity coefficient of rocks. Methods for determining the mechanical properties of rocks. Stressed state of rocks in the massif. Normal and shear stresses. Stressed condition of rocks in the near-wellbore space. Reservoir pressure. Rock pressure. Effective pressure. Deformation processes in productive formations during their development.	18	10	10	46

1	2	3	4	5
Topic 6. Acoustic and thermal properties of rocks Acoustic properties of rocks. Longitudinal and transverse waves. Reflection and attenuation coefficients. Factors affecting the acoustic properties of rocks (pressure, temperature, saturation, structure and texture of rocks). Heat capacity. Thermal conductivity. Thermal diffusivity. Methods for determining the thermal properties of rocks.				
Module 2. Reservoir fluid characteristics Topic 1. Physical and chemical properties of natural and associated gases. Composition of natural and associated gases. Basic gas properties. Density. Viscosity. Critical and reduced gas parameters. Gas supercompressibility coefficients. Dependence of gas properties on its composition, pressure and temperature. Gas moisture content. Conditions for the formation of crystalline hydrates in natural gas. Composition and properties of gas-condensate mixtures. Topic 2. Physical and chemical properties of reservoir oil. Oil saturation and methods for its determination. Oil composition. Physicochemical, thermal and electrical properties of reservoir oil. Density. Viscosity. Rheological characteristics of oils. Static shear stress. Instruments for studying the properties of oil. Downhole samplers. Solubility of gases in oil. Henry's Law. Influence of gas saturation on the physical and chemical properties of oil. Saturation pressure. Compressibility, volumetric ratio and oil shrinkage. Reservoir oil degassing curve. Topic 3. Physicochemical properties of formation waters. Composition of formation waters. Density. Viscosity. Compressibility. Thermal expansion. Mineralization. Electrical conductivity. Solubility of natural gases in formation water. Influence of pressure and temperature on the physical properties of formation waters. Thermodynamic and physicochemical conditions of salt crystallization from reservoir waters. Formation water hardness and acidity. Residual water condition in productive reservoirs.	6	6	6	12
Module 3. Oil and gas recovery. Topic 1. Surface molecular properties of reservoir systems Surface tension at the boundaries of the media, its dependence on the type of fluids, salinity, composition, pressure and temperature. Methods for determining the surface tension at the liquid-liquid, liquid-gas interface. Wettability of rocks – oil and gas reservoirs. Hydrophilic and hydrophobic rocks. Dependence of wettability on pressure, temperature, type of liquid and type of surface. The role of reservoir rock wettability during the displacement of oil and gas by water. Topic 2. The mechanism of oil displacement by water from porous media Sources of reservoir energy. Physical foundations of oil and gas displacement from porous media. Forces acting in the reservoir during the displacement of oil	8	2	2	12

1	2	3	4	5
and gas by water. The mechanism of oil displacement by water from fictitious soil. The mechanism of oil displacement by water from real soil. The Jamin effect. The use of surfactants to enhance oil recovery. Surfactants (surfactants). Capillary pressure, methods for its determination. Capillary absorption. Physicochemical basis for increasing the efficiency of collectors. Topic 3. Modeling of filtration processes in oil and gas deposits. Experimental studies of the processes of oil and gas displacement by water. Displacement ratio. Methodology for preparing and conducting an experiment to displace oil by water. Instruments and apparatus for modeling the displacement process. Similarity criteria. Modern directions of research in the field of physics of oil and gas reservoirs for solving problems of enhanced oil recovery of reservoirs.				
Total with regard to semester	34	18	18	72
Total with regard to the course	34	18	18	72

Topics of exemplary practical work

Sl.№	Topic of practical (seminar) work
1	Plotting the integral and differential particle size distribution function by sieve analysis
2	Calculation of the carbonate content of rocks
3	Calculation of total, open and effective porosity of rocks
4	Plotting the capillary pressure curve for different types of reservoirs
5	Calculation of residual water saturation from centrifugation data
6	Calculation of the mean, modal and median pore radii from centrifugation data
7	Calculation of the thickness of the OWC zone according to the analysis of reservoir properties of rocks
8	Plotting the porosity parameter and the saturation parameter from electrometric data
9	Calculation of oil and water saturation of core samples according to analysis data on the LR-4 device (Saksa)

Topics of exemplary laboratory practice

Sl.№	Topic of laboratory work
1	Determination of the particle size distribution of rocks by the sieve method
2	Determination of the carbonate content of rocks by the gasometrical method on the Clark AK-4 device
3	Determination of the absolute permeability coefficient of rocks at stationary gas filtration
4	Determination of the open porosity coefficient by the Preobrazhensky method
5	Determination of the clay content of sedimentary rocks by the elutriation method (Sabanin's method)
6	Determination of electrical characteristics of reservoir rocks
7	Study of capillary phenomena by capillary impregnation of rocks
8	Determination of the average size of quartz grains of the mineral skeleton of cemented reservoir rocks by the optical method
9	Determination of the residual water saturation coefficient by the Messer method

5. ORGANIZATIONAL AND PEDAGOGICAL CONDITIONS

5.1. EDUCATIONAL TECHNOLOGIES USED FOR COMPETENCES FORMATION

Holding lectures in the discipline is based on the active method of training in the process of which students are not passive but active participants of the lesson answering questions of the teacher. Teacher's questions are aimed at activating the process of learning material as well as at the development of logical thinking. The questions stimulating associative thinking and connecting new material with the previous one are identified by the teacher in advance.

Practical lessons are held by realization of the method based on active training: problem areas are determined, groups are formed. The following aims are pursued in the process of practical education: use of definite disciplines knowledge and creative methods in solving problems and decision-making; students' skill-building of teamwork, interpersonal communication and development of leadership skills; consolidation of the basic theoretical knowledge.

Laboratory classes are based on an interactive learning method in which students communicate not only with the teacher but also with each other. At the same time, students ' activity in the learning process dominates. The teacher's place in interactive classes is reduced to orienting students ' activities to achievement of the goals of studies.

Interactive lectures, group discussions, role-playing games, training sessions, and analysis of situations and simulation models are used in academic studies

5.2. STUDENTS' MANUAL FOR THE COURSE STUDY

Learning the course students are recommended to fulfill the following positions:

1. Learning of the discipline should be done systematically.

2. After learning one of the course unit with the help of the text-book or lecture notes it is recommended to reproduce in memory the basic terms, definitions, notions of the unit.

3. Special attention should be paid to the reports on practical studies, laboratory works and individual complex tasks for self-work.

4. The topic of questions studied individually is given by the teacher at the lectures. Also the teacher refers to the literary resources (first of all, to the newly published in periodicals) in order the students understand the problems touched on the lectures in detail.

6. LIST OF TEACHING MATERIALS AND INFORMATION SUPPLY FOR STUDENTS' SELF WORK IN THE DISCIPLINE

6.1. PAPER-BASED COURSEWARE

Sl.№	Bibliographic entry (author, title, mode of publication, place, publishing house, year of publication, number of pages)	Number of copies in the library
	1. Basic literature	
1	Zhumagulov B.T. The Fluid Dynamics of Oil Production / B.T. Zhumagulov, V.N. Monakhov. – Milan: Without publ., 2003.	1
2	Oil and Gas: Student's Book : in 2 vol. – Oxford: Oxford Univ. Press, 2011.	1
3	Peyret R. Computational Methods for Fluid Flow / R. Peyret, T. D. Taylor. – New York: Springer-Verlag, 1983.	5
	2. Additional literature	
	2.1. Educational and scientific literature	
1	Underground Fluid Mechanics / Подземная гидромеханика : учебное пособие на английском языке / А. В. Хандзель, П. Н. Ливинцев, Н. М. Клименко, А. О. Шестерень. – Ставрополь: Северо-Кавказский федеральный университет, 2016.	0
2	Suk M. Petrology of Metamorphic Rocks / M. Suk. – Praha: Academia, 1983.	1
3	Pirson S. J. Teaching about the oil reservoir: trans. from English / S. J. Pirson. – Moscow: Gostoptekhizdat, 1961.	
	2.2. Standardized and Technical literature	
1	Vol. 1 / L. Lansford, V. D`Arcy. – Oxford: Oxford Univ. Press, 2011. – (Oil and Gas: Student's Book: in 2 vol.; Vol. 1).	129
2	Vol. 2 / J. Naunton, A. Pohl. – Oxford: Oxford Univ. Press, 2011. – (Oil and Gas: Student's Book: in 2 vol.; Vol. 2).	70
	3. Students' manual in mastering discipline	
1	Mechanics of Fluids. – Oxford, Warszawa: Pergamon Press, Widawnictwa Haukowo-Techniczne, 1967. – (Vocabulary of Mechanics in five languages: English. German. French. Polish. Russian; Vol. 2, Group 15.).	1
	4. Teaching and learning materials for students' self-work	
1	Marchioro C. Vortex Methods in Two-Dimensional Fluid Dynamics / C. Marchioro, M. Pulvirenti. – Berlin: Springer-Verlag, 1984.	1

6.2. LICENSE AND FREE DISTRIBUTED SOFTWARE USED IN THE COURSE EDUCATIONAL PROCESS

Type of Software	Software branding
OS	Windows 10 (Azure Dev Tools for Teaching)
Office Applications	Adobe Acrobat Reader DC
Image processing software	Corel CorelDRAW Suite X4
General purpose application software	Mathematica Professional Version (license L3263-7820*)
General purpose application software	Microsoft Office Visio Professional 2016 (Azure Dev Tools for Teaching)
General purpose application software	WinRAR (license №879261.1493674)
Management systems for projects, research, development, design, modeling and implementation	Autodesk AutoCAD 2019 Education Multi-seat Stand-alone

6.3. MODERN PROFESSIONAL DATABASES AND INQUIRY SYSTEMS USED IN THE COURSE EDUCATIONAL PROCESS

Branding	Reference to information resource
Scopus database	https://www.scopus.com/
Web of Science Database	https://www.webofscience.com/
Scientific electronic library database (eLIBRARY.RU)	https://elibrary.ru/
Scientific Library of the Perm National Research Polytechnic University	https://lib.pstu/
Lan Electronic Library System	https://e.lanbook.com/
Electronic library system IPRbooks	https://www.iprbookshop.ru/
Information resources of the Network ConsultantPlus	https://www.consultant.ru/
Company database EBSCO	https://www.ebsco.com/

7. LOGISTICS OF THE COURSE EDUCATIONAL PROCESS

Type of classes	Name of the necessary basic equipment	Number of units
Course Work (CW)	Desks, teacher's table, chairs	30
laboratory work (LW)	Complete computers (system unit, monitor, keyboard, and mouse) with Internet access – 15 pieces. Desks, teacher's table, chairs	15
laboratory work (LW)	Multimedia complex consisting of multimedia – ceiling mount ViewSonic PG705HD projector, SmartBoard 690 interactive whiteboard, acoustic system.	1
laboratory work (LW)	Clarke AK-4 apparatus for determining the coefficient carbonate content of rocks.	1
laboratory work (LW)	Electrodynamic vibration stand PE – 6700	1
laboratory work (LW)	Combined meter Seven Multi	1
laboratory work (LW)	Spectrophotometer ECOVIEW-B1100	1
laboratory work (LW)	Stalagmometer ST-3	1
laboratory work (LW)	Installation for saturation of rock samples	1
laboratory work (LW)	Universal rotary viscometer RV 2.1	
laboratory work (LW)	Automatic tensiometer K11	1
lectures (L)	Multimedia complex consisting of multimedia – ceiling mount ViewSonic PG705HD projector, SmartBoard 690 interactive whiteboard, acoustic system. Desks, teacher's table, chairs	1
Practice	Desks, teacher's table, chairs	30

8. FUND OF THE COURSE EVALUATING TOOLS

Ministry of Science and Higher Education of the Russian Federation

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Perm National Research Polytechnic University

FUND OF ESTIMATING TOOLS

For students' midterm assessment in the discipline
"Petrophysics"
Supplement to the Academic Course Working Program

Training program	21.03.01 Oil and Gas Engineering
Direction (specialization) of educational program	Oil and Gas Engineering
Graduate qualification	Bachelor's degree
Graduate academic chair	Oil and Gas Technology
Form of study	Full-time studies

Year (-s): 2 **Semester (-s)**: 3

Workload:
in credits: 5 CU
in hours: 180 h

The form of midterm assessment:
Exam: 3rd semester

Perm 2021

Fund of estimating tools for midterm assessment of students' learning the subject "Petrophysics" is the part (supplement) to the academic course working program. Fund of estimating tools for midterm assessment of students' learning the discipline has been developed in accordance with the general part of the fund of estimating tools for midterm assessment of the basic educational program which determines the system of the midterm assessment results and criteria of putting marks. Fund of estimating tools for midterm assessment of students' learning the subject determines the forms and procedures of monitoring results and midterm assessment of the subject leaning by the students.

1. LIST OF CONTROLLED RESULTS OF STUDYING DISCIPLINE, OBJECTS OF ASSESSMENT AND FORMS OF CONTROL

According to the Academic Course Working Program mastering course content is planned during one semester (the seventh semester of curriculum) and is divided into two educational modules. Classroom activities, lectures and laboratory work as well as students' self-work are provided for every module. In the frames of mastering course content such competences as *to know, to be able, to master* pointed out in the ACWP are formed. These competences act as the controlled results of learning the discipline "Petrophysics" (Table 1.1).

Monitoring of the acquired knowledge, abilities and skills is made in the frames of continuous assessment, progress check and formative assessment in the process of studying theoretical material, reports on laboratory works and during examination. Types of control is given in Table 1.1

Table 1.1 – List of controlled results of learning the discipline

Controlled results of learning the discipline (KAS)	Type of control					
	Continuous assessment		Progress check		Formative assessment	
	D	AC	LWR/ PWR	T/CW		Test
1	2	3	4	5	6	7
Acquired knowledge						
K.1 Knows laboratory and downhole methods for analyzing petrophysical information on technological processes of productive formations' waterflooding in the development of deposits and artificial lift of oil and gas	+			+		+
Acquired abilities						
A.1 Is able to plan and carry out laboratory experiments to determine the reservoir-filtration, lithological-structural, physical and mechanical properties of the oil reservoir from the core material			+			
A.2 Is able to process experimental data using modern applied software products			+			

1	2	3	4	5	6	7
A.3. Is able to interpret the results and draw conclusions about the conditional properties of reservoir rocks			+			
Mastered skills						
B.1 Masters the skills to use graphic and statistical software packages to determine the capacitive, filtration, structural, mechanical and electrical properties of reservoir systems in exploration, development and operation of oil and gas production facilities.			+			

D – topic discussion; AC –colloquium (discussion of theoretical material, academic conference); CT – case-task (individual task); LWR – report on laboratory work; PWR – report on practical work; T/CW – progress check (control work); TQ – theoretical question; PT – practical task; CT – complex task of grading test.

Final assessment of the learned discipline results is the midterm assessment which is made in the form of test taking into consideration the results of the running and progress check.

2. TYPES OF CONTROL, STANDARD CONTROL TASKS AND SCALES OF LEARNING RESULTS ASSESSMENT

Continuous assessment of the academic performance is aimed at maximum effectiveness of the educational process, at monitoring students' specified competencies formation process, at increase of learning motivation and provides the assessment of mastering the discipline. In accordance with the regulations concerning the continuous assessment of the academic performance and midterm assessment of students taught by the educational programs of Higher education – programs of the Bachelor's Course, Specialists' and Master's Course the next types of students' academic performance continuous assessment and its periodicity is stipulated in PNRPU:

– acceptance test, check of the student's original preparedness and his correspondence with the demands for the given discipline learning;

– continuous assessment of mastering the material (the level of mastering the component "to know" defined by the competence) at every group studies and monitoring of lectures attendance;

– interim and progress check of students' mastering the components "to know" and "to be able" of the defined competences by computer-based or written testing, control discussions, control works (individual home tasks), reports on laboratory works, reviews, essays, etc.

Discipline progress check is conducted on the next week after learning the discipline module, while the interim control is made at every monitoring during the discipline module study;

– interim assessment, summarizing of the current students' performance at least once a semester in all disciplines for every training program (specialty), course, group;

– retained knowledge control.

2.1. CONTINUOUS ASSESSMENT OF EDUCATION

Continuous assessment of learning is made in the form of discussion or selective recitation on every topic. According to the four-point system the results of assessment are put into the teachers' note-book and are considered in the form of integral marks in the process of the midterm assessment.

2.2. PROGRESS CHECK

For the complex assessment of the acquired knowledge, abilities and skills (Table 1.1) progress check is carried out in the form of laboratory and practice work, presentation and midterm control works (after learning every discipline module).

2.2.1. Presentation of laboratory work

It is planned 9 laboratory works all in all. Standard topics of laboratory work are given in ACWP.

Presentation of laboratory work is made by the student individually or by the group of students. Standard scale and criteria of assessment are given in the general part of FET of the educational program.

2.2.2. Midterm control work

According to ACWP 2 midterm control works (CW) are planned to be realized after learning the educational modules of the discipline by the students.

The first CW is realized with respect to the module 1 "Petrophysical properties of rocks", the second CW – with respect to the module 2 "Reservoir fluid characteristics".

Standard tasks of the first CW:

- Determination permeability of rocks
- Determination of acoustic properties of rocks

Standard tasks of the second CW:

- Calculation of the electrical conductivity
- Monitoring of electrical conductivity
- Determination of oil saturation
- Determination of formation waters composition

Standard scale and criteria of the results of the midterm control work assessment are given in the general part of FET of the educational program.

2.3. FULFILLMENT OF THE COMPLEX INDIVIDUAL SELF-WORK TASK

Individual complex tasks for the students are used for assessment of their skills and abilities acquired in the process of learning the discipline in which the course project or course paper is not stipulated.

Standard scale and criteria of assessment of the individual complex task presentation are given in the general part of FET of the educational program.

2.4. MIDTERM ASSESSMENT (FINAL CONTROL)

Admission for midterm assessment is made according to the results of continuous assessment and progress check. Preconditions for admittance are successful presentation of all laboratory and practice works and positive integral estimation with respect to the results of continuous assessment and progress check.

2.4.1. Midterm assessment procedure without additional evaluation testing

Midterm assessment is made in the form of a test. Credit on the discipline is based on the results of the previously fulfilled by the student individual tasks on the given discipline.

Criteria of putting the final mark for the components of competences in the process of midterm assessment made in the form of test are given in the general part of FET of the educational program.

2.4.2. Midterm assessment procedure followed by evaluation testing

In definite cases (for example, in case of re-attestation of the discipline) midterm assessment in the form of the test on this discipline can be made as the ticket-based evaluation test. Every ticket includes theoretical questions(TQ) aimed at control of the acquired knowledge, practical tasks (PT) aimed at mastered abilities, and complex tasks (CT) aimed at control of the acquired skills of all declared competences.

The ticket is formed so that the included questions and practical tasks could estimate the level of maturity of **all** declared competences.

2.4.2.1. Standard questions and tasks the discipline testing

Standard questions for the acquired knowledge control:

- laboratory and downhole methods for analyzing petrophysical information on technological processes of waterflooding;
- artificial lift of oil and gas;
- core study in modern core storage.

Standard questions and practical tasks for the mastered abilities control:

- plan and carry out laboratory experiments to determine the reservoir-filtration, lithological-structural, physical and mechanical properties of the oil reservoir from the core material;
- process experimental data using modern applied software products;
- interpret the results and draw conclusions about the conditional properties of reservoir rocks.

Standard complex tasks for the acquired skills control:

- ability to use graphic packages to determine the capacity of reservoir systems;
- ability to use statistical software packages to determine mechanical and electrical properties;
- ability to use graphic software packages to determine development and operation of oil and gas production facilities;

2.4.2.2. Scales of test assessment of educational achievements

Evaluation of discipline achievements in the form of maturity level of the components *to know, to be able, to master* of the declared competences is made according to the four-point assessment scale.

Standard scale and criteria of estimating educational achievements in the process of testing for the components *to know, to be able, to master* are given in the general part of FET of educational program.

3. ASSESSMENT CRITERIA FOR COMPONENTS AND COMPETENCES LEVEL OF MATURITY

3.1. ASSESSMENT OF COMPETENCES COMPONENTS LEVEL OF MATURITY

While estimating the level of competences maturity by selective control in the process of testing it is considered that *the mark obtained for the components of the examined competence is combined with the corresponding component of all competences formed in the frames of the given academic course.*

General assessment of maturity level of all competences is made by aggregation of marks obtained by the student for each component of the formed competences taking into account the results of continuous assessment and progress check in the form of integral mark according to the four-point scale. All control results are put into the assessment sheet by the teacher according to the results of midterm attestation.

The form of the assessment sheet and requirements for its completion are given in the general part of FET of the educational program.

While making the final assessment of the midterm attestation in the form of test standard criteria given in the general part of FET of the educational program are used.