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
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ACADEMIC COURSE WORKING PROGRAM

Academic course: Petroleum geology
(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): 144 (4)
(Hours (CU))

Training program (degree): 21.03.01 Petroleum engineering
(Code and denomination of degree)

Direction: Oil and Gas Engineering
(Title of curriculum)

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1. GENERAL PROVISIONS

1.1. GOALS AND OBJECTIVES OF THE COURSE

The goal of the course is to study the geological structure of natural reservoirs, oil and gas fields, oil and gas deposits, oil and gas physical and chemical properties, geological patterns of oil and gas fields location.

As a result of the course the student:

– knows the methods of analyzing information concerning the technological processes and operation of technological devices in O&G industry;

– is able to plan and conduct necessary experiments including those in which software is applied, interpret the results and draw appropriate conclusions;

– has mastered the skills of using physical and mathematical apparatus for solving computational and analytical tasks in professional activity.

1.2. PRESCRIBED OBJECTS OF THE COURSE

Natural reservoirs, traps, deposits, oil and gas fields, their geological structure; the main geological patterns of oil and gas fields location, geochemistry of dispersed organic matter

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 be able to, 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** the methods of analyzing information concerning the technological processes and operation of technological devices in O&G industry.	**Knows** the methods of analyzing information concerning the technological processes and operation of technological devices in O&G.	Interview
	IA-2$_{PC-3.1}$	**To be able to** plan and conduct necessary experiments including those in which software is applied, interpret the results and draw appropriate conclusions.	**Is able to** plan and conduct necessary experiments including those in which software is applied, interpret the results and draw appropriate conclusions.	Interview, Report on practical work

1	2	3	4	5
	IA-3$_{PC-3.1}$	**To master the skills** for using physical and mathematical apparatus for solution of computational and analytical tasks in professional activity.	**Has mastered the skills** of using physical and mathematical apparatus for solution of computational and analytical tasks in professional activity.	Test

3. FULL TIME AND FORMS OF ACADEMIC WORK

Form of academic work	**Hours in all**	**Distribution in hours according to semesters**
		Number of semester
		1
1. Holding classes (including results monitoring) in the form: 1.1.Contact classwork, including:		
– lectures (L)	36	36
– 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)	70	70
2. Intermediate attestation		
Exam		
Grading test	1	1
Test (Credit)		
Course Project (CP)		
Course Work (CW)		
Workload in hours	**144**	**144**

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**
Semester 1				
Module 1. General Geology	9	4	4	17
Module 2. Petroleum geochemistry	9	6	4	19
Module 3. Oil and Gas Reservoirs	9	4	4	17
Module 4. Reservoir modeling	9	4	6	17
Total with regard to 1st semester	36	18	18	70
Total with regard to the course	36	18	18	70

Topics of exemplary practical work

Sl.№	Topic of practical (seminar) work
1	Geologic time. Definition of layers sequence formation. Description of stratigraphic unconformities.
2	Definition of weathering, its types.
3	Definition of petroleum properties.
4	Various types of faults and folds.
5	Calculation of core samples porosity and permeability coefficients .
6	Definition of reservoirs types.
7	Various types of traps.
8	Definition oil and gas fields types.
9	Calculation of the trap filling factor.

Topics of exemplary laboratory practice

Sl.№	Topic of laboratory work
1	Structural mapping.
2	Study of minerals (silicates, carbonates, oxides and hydroxides) .
3	Study of minerals (sulfides, sulfates, halides).
4	Study of minerals (native elements).
5	Study of rocks (sedimentary).
6	Study of rocks (igneous).
7	Study of rocks (metamorphic).
8	Basics of geological modeling.
9	Basics of hydrodynamic modeling.

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 formulated 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, it is advisable for students to implement the following recommendations:

1. Learning of the discipline should be done systematically.

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

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

4. The topics list for individual study is given by the teacher at the lectures. The teacher also provides students with literary sources (first of all, new ones in the periodical scientific literature) for a more detailed understanding of the issues presented at the lectures.

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	2	3
	1. Basic literature	
1.	Horn G. M. Coal, Oil, and Natural Gas / G. M. Horn. – New York: Chelsea Clubhouse, 2010.	1
2	Oil and Gas : Student's Book : in 2 vol. – Oxford: Oxford Univ. Press, 2011.	129
	2. Additional literature	
	2.1. Educational and scientific literature	
1.	Zhumagulov B.T. The Fluid Dynamics of Oil Production / B.T. Zhumagulov, V.N. Monakhov. – Milan: Without publ., 2003.	1
2.	Peyret R. Computational Methods for Fluid Flow / R. Peyret, T. D. Taylor. – New York: Springer-Verlag, 1983.	5
	2.2. Standardized and Technical literature	
	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

1	2	3
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. ELECTRONIC COURSEWARE

Kind of literature	Name of training tool	Reference to information resource	Accessibility of EBN (Internet/local net; authorized free access)
Additional literature	Zhumagulov B.T. The Fluid Dynamics of Oil Production / B.T. Zhumagulov, V.N. Monakhov. – Milan: Without publ., 2003.	*http://elib.pstu.ru/vufind/Record/RUPSTUbooks 110755*	the local network
Additional literature	Vol. 2 / J. Naunton, A. Pohl. – Oxford: , Oxford Univ. Press, 2011. – (Oil and Gas : Student's Book : in 2 vol.; Vol. 2).	*http://elib.pstu.ru/vufind/Record/RUPSTUbooks 156679*	the local network
Additional literature	Horn G. M. Coal, Oil, and Natural Gas / G. M. Horn. – New York: Chelsea Clubhouse, 2010.	*http://elib.pstu.ru/vufind/Record/RUPSTUbooks 157259*	the local network

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

Type of Software	Software branding
Reservoir simulator	Tempest More (Roxar) (education license)
Reservoir simulator	T-Navigator (education license)
Simulator for Geological modeling	Irap RMS (Roxar) (education license)

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

Branding	Reference to information resource
Mineral's catalog	https://catalogmineralov.ru/
BSGF – Earth Sciences Bulletin	https://www.bsgf.fr/

7. LOGISTICS OF THE COURSE EDUCATIONAL PROCESS

Type of classes	Name of the necessary basic equipment	Number of units
Lecture	Multimedia Projector	30
Modeling laboratory work	Computer equipment	30
Laboratory work	Rocks and Minerals samples	30

8. FUND OF THE COURSE EVALUATING TOOLS

Described in a separate document

Ministry of Science and Higher Education of the Russian Federation

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FUND OF ESTIMATING TOOLS

For students' midterm assessment in the discipline "Petroleum geology"

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): 1 **Semester (-s):** 1

Workload:
in credits: 4 CU
in hours: 144 h

The form of midterm assessment:
Grading test 1 semester

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Fund of estimating tools for midterm assessment of students' learning the subject "Petroleum geology" 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 for one semester (the first semester of curriculum) and is divided into four 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 (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 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 To know the geological processes on the Earth, the concept of geological time, minerals and rocks, methods of obtaining information of the geological object	D	AC		CW1		D
K.2 To know reservoir rocks, hypotheses of the oil origin, mechanisms of oil fields formation	D	AC		CW2		D
K.3. To know principles of natural reservoirs classification, the basics of reservoir modeling	D	AC		CW3		D
Acquired abilities						
A.1 To be able to study the properties of minerals and rocks			LWR	CW 1		PT
A.2 To be able to study the geological structure of oil and gas fields and deposits, assess their main characteristics			PWR	CW2		PT

1	2	3	4	5	6	7
A.3. To be able to study reservoir and oil field condition with modeling.			LWR	CW3		PT
Mastered skills						
S.1 To master the skills of methodology for substantiating the geological and geochemical patterns of oil and gas fields location and issues of their formation.			PWR			CT
S.2 To master the skills of methodology for determination of the reservoir main properties			PWR			CT
S.3 To master the skills of methodology for determination of the trap filling factor			PWR			CT

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 progress is the midterm assessment which is made in the form of a test considering the current and progress check results.

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 mark 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 work presentation, practical work presentation and midterm control works (after learning every discipline module).

2.2.1. Presentation of laboratory work

It is planned 9 laboratory work 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. Presentation of practical work

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

Presentation of practical 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.

2.2.3. Midterm control work

According to ACWP 4 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 on module 1 "General Geology", the second CW – on module 2 "Petroleum geochemistry", the third CW – on module 3-4 "Oil and Gas Reservoirs" and "Reservoir modeling".

Standard tasks of the first CW:

1. What is the shape of the Earth?

a. Geoid b. Ball c. Ellipsoid d. Plate

2. What is the difference between minerals and rocks?
3. Oxygen, water, acid rain – what is the type of weathering agents?

Standard tasks of the second CW:
1. Give the classification of oil by viscosity.
2. What are the main properties of gas?
3. Describe the primary oil migration.

Standard tasks of the third CW:
1. Determine the type of reservoir (layer reservoir, massive reservoir or lithologically limited reservoir).
2. Draw a simple anticlinal trap.
3. What initial data are needed for geological modeling?

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 task for the students is used for assessment 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 practical 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:

1. Describe the process of accumulating oil in a trap.
2. List the types of traps.
3. What is the difference between reservoir and cap rocks?
4. What main properties of oil do you know?

Standard questions and practical tasks for the mastered abilities control:

1. Determine the type of mineral.
2. Determine the type of reservoir by porosity and permeability.
3. Determine the type of field by phase state.
4. Determine the type of the trap.

Standard complex tasks for the acquired skills control:

1. Calculate the porosity factor of the core sample.
2. Calculate the coefficient of the core sample permeability.
3. Build a structural map for the top of the reservoir by triangle method.
4. Calculate the fill factor of the trap.

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 got 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 got 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.